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Cooperative Extension Service

Vegetable Production Guide for Commercial Growers, 2024-25

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Vegetable Production Guide for Commercial Growers

Edited by:

Extension Horticulturists
Rachel Rudolph
Shawn Wright

Extension Entomologist
Ric Bessin

Extension Plant Pathologists
Nicole Gauthier
Kim Leonberger
Misbah Munir

Contents

Cover photo: Flower of cucurbit plant. Image by Kim Leonberger, University of Kentucky

Introduction

Fruit and Vegetable Production and Marketing

Successful vegetable production generally requires the grower to make daily decisions regarding pest management, irrigation, and cultural practices. Would-be growers unwilling to make serious investments of time (and money) should not attempt to expand beyond a space at the farmers' market. It is important for vegetable growers to have a market outlet for their product before they choose to start production. Good marketing plans start with the customer and work backward to production. Potential growers should first determine exactly what buyers want, how they want it, and when they want it. They then must determine how these crops should be grown. Even selecting varieties and determining planting times are basic marketing decisions. Kentucky growers should pay particular attention to comparisons of marketing time required, compatibility with off-farm employment, compatibility with tobacco production, and other farm demands. Individual situations vary, and producers often must learn about their particular markets by starting small and getting a foot in the door.

Marketing Options

Direct Marketing. Marketing directly to consumers includes sales at local farmers' markets, on-farm markets, roadside stands, farm festival markets, pick-your-own sites, or any combination of these methods. Direct marketing of vegetables has expanded considerably in Kentucky in recent years. Growers have gravitated to direct marketing because they have the flexibility to determine how much or little they wish to grow and, because they can often charge retail prices for their product, their per-acre revenue may be higher.

On-Farm or Roadside (Tailgate) Markets. These markets need not be elaborate but do need to be highly visible and located close to high-traffic areas for success. Direct marketing can also succeed in more remote locations but will require more advertising and promotion.

Many consumers in urban centers now consider visits to on-farm or farmers' markets recreational activities because people enjoy seeing farms and talking with farmers. Some growers have developed seasonal festival days and markets to satisfy this demand. Such "entertainment farming" and some other forms of direct marketing require liability insurance coverage, large time commitments, and employees with friendly, courteous attitudes.

Pick-Your-Own, or "U-Pick" Sales. This type of direct marketing appears to be declining nationally because consumers have less time and energy available for harvesting produce. U-picks eliminate some of the harvesting, transportation, and marketing costs for growers but may require additional management, supervision, and liability insurance coverage.

Local Town, County, or Community Farmers' Markets. The number of registered farmers' markets has continued to grow in Kentucky. According to the Kentucky Department of Agriculture, over 159 markets were operating in Kentucky in 2017, representing over 2,500 different vendors from 106 different counties. Markets located in larger metropolitan areas tend to generate greater overall sales as well as greater per-vendor sales. These markets are probably the easiest way for new growers to sell small volumes of produce. Less marketing time is required, and individual growers do not usually bear all advertising and promotion costs. Farmers should check with their local county agents to determine what rules and regulations each market may have. Those producers wanting to market a processed food product should also check with the Departments of Agriculture and Public Health about the regulations governing the sale of processed food. In addition, the Kentucky Department of Agriculture has printed a farmers' market manual. An electronic version of this manual can be found at: kyagr.com/marketing/farmmarket.

Vegetable marketing and production plans need to be developed simultaneously; the most successful growers put equal emphasis on growing and marketing their products.

Community Supported Agriculture (CSA). Though the concept of community supported agriculture (CSA) began in Europe as early as the 1960s, it is still relatively new to many regions of the United States. Basically, a CSA consists of "shareholders" who pay a set fee to a grower or group of growers for a weekly supply of fresh vegetables during the growing season. Because the members of a CSA pay for their "subscription" at the beginning of a growing season, they share some of the risk with the farmer. As part of their agreement with the grower, members acknowledge that a poor harvest due to unfavorable weather or pests means their shares may be smaller than usual. By direct sales to community members, growers receive better prices for their crops and can gain some financial security. Shareholders often have a greater sense of community involvement, knowing that they are helping support local agriculture.

Produce Auctions. Produce auctions have been popular for small growers in some parts of Kentucky.

Growers bring produce to the auction facility, where it is sold to the highest bidder. The auction company (sometimes a growers' organization) charges a flat commission of about 10 to 15 percent. Both large and small lots are accommodated at some auctions. At the large auctions, some of the bidders are operators of medium-to-large retail produce markets and stands.

Marketing Cooperatives. A marketing cooperative is just one form of indirect marketing in which the producer deals with an intermediary rather than the final consumer. Although most forms of indirect marketing require less time of individual growers, they usually demand more product uniformity, quality, and post-harvest care.

Grower-owned cooperatives or marketing associations are able to assemble truckloads of produce required by large customers, which would not be possible for small growers acting individually. Formally organized cooperatives also may provide technical assistance to growers and help secure seed, boxes, and other needed supplies. In some cases, specialized equipment is shared by growers.

Co-ops usually own and operate facilities with some combination of grading, packing, cooling, and storage equipment for their members. Members typically employ a manager to oversee the co-op's daily operations. There are several small growers' cooperatives with grading, packing, and cooling facilities in Kentucky. Co-ops can offer good marketing opportunities for new growers in counties near the co-op facilities. For long-term success it is advisable that rules requiring minimum standards for quality be set. Poor quality produce that is allowed into the co-op can depress profits for all those involved.

Local Wholesalers, Grocers, and Restaurants. Many potential buyers can be found among local wholesalers, grocery stores, and restaurants. Most metropolitan areas have produce wholesalers who can be dependable buyers of moderate volumes. Local grocery stores (and some chain stores) are sometimes willing to buy directly from growers through direct store deliveries (DSDs). DSDs often are possible with smaller grocery stores or chains but are discouraged by many larger chains.

Many restaurants buy from local or regional wholesalers. However, more and more of them (usually upscale establishments) are promoting locally grown and seasonal items on their menus, so individual growers may be able to sell to them. Like most other forms of produce marketing, restaurant sales are based on good relationships developed over time.

Regional Wholesalers, Chain Store Distribution Centers, and Brokers. Marketing to regional wholesalers or large chain-store distribution centers requires consistent quality, often significant volumes, and in some cases, year-round supplies. These buyers often have specific and demanding requirements for product uniformity, types of containers, cooling, transportation, and delivery of fresh produce. In some cases, especially when supplies are plentiful, produce quality must exceed USDA grading standards. Increasingly, grower-shippers also are being asked to supply produce to their supermarket chain buyers with price-lookup (PLU) stickers already applied.

Larger buyers look for quality and consistency. They need good incentives to interrupt year-round supplies from other parts of the country to buy more local produce. Some chain store buyers will pay a premium for top-quality local produce.

Some growers use brokers to market produce. The brokers negotiate either purchases on behalf of the buyer or produce sales on behalf of the seller. Unlike wholesalers, brokers do not take delivery nor assume ownership (title) of the produce. Brokers usually never see what they are quoting for sale or negotiating to buy. Brokers charge a percentage commission on all sales or a flat rate for each carton of produce sold.

Processors. Nationwide consumption and demand for most canned and frozen vegetable products have been flat or declining. Much consolidation of production and processing vegetables has occurred in recent years, with most of the industry now located in California and a handful of northern states. No traditional vegetable processing companies are left in Kentucky.

Several fresh-cut processors exist in the state and have indicated a desire to buy more products from within Kentucky. It is unlikely, however, that fresh-cut and other forms of processing will represent a significant market for Kentucky produce in the near future.

Getting Help

A number of organizations are working to create new marketing opportunities for Kentucky vegetable growers:

Cooperative Extension Service. Many county Extension agents know the production and marketing opportunities in their counties. They can provide vegetable production information and access to marketing and production specialists. In addition, county Extension offices can obtain information from produce industry directories such as The Red Book or The Blue Book. These publications list produce buyers by city and state and also include ratings for promptness of payment and other pertinent information.

Kentucky Vegetable Growers Association. This organization sponsors annual educational meetings (usually during the first week of January) that include special sessions on produce marketing. Ask your county Extension agent to put you on the mailing list for the annual meeting program and registration form. The KVGA website is kyvga.com.

Kentucky Department of Agriculture (KDA). The Kentucky Department of Agriculture Division for Value-Added Horticulture and Aquaculture maintains a directory of Kentucky vegetable growers,

The Kentucky Department of Agriculture Office of Agricultural Marketing and Product Promotion supplies this logo to qualified growers and marketers.

marketing cooperatives, and produce markets and is working to develop several new programs linking vegetable producers and buyers. The department also supplies the "Kentucky Proud" logo to qualified growers and marketers and administers the Kentucky organic certification program. See Appendix A for KDA website addresses.

Kentucky Farm Bureau. The Kentucky Farm Bureau's Certified Roadside/Farm Market Program can put your farm market on the map. Attractive brochures with your market location, featured products, and other details are made available at the state's welcome centers, at some state tourist attractions, and on the Internet. Contact your local Kentucky Farm Bureau office or see Appendix A for the website address.

The Internet. A wide variety of information on vegetable production and marketing is available on the Internet. Internet resources include Extension publications on how best to grow, harvest, cool, grade, and pack vegetable crops. Wholesale prices are also posted from markets around the country along with situation reports for certain crops. For some of the best websites for commercial vegetable growers, see Appendix A.

General Production Considerations

Variety Selection

Most of the varieties listed in this guide have been selected through extensive trialing at the University of Kentucky and on farms across the Commonwealth. The varieties have been selected because they have shown the ability to produce high yields while maintaining a uniform quality. Most of the varieties also have been selected based on having some level of disease resistance. Judicious selection of resistant varieties can help growers reduce pesticide costs and increase profits. However, for many farmers selling direct retail, the absolute highest yield may not be as important as a particular quality attribute such as flavor or color. Keep in mind that the recommendations that are listed are simply that—recommendations. This means that these varieties have proven themselves to have reliable performance, and should do well in most instances. However, the omission of a variety does not mean it is necessarily a bad variety, just that we may not have enough information to recommend it.

Plant Spacing

The plant spacings listed throughout this guide reflect the optimum growing conditions to produce maximum commercial yields of a given crop. However, many vegetable growers in Kentucky produce a wide variety of crops. Therefore, you may find yourself planting on a slightly different spacing than is recommended simply to make the crops you are growing fit better into your production system. The "Plant Populations" table (page 8) lists the plant populations required per acre for a given row and in-row spacing.

Drip Irrigation for Vegetable Crops

A good guideline for commercial vegetable production is "if you can't irrigate it, don't plant it." Droughts are not uncommon in Kentucky; the drought of 1999 was worse than severe droughts that occurred in 1988, 1954, and 1930. The high temperatures and dry conditions during the summer of 2012 meant the entire state was considered to be under "severe or extreme" drought conditions. No one should consider commercial vegetable production without 1) access to water for irrigation and 2) access to a good high-pressure sprayer for disease control (see the "Disease Management" section). Drip irrigation makes sense for many vegetable crops grown in Kentucky. It has become standard practice for growers wanting to participate in wholesale vegetable markets. High yields from drip irrigation help keep growers in business during years when produce supplies are plentiful and margins are lower than usual. Those able to increase yields with drip can often achieve good returns in spite of lower prices. Results from numerous on-farm demonstrations at the University of Kentucky and Kentucky State University have shown that yields are usually doubled (sometimes tripled) with drip compared to non-irrigated, rain-fed production.

Although drip is best used together with plastic mulch on crops such as tomatoes, peppers, melons, and squash, even bare-ground plantings can benefit from drip irrigation. Some Kentucky growers have rolled out drip tube on bare-ground plantings of cabbage, sweet corn, and pumpkins. This practice has often made the difference between having a crop and not having one.

Water Resources

Water savings with drip are substantial—roughly half as much water can do the same or better job than a sprinkler system. A constant water source is essential. Even with water-saving drip, there are cases of water supplies drying up or being cut off in a drought year. County water has been used successfully by a number of growers in the state; it has been profitable in nearly all cases where it has been used. Other growers use streams, lakes, springs, or farm ponds. Several growers have constructed large farm ponds specifically for drip irrigation on vegetables. The size of the pond is critical, because some vegetable crops use enormous volumes of water (see "Tomato Crop Water Usage" graphic).

Installation and Equipment Costs

Contrary to popular opinion, drip irrigation is a relatively cheap and easy technology. It does not require an engineering degree or years of experience to install and operate a typical small-farm system. Costs for reusable equipment and components, together with annual disposable supplies, are about $2,550 (see drip irrigation costs example) for a one-acre system, with an additional $400 per-acre expense for each additional acre for systems up to about 10 acres in size. The $400 per-acre annual costs are for disposable drip irrigation tube (often called drip "tape") and embossed black plastic mulch.

The costliest piece of farm equipment required is the plastic layer/bed shaper; this machine costs from approximately $1,200 for a flatbed layer to about $5,000 for a plastic layer plus bed shaper with hydraulic counter-sway. Plastic layers are now also for lower horsepower tractors. These smaller plastic layers require only 35 hp to be pulled and do a fine job. Most growers who are farming a limited acreage have found these bed shapers/layers to be a better choice than traditional bed shapers. The waterwheel setter that is commonly used for transplanting through plastic mulch costs about $1,900-$2,300. Mulch layers that also form raised beds will require considerably more tractor horsepower. Raised beds may not be necessary on well-drained ground where standing water does not occur.

To help introduce the technology and reduce costs, many counties

have bought machinery to rent or loan to local farmers. In addition, UK Horticulture Department Extension associates and county Extension offices often conduct annual on-farm demonstrations that help new growers install small farm drip systems.

Setting up a small, low-pressure drip system involves more plumbing than engineering. Although most growers will need some experienced help with the initial layout and design specifications (pump sizes, filter, delivery line size, field zoning, etc.), actual installation and maintenance are very easy.

System Components

A small drip system consists of:

- Water source
- Pump at the water source
- Check valve and/or backflow prevention valve[1] (for city water)
- Fertilizer injector
- Filter
- Pressure regulator and gauge
- Intake and delivery lines
- Drip tubes (drip tape)

[1]Growers using city water are required by law to install a more sophisticated backflow prevention device rather than a simple check valve. Most of the items listed are available from dealers in Kentucky. See your county Extension agent for a list of irrigation dealers in the state.

Fertigation

Fertigation is the application of water-soluble fertilizer through the drip system using an injector that feeds the solution into the drip lines. Our fertigation recommendations are relatively simple and are found under the individual crops in this publication. We recommend not fertigating phosphorus on medium-textured soils in Kentucky. All the soil test-recommended potassium should be applied prior to planting on some soils, but additional potassium applied through the fertigation system may help reduce ripening disorders in tomatoes (see the "Fruiting Vegetable" chapter for details). Phosphorus and potassium should be broadcast with rates determined by soil test results prior to laying plastic.

Although all of the crop's nitrogen (N) requirement can be applied prior to laying plastic, most growers prefer to split N applications between a preplant dose and sidedressings applied at intervals through the drip system. Apply about half to two-thirds the N requirement preplant and dividing the remaining amount into weekly fertigations. Most growers use calcium or potassium nitrate, usually dissolved in water prior to fertigating. Although many fertilizers are easily soluble together, care must be taken not to mix fertilizers that may precipitate when together. This can lead to emitters clogging, resulting in inadequate irrigation. Often, high-phosphorous fertilizers can precipitate when mixed with sufficient concentrations of calcium.

PLANT POPULATIONS PER ACRE FOR A GIVEN ROW AND IN-ROW SPACING[1]

Row-spacing: center to center (inches)	In-row spacing (inches)[2]									
	6	9	12	15	18	24	30	36	42	48
30	34,848	23,232	17,424	13,939	11,616	8,712	6,970	5,808	4,978	4,356
36	29,040	19,360	14,520	11,616	9,680	7,260	5,808	4,840	4,149	3,630
42	24,891	16,594	12,446	9,956	8,297	6,223	4,978	4,149	3,556	3,111
48	21,780	14,520	10,890	8,712	7,260	5,445	4,356	3,630	3,111	2,723
54	19,360	12,907	9,680	7,744	6,453	4,840	3,872	3,227	2,766	2,420
60	17,424	11,616	8,712	6,970	5,808	4,356	3,485	2,904	2,489	2,178
66	15,840	10,560	7,920	6,336	5,280	3,960	3,168	2,640	2,263	1,980
72	14,510	9,673	7,255	5,804	4,837	3,628	2,902	2,418	2,073	1,814
78	13,403	8,935	6,702	5,361	4,468	3,351	2,681	2,234	1,915	1,675
84	12,437	8,291	6,219	4,975	4,146	3,109	2,487	2,073	1,777	1,555
90	11,616	7,744	5,808	4,646	3,872	2,904	2,323	1,936	1,659	1,452
96	10,890	7,260	5,445	4,356	3,630	2,723	2,178	1,815	1,556	1,361

[1] Assuming an entire acre is planted, drive rows are not accounted for.
[2] Assumes a single row

DRIP IRRIGATION COSTS: *(for up to 5-acre system)*

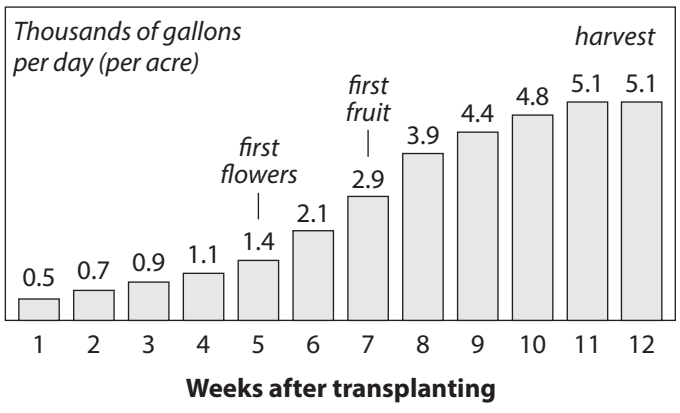
Item	***Cost (2015)***
2 in. centrifugal pump w/163cc engine	*$700*
Filter, sand (100 gpm)*	*725*
Single filter backflush valve	*260*
Fertilizer Injector	*200*
Layflat, 2" (300 ft. roll)	*105*
Suction hose and strainer	*95*
Fittings, valves, gauges, etc.	*100*
Total (5-7 yrs. reusable)	***$2,185***

Annual per-acre expenses

- *8-10 mil drip tape and black plastic mulch (1 mil, 4 ft wide): $0.05/ft x 7,260 linear ft ~ $400*
- *depreciation/rental costs on mulch layer and waterwheel setter*

**If using 2 sand filters a dual flush manifold adds $170 over a single flush manifold.*

TOMATO CROP WATER USAGE



Insect Management

Proper early identification of insect problems is essential in achieving satisfactory control. The following guidelines should aid in avoiding economic damage to vegetable crops from insect pests.

Although insecticides are important tools, successful management of insect and mite pests relies primarily on cultural practices. Proper cultural practices can minimize the chance for initiation and buildup of infestations. Early detection and diagnosis are key to pest management, as are the proper choice and proper application of pesticides when they are required. Vegetable producers should recognize and understand which pests have caused problems on their farms in the past and use nonchemical, preventive methods to help manage these pests when possible. Producers should regularly monitor insect and mite pests known to be problems in their areas and on the crops they are growing. Integrated pest management (IPM) guidelines for several commercial vegetable crops (cabbage, sweet corn, peppers, pumpkins) have been published by the University of Kentucky and are available through your county Extension office or on the Internet (see Appendix A).

Use crop rotation as a means of controlling certain insects such as corn rootworms in sweet corn. Grow varieties that are resistant to insects and disease when possible. Destroy or plow under crop residues immediately after the crop is harvested to reduce overwintering pest populations. Stimulate plant growth by proper irrigation and fertilization. Control weeds in and around crop fields. Weeds can be attractive to pest insects and may serve as hosts to insect-vectored diseases.

The following suggestions primarily are preventive methods rather than controls, and most should be carried out far in advance of the insect's appearance:

- Always properly identify and evaluate your insect problem.
- Learn to identify and conserve beneficial and harmless insects.
- Scout your fields on a regular basis to monitor insect activity and possible damage.
- Use IPM guidelines and treatment thresholds—available for most vegetable crops—to help you determine what level of damage can be tolerated before economic losses occur and treatment is required.
- If an insecticide is needed, select one that best fits your situation.
- Select an insecticide that is labeled for a wide variety of crops; this will minimize the chance of accidentally treating a crop that should not be treated with that insecticide and will reduce the number of products that must be purchased and stored.
- If possible, buy pesticides in quantities small enough to use up during the growing season.
- Select insecticides that do not require a long waiting period from application to harvest so you are not hampered in harvesting when the crop is ready.

Insecticides used to control vegetable insect pests come in several different forms. Dusts, baits, and granules are dry forms used as purchased. Baits are formulated with a pest attractant; dusts and granules include an inert carrier. Dry flowables (DF), emulsifiable concentrates (EC), flowables (F), liquids (L), soluble powders (SP), suspension concentrates (SC), water-dispersable granules (WDG), and wettable powders (WP) are formulations of insecticides that disperse when mixed in water. The latter are all used as sprays. For best results when applying dusts and sprays, thoroughly cover surfaces of infested plants.

Greenhouse Insect and Mite Management

The warm, humid conditions and abundant food in the greenhouse are ideal for pest buildup. Problems can be chronic unless recognized and corrected. Many insecticides used on vegetables in the field are prohibited in the greenhouse (see the "Relative Efficacy of Insecticides" table on the inside back cover).

Cultural Controls

Pests may enter the greenhouse in the summer when the ventilators are open. Others may be brought into the greenhouse on new plant material or in soil. Many are able to survive short periods of time between harvest or plant removal and production of the next crop. Cultural controls are the primary defense against infestation.

The following are proper cultural practices that will help prevent pest infestations:

- Maintain a clean, closely mowed area around the greenhouse to reduce pests that develop in rank growth.
- Remove all plants or any plant debris, and clean the greenhouse thoroughly after each production cycle.
- Keep doors, screens, and ventilators in good repair; use insect-proof netting when possible. (The extremely fine netting for thrip exclusion has been shown to limit air movement and may negatively impact disease management.)
- Use clean or sterile soils or ground media, tools, flats, and other equipment.
- Inspect new plants thoroughly to prevent introduction of insect or disease-infested material into the greenhouse.
- Watch for leaks or pooled water that can lead to fungus gnat infestations.
- If possible, allow the greenhouse to freeze in winter to eliminate tender insects such as whiteflies.
- Avoid wearing yellow clothing, which is attractive to many insect pests.
- Eliminate infestations by discarding or removing heavily infested material.

Monitoring

Early detection and diagnosis of pest infestations will allow you to make pest control decisions before the problem gets out of hand. It is good practice, therefore, to make weekly inspections of plants in all sections of the greenhouse.

Insect monitoring devices are also available. Yellow sticky cards (PT Insect Monitoring Cards, or Gempler's—gemplers.com) are highly attractive to winged aphids, leafminer adults, whiteflies, leafhoppers, thrips (blue cards can also be used with thrips), various flies, and other insects. These cards can be used to alert you to the presence of a pest and identify hot spots in the greenhouse. One to three cards per 1,000 square feet in the greenhouse is recommended; the cards should be changed weekly. If you cannot identify a trapped insect, contact your county Extension agent for assistance. Mass trapping products such as sticky tapes also are available for thrips, whitefly, leafminer, and fungus gnat detection and management.

Protecting Honey Bees from Pesticides

Many valuable crops cannot be economically produced unless adequate numbers of honey bees are present to pollinate them. In addition, honey bees produce more than $50 million in honey and beeswax annually. Many pesticides are extremely hazardous to honey bees, but damage can be minimized if the pesticide user and the beekeeper cooperate and each takes the proper precautions.

Crops Pollinated by Honey Bees

Some of the crops that require bee pollination are cucumber, squash, pumpkin, watermelon, and muskmelon. Honey bee colonies can be rented in many areas. One or two good hives of bees per acre is suggested to ensure a good yield of high quality fruit, particularly now that parasitic mites are killing many of the wild honey bees.

The Pesticide User's Role

- Be familiar with the Kentucky Pollinator Protection plan (https://www.kyagr.com/statevet/documents/OSV_Bee_KY-Pollinator-Pro-Plan.pdf).
- Know if and where managed honey bee colonies are located near your fields and how to contact these beekeepers.
- Use pesticides only when needed and only at the rates recommended on the label.
- If possible, select one of the least hazardous pesticides to pollinators, especially for use on flowering plants that attract bees. Pesticides with the honey bee inside the red diamond icon require notification of nearby beekeepers if applied to crops or weeds in bloom (see labels for specific instructions). An online communication tool is available to notify beekeepers anonymously within 5 miles 48 hours prior to the application (https://www.kyagr-apps.com/Pollinator/).
- Do not apply pesticides when honey bees are active in the field. Applications late in the afternoon (after 6:00 pm) or at night are least likely to damage bees.
- Do not apply pesticides when plants are in flower unless absolutely necessary.
- Avoid pesticide drift into apiaries or areas where crops or wild plants are flowering. Plant crops requiring heavy pesticide applications in areas as far from managed honey bee colonies as possible.
- Notify nearby beekeepers several days before you apply a pesticide as indicated by the labeling.

The Beekeeper's Role

- Be familiar with the Kentucky Pollinator Protection plan (https://www.kyagr.com/statevet/documents/OSV_Bee_KY-Pollinator-Pro-Plan.pdf).
- Locate colonies away from areas of heavy pesticide use when practical.
- Post your name, address, and phone number conspicuously at your apiary, and tell neighboring farmers where your colonies are located.
- Know what pesticides are commonly used in your area, and be prepared to confine or remove your bees if notified that a pesticide will be applied. Commonly used pesticides, grouped according to hazard, are listed, right. A plastic sheet can be used at night or in the early morning to confine bees and protect them from short-residual pesticides. However, heat builds up rapidly once the plastic is exposed to the sun, and it must be removed. Wet burlap can be used for periods of a day or more. This may be impractical for large numbers of hives.
- Relocate colonies that are in danger of repeated contact with pesticides in Group 1 in the table "Commonly Used Pesticides," right.
- Register your hive locations with the Kentucky Department of Agriculture to receive timely pesticide application notifications near your colonies (https://www.kyagr-apps.com/Pollinator/).
- Be prepared to temporarily move or close colonies if warned of a risky pesticide application in your area.

BIOLOGICAL PRODUCTS FOR INSECT CONTROL IN GREENHOUSES

Biocontrol Agent	Insects and Mites to be Controlled	Comments
Encarsia formosa	Greenhouse whitefly	Minute wasp that is a parasitoid of whiteflies immatures (3rd and 4th instars). Not effective against silverleaf whiteflies.
Eretmocerus eremicus, Eretmocerus mundus	Silverleaf whitefly	Minute wasp that is a parasitoid of whiteflies immatures (3rd and 4th instars). Will also attack greenhouse whitefly.
Delphastus catalinae	Whiteflies, both greenhouse and silverleaf	A tiny predatory beetle that feeds on the eggs and nymphs.
Verticillium lecanii	Whiteflies, thrips, and spider mites	A white entopathogenic fungus that attacks insects, killing them in 7 to 10 days. More effective on whiteflies than the other pests.
Amblyseius swirskii, Hypoaspis miles, Neoseiulus cucumeris	Immature thrips and whiteflies	Small predatory mites that hunt for insect prey. Often found under leaves near the main vein.
Mesoseiulus longipes, Neoseiulus californicus, Phytoseiulus persimilis, Galendromus occidentalis	Spider mites	Small predatory mites that hunt for spider mites. Will feed on pollen in the absence of prey.
Minute pirate bugs: *Orius insidiosus, Orius laevigatus, Orius strigicollis*	Thrips, and to a less extent aphids, and other insect eggs.	Tiny predatory bugs that can be used against thrips.
Green lacewings: *Chrysoperla carnea*	Aphids, but will also feed on thrips, whiteflies, and moth eggs.	Both the larvae are predatory on these greenhouse pests. Sold as eggs or larvae.
Lady beetles: *Adalia bipunctata, Hippodamia convergens*	Various species of aphids	
Aphidius colemani, Aphidius ervi, Aphidius matricariae, Aphelinus abdominalis	Various species of aphids	These minute wasps are parasitoids of aphids. Aphids will form mummies when attacked. Different species have a preference to different aphid hosts.
Aphidoletes aphidimyza	Various species of aphids	A predatory midge that feeds on aphids.

INSECTICIDES EXPRESSLY LABELLED FOR GREENHOUSE-GROWN VEGETABLES

Product	IRAC Code	Crops	Target Pests	Comments
Admire 4.6 F	4A	Cucurbits, fruiting vegetables	Aphids, whiteflies	Planthouse use for transplant production
Admire 4.6 F	4A	Cucumbers	Aphids, whiteflies	Drench applications for plants in soil only
Agri-Mek 0.7 SC	6	Tomatoes	Spider mites, russet mite, thrips, leafminers	Not for use on plants grown for transplants
Akari 5 SC	21A	Cucumbers, tomatoes, peppers	Various mites, psyllid, whiteflies	
Altus 1.67 SL	4D	Cucumbers, lettuce, tomatoes, peppers	Aphids, leafhoppers, squash bug, whiteflies, Colorado potato beetle, psyllids	Foliar or drench applications
Altus 1.67 SL	4D	Brassica leafy vegetables, cucurbit vegetables, fruiting vegetables, leafy vegetables, legume vegetables, root vegetables, turnip greens	Aphids, leafhoppers, squash bug, whiteflies, Colorado potato beetle, psyllids	For transplant production only. Foliar or drench applications
Beleaf 50 SG	29	Tomatoes, cucumber, peppers	Aphids, plant bugs, whiteflies, psyllids, thrips	
Distance 0.86 EC	7C	Fruiting vegetables	Aphids, whiteflies, fungus gnats, shore flies	Do not apply to tomato varieties with fruit less than 1 inch in diameter or non-bell peppers
Exirel 0.83 SE	28	Cucumber, eggplant, pepper, tomato	Loopers, armyworms, aphds, whiteflies	Not for transplant production
Floramite SC	20B	Tomatoes	Two-spotted spider mite, broad mite	Not for transplant production
Kanemite 15 SC	20B	Fruiting vegetables, cucurbit vegetables	Two-spotted spider mite, broad mite	Not for transplant production
Pylon 2 L	13	Fruiting vegetables	Beet armyworm, southern armyworm, fall armyworm, yellow-striped armyworm, tomato pinworm, tomato fruitworm, hornworms, two-spotted spider mite, broad mite, thrips	Only for greenhouse use
Quasar 8.5 SL	4A	Tomatoes	Aphids, whiteflies, thrips, psyllids	
Rimon 0.83 EC	15	Tomato, cucumbers	Armyworms, Colorado potato beetle, European corn borer, leafminers, tomato fruitworm, tomato pinworm, thrips, whiteflies, stink bugs, pepper weevil	
TriStar 8.5 SL	4A	Peppers	Aphids, whiteflies, thrips, psyllids	
Quasar 8.5 SL TriStar 8.5 SL	4A	Transplants of leafy greens, leaf petiole vegetables, fruiting vegetables, brassica head and stem vegetables, kohlrabi, celtuce, Florence fennel, cucurbit vegetables, onions and other bulb vegetables	Aphids, whiteflies, thrips, leaf eating beetles, fungus gnat larvae, plant bugs, caterpillars, leafhoppers, mealybugs	

INSECTICIDE RESISTANCE ACTION COMMITTEE (IRAC) GROUPINGS

These insecticide groupings now appear on many labels. The groupings are based on mode of action of the insecticides. The codes allow users to determine if different insecticides share the same mode of action. This information should be used by growers to prevent/delay the development of resistance by not overusing products with the same mode of action.

Insecticide	Grouping
Acramite	20D
Actara	4A
Admire	4A
Agri-Mek	6
Altus	4D
Asana XL	3A
Assail	4A
Avaunt	22
Aztec	1B, 3A
Baythroid	3A
Belay	4A
Beleaf	29
Blackhawk	5
Brigade	3A
Bt kurstaki	11A
Coragen	28
Counter	1B
Courier	16
Danitol	3A
Diazinon	1B
Dibrom	1B
Dimethoate	1B

Insecticide	Grouping
Dimilin	15
Exirel	28
Force	3A
Fulfill	9B
Harvanta	28
Hero	3A
Intrepid	18
Kanemite	20B
Knack	7C
Lannate	1A
Magister	21A
Malathion	1B
Miteus	21A
Mocap	1B
Movento	23
Mustang Maxx	3A
Nealta	25
Nurizma	30
Oberon	23
Platinum	4A
Portal	21A
Pounce	3A

Insecticide	Grouping
PQZ	9B
Proaxis	3A
Proclaim	6
Pylon	13
Radiant	5
Rimon	15
Scorpion	4A
Sefina	9D
Sevin	1A
Sivanto	4D
Thimet	1B
Torac	21A
Transform	4C
Trident	11A
Trigard	17
Venom	4A
Verimark	28
Versys	9D
Vydate	1A
Warrior	3A
Zeal	10B

COMMONLY USED PESTICIDES AND THEIR RELATIVE HAZARDS TO HONEY BEES[1]

Group 1. Hazardous
abamectin (Agri-Mek)
acephate (Orthene)
bifenthrin (Brigade, Capture)
carbaryl (Sevin)
clothianidin (Belay)
cyantraniliprole (Exirel, Verimark)
cyfluthrin (Baythroid XL)
deltamethrin (Decis)
diazinon
dimethoate (Cygon)
dinotefuran (Scorpion, Venom)
emamectin benzoate (Proclaim)
esfenvalerate (Asana XL)
fenazaquin (Magister)
fenropathrin (Danitol)
gamma-cyhalothrin (Proaxis)
imidacloprid (Admire, Macho, Nuprid)
indoxacarb (Avaunt eVo)
lambda-cyhalothrin (Warrior)
malathion
methomyl (Lannate)
naled (Dibrom)
permethrin (Ambush, Pounce)
phosmet (Imidan)
thiamethoxam (Platinum, Actara)
tolfenpyrad (Torac)
zeta-cypermethrin (Mustang Maxx)

Group 2. Moderately Hazardous
disulfoton (Di-Syston)
DSMA
MSMA
oxamyl (Vydate)
paraquat (Gramoxone)
phorate (Thimet)
pyriproxifen (Esteem, Knack)
spinosad (Entrust, Tracer)
spinetoram (Radiant)

Group 3. Relatively Nonhazardous
azadirachtin (Align, Neem)
Bacillus thuringiensis
Bordeaux mixture
bromoxynil
cyromazine (Trigard)
captan
copper oxychloride sulfate
copper 8-quinlinolate
copper sulfate (Monohydrated)
dazomet (Basamid)
dicamba (Banvel D)
diflubenzuron (Dimilin)
dinocap (Karathane)
diquat
dodine (Cyprex)
endothall
EPTC (Eptam)
kaolin (Surround)
mancozeb
MCPA
nicotine sulfate
pyrethrins
simazine (Princep)
sulfur
thiram
Zineb
Ziram
2,4-D
2,4-DB

1 Adapted from E-53, "Protecting Honey Bees from Pesticides," G. Hunt, R. Edwards, R. Foster, Purdue University Cooperative Extension Service

Weed Management

The use of herbicides suggested in this publication is based on research at the University of Kentucky and elsewhere in the region. We have compiled lists of effective herbicides with their rates and times of application, along with selected information on the use and precautions of select pesticides. It is not possible to include every comment and suggestion in the limited space allowed in this publication. Growers are encouraged to obtain a copy of the label and read it carefully. Copies of most labels can be found at http://www.cdms.net/Label-Database. Most herbicides are now manufactured under different trade names by different companies. Only one representative trade name is presented in this publication for each active ingredient. Growers should compare costs of different brands that have the same active ingredient. Pesticide labels may change after the printing of this publication, so growers must always consult the label for the final word on crops covered, precautions, rates, and application methods. **The label is the law!**

Carefully follow the precautions stated on the container label. The use of herbicides for purposes other than those specified on the approved label is a violation of federal law. Such applications can be hazardous to people, the environment, and to crops. Use herbicides only on crops for which they are approved and recommended on the label. Use only recommended amounts. **Using too much material is a violation of the law!** It may damage the crop, make it unsafe for consumption, and wastes money. The EPA is authorized to seize any raw agricultural commodity moving in interstate commerce that has a pesticide residue in excess of the established tolerance. Residues of unlabeled chemicals detected on fresh produce can be traced back to your farm.

Apply herbicides only at times specified on the label for the growth stage of the crop and the weed. Observe the recommended intervals between the time of treatment and re-entry times and pre-harvest intervals. Guard against possible drift injury to nearby susceptible crops by spraying at lower pressures, using drift-reduction nozzles, and checking weather conditions prior to spraying. The use of herbicides should supplement other good weed-management practices.

Types of Herbicide Formulations

Herbicides may be formulated as solutions (L), emulsifiable concentrates (EC), microencapsulated (ME), wettable powders (WP), flowables (F), wettable dispersible granules (WDG), and granules (G), to name a few. Many herbicides are added to water and applied as solutions. Many spray mixtures require constant agitation to prevent the herbicides from settling to the bottom of the tank. Granular herbicides are applied dry. Do not mix different granular pesticides or mix them with fertilizers. Some herbicides are labeled for application through an irrigation system, others as fertilizer mixtures.

Method and Time of Treatment

Herbicides are applied in the following ways:

- **Preplant incorporated (PPI):** incorporated into the soil prior to planting the crop
- **Pre-emergence (PRE):** on the soil after planting but before weeds emerge
- **Post-transplant:** on the soil after crop is transplanted either before weeds emerge or after clean cultivation
- **Post-emergence (POST):** on weeds after weeds have emerged
- **Directed post-emergence:** as a directed or shielded post-emergence on small weeds in rows of taller crops or in row middles.

Follow specified amounts and pressures on the label in order to achieve complete coverage.

Tank Mixtures

For broad-spectrum weed control, more than one herbicide may be necessary. It is quite common to tank-mix two or more pre-emergent herbicides to obtain adequate weed control in vegetable crops. Due to space limitations, only a fraction of the allowable tank mixes are listed. Look on the label for a complete list.

Crop Rotation

Because soil residual activity varies considerably among different herbicides, follow the directions closely for crop rotation on the labels of all products used. See the "Herbicide Label Restrictions" table on page 16 for restrictions on planting vegetables after using specific herbicides.

Herbicide Sprayers

Even distribution of herbicides at the proper rate is essential to good weed control. A small variation in the rate of application of some herbicides may result in failure to control weeds, or it may cause crop injury. For spray applications of herbicides, a low-pressure sprayer that accurately sprays between 15 to 30 pounds per square inch is the most suitable for either broadcast or band spraying. Hand sprayers of 3- or 4-gallon capacity are suitable for small areas or for spot spraying. Tractor-mounted sprayers, pump-driven from the power takeoff, are quite satisfactory for field spraying.

A good herbicide sprayer should:

- Have a pump that is easily replaced, be resistant to wear and chemical oxidation, and have a capacity of 8 to 15 gallons per minute.
- Have a boom equipped with nozzles with replaceable tips. Nozzle spacing will depend on many factors, such as your crop and your equipment. For broadcast spraying, many manufacturers recommend 16- to 20-inch spacing between nozzles on the boom.
- Have mesh screens for the suction line and nozzles and a gauge that measures pressure accurately from

0 to 100 pounds per square inch. Mesh screen size may vary with the herbicide used. For most herbicides, a 50-mesh size is quite adequate.
- Have a mechanical or jet agitator to keep the spray solution well mixed and prevent the herbicide from settling to the bottom of the tank.

Hand Sprayers

To spray herbicides on small areas, the most reliable method of application is the 1- to 3-gallons compressed-air sprayer. These sprayers are simple to operate but require careful calibration to assure even distribution of the herbicide over the sprayed area. A general rule is to use 1 gallon of the herbicide mixture for every 400 square feet of soil surface. This volume should be sprayed evenly over the 400 square feet. Do not guess distances or areas to be sprayed. If you have not used a hand sprayer previously, it is a good idea to practice using the sprayer with water the first time. Accurately measure the amount of herbicide that is to be added to the sprayer. See Appendix C for converting rates per acre to rates for small areas.

Cleaning Sprayers

Clean herbicide sprayers thoroughly after each use especially for sulfonylureas (Group 2), growth regulator type herbicides, and oil-based herbicides. For many products, the screens and filters should also be taken apart and cleaned. Triazine product residues, for example, can adhere to screens and will injure non-target, sensitive crops. Flushing tanks, lines, booms, and nozzles with water is usually sufficient for sprayers used only with pre-emergence herbicides. For most other herbicides, the sprayer should first be rinsed with water, then cleaned with one of the following in 50 gallons of water:
- A half-gallon of household ammonia (let stand in sprayer overnight)
- 4 pounds trisodium phosphate cleaner
- 2 ½ pounds sal soda (washing soda/sodium carbonate)
- 2 pounds activated charcoal (leave in sprayer and lines 10 minutes)

NOTE: To remove traces of oil-based herbicides such as ester formulations of 2,4-D, rinse the sprayer with kerosene before rinsing it with water and the cleaners listed above. For specific cleaning directions, refer to the label.

Do not use herbicide sprayers to apply other pesticides on vegetable crops. In addition to the potential hazard to the crop from traces of herbicides left in the system, pressures used in herbicide sprayers are inadequate for spraying insecticides and fungicides. When an enterprise requires two herbicide sprayers, use only growth regulator type herbicides (e.g. 2,4-D) in one sprayer and use the other for other herbicides.

Dual Magnum 24(c) Label

Syngenta has agreed to provide a special local need label for the use of Dual Magnum in a wide selection of crops. Crops of specific interest to growers include cucumber, watermelon, transplanted cabbage, transplanted pepper, and okra among others. See the label for a full list. Growers must have a copy of the label in their possession when applying Dual Magnum to these crops. In addition, the use of Dual Magnum on crops listed in the special local need label may result in crop injury, crop yield reduction and/or crop loss. The decision to use this product in the manner described in the supplemental labeling must be made by each individual user on the basis of (i) anticipated benefits versus the potential risk, (ii) the severity of the target pest infestation, (iii) the cost and availability of alternative pest controls, and (iv) any other relevant factors.

RELATIVE RESPONSE OF WEEDS TO HERBICIDES*

	Cocklebur	Crabgrass	Fall Panicum	Foxtail	Galinsoga	Jimsonweed	Johnsongrass (seedlings)	Lambsquarters	Morningglory	Nutsedge, Yellow	Pigweed	Purslane	Ragweed, Common	Ragweed, Giant	Smartweed	Velvetleaf	Black Nightshade
Preplant Incorporated																	
Command	P	G	G	G	G	P	F	G	P	N	P	E	G	P	G	G	P
Devrinol	N	G	G	G	P	N	F	F	N	P	F	G	F	N	N	P	P
Eptam	P	G	G	G	F	N	G	P	N	G	F	P	P	P	P	P	N
Prefar	P	G	G	G	P	P	P	G	P	N	G	P	P	P	N	F	P
Treflan	N	G	G	G	P	N	G	F	N	N	G	F	P	N	N	N	N
Pre-emergence																	
Atrazine	G	P	P	F	G	G	N	G	G	P	G	G	G	G	G	G	G
Curbit	N	G	G	G	P	N	G	G	N	N	G	G	N	N	N	N	N
Dual	N	G	G	G	G	N	F	F	N	G	G	G	P	P	F	N	G
Goal	N	F	F	F	G	F	N	F	N	N	G	G	G	G	G	G	G
Micro-Tech	N	G	G	G	G	N	F	F	N	G	G	G	P	P	F	N	G
Sandea	G	N	N	N	P	P	N	F	F	G	G	N	G	G	G	G	N
Sencor	F	P	P	P	G	G	P	G	F	N	G	G	G	F	G	F	P
Lorox	F	F	F	F	G	F	P	G	F	N	G	G	G	F	F	F	P
Prowl	N	G	G	G	F	N	F	F	N	N	G	F	P	P	F	F	P
Post-emergence																	
Basagran	G	N	N	N	G	G	N	G	G	N	F	G	G	F	G	G	G
Fusilade	N	G	G	G	N	N	G	N	N	N	N	N	N	N	N	N	N
Poast	N	G	G	G	N	N	G	N	N	N	N	N	N	N	N	N	N

G = Good F = Fair P = Poor N = None
** This table should be used only as a guide for comparing the relative effectiveness of herbicides to a particular weed. The response listed is based on using the maximum recommended rates for a particular herbicide under adequate and good growing conditions. If growers are getting satisfactory results under their conditions, they should not necessarily change products as a result of the information in this table.*

HERBICIDE LABEL RESTRICTIONS* ON VEGETABLE CROP ROTATIONS

Herbicide	Tomato[1]	Pepper	Snap Bean	Sweet Corn	Pumpkin	Melon[2]	Cole Crops[3]
Soybean or Tobacco Herbicides							
Canopy	10-B	18-B	18-B	18-B	18-B	18-B	18-B
Classic	10-B	30-B	12-B	18-B	18-B	18-B	18-B
Command	9-12[4]	NR	9	9	NR	9	12
Dual4	2	2	NR	NR	2	12	2
TriCor	4-10	18	18	18	18	18	18
Prowl	AH	AH	AH	AH	AH	AH	AH
Pursuit	18	18	NR	18	30	18	30
Reflex	18	18	NR	18	18	18	18
Roundup	NR	NR	NR	NR	NR	NR	NR
Scepter	18	18	11	18	18	18	18
Spartan	12	12	12	18	12	12	6[6]
Blazer or Status	AH	AH	AH	AH	AH	AH	AH
Corn Herbicides							
Aatrex	SY	SY	SY	NR	SY	SY	SY
Accent	10[5]	10[5]	10[5]	10	10[5]	10	10[5]
Beacon	18	18	18	8	18	18	18
Bicep	24	24	24	NR	24	24	24
Callisto	18	18	18	NR	18	18	18
Lightning	40	40	9.5	18	40	40	40
Permit	8	10	9	3	9	9	15-18
Princep	SY	SY	SY	NR	SY	SY	SY
Roundup	NR	NR	NR	NR	NR	NR	NR
Spirit	10	18	10	8	18	18	10[6]

** Waiting period (number of months after application) before the vegetable crop can be planted.*

[1] Transplanted tomatoes only.
[2] Muskmelons and watermelons.
[3] Broccoli, cabbage, and cauliflower.
[4] Depends on rate applied; consult label.
[5] 18 months with a soil pH of greater than or equal to 6.5.
[6] Cabbage only.

B: Field or soil bioassay should be conducted before planting the crop; consult label.
NR: No rotation restriction exists or herbicide labeled for the crop.
AH: After harvest—can be planted in fall or spring following application.
SY: The crop cannot be planted until the second year after application (cannot be planted the year following application).

***WARNING:** This information is for preliminary planning only! Follow manufacturer's instructions on product labels to determine the most up-to-date rotation restrictions and other special conditions that may apply.*

COMMON/TRADE NAMES OF HERBICIDES

Common Name	Trade Name
2,4-D amine	Several names
acetochlor	Surpass
alachlor	Micro-Tech, Partner
atrazine	Aatrex
bensulide	Prefar
bentazon	Basagran
bromoxynil	Buctril
carfentrazone	Aim
clethodim	Select
clomazone	Command
clopyralid	Stinger, Clopyr Ag
DCPA	Dacthal
dicamba	Clarity
dimethenamid-P	Outlook
diquat	Reglone
diuron	Karmex
EPTC	Eptam, Eradicane
ethalfluralin	Curbit, Sonalan
fluazifop-p	Fusilade DX
flumioxazin	Chateau
fluroxypyr	Starane
fomesafen	Reflex
glufosinate	Rely

Common Name	Trade Name
glyphosate	Roundup
halosulfuron	Permit, Sandea
imazamox	Raptor
imazethapyr	Pursuit
linuron	Lorox
mesotrione	Callisto
metolachlor	Dual Magnum
metribuzin	Tricor
napropamide	Devrinol
nicosulfuron	Accent
norflurazon	Solicam
oxyfluorfen	Goal
paraquat	Gramoxone
pendimethalin	Prowl
prometryn	Caparol
pronamide	Kerb
quizalofop	Assure II
rimsulfuron	Matrix
sethoxydim	Poast
terbacil	Sinbar
topramezone	Impact
trifluralin	Treflan

WEED SUSCEPTIBILITY OF SELECTED HERBICIDES LABELED FOR USE IN VEGETABLE CROPS

Herbicide	Weeds Controlled	
Basagran (bentazon)	Sedges	Yellow nutsedge
	Broadleaves	Canada thistle, purslane, lambsquarters, ragweed, galinsoga, jimsonweed, smartweed, velvetleaf, wild mustard, cocklebur
Buctril (bromoxynil)	Broadleaves	Mustard, cocklebur, pennycress, jimsonweed, annual morningglory, nightshade, lambsquarters, smartweed, pigweed
Command (clomazone)	Grasses	Barnyardgrass, crabgrass, fall panicum, foxtail, goosegrass, seedling johnson grass
	Broadleaves	Purslane, ragweed, jimsonweed, lambsquarters, smartweed, velvetleaf
Curbit (ethalfluralin)	Grasses	Annual bluegrass, crabgrass, barnyardgrass, foxtail, goosegrass, fall panicum, seeding johnson grass, shattercane, witchgrass
	Broadleaves	Wild buckwheat, carpetweed, chickweed, lambsquarters, pigweed, nightshade, purslane
2,4-D amine	Broadleaves	Carpetweed, dandelion, dock, galinsoga, pigweed, jimsonweed, lambsquarters, morningglory, plantain, ragweed, smartweed, thistle, wild mustard
Devrinol (napropamide)	Grasses	Barnyardgrass, crabgrass, goxtail, goosegrass, seedling johnson grass, panicum, annual bluegrass
	Broadleaves	Chickweed, purslane, common groundsel, prostrate knotweed, lambsquarters, pigweed, prickly lettuce
Dual II Magnum (s-metolachlor)	Grasses	Barnyardgrass, crabgrass, fall panicum, foxtail, goosegrass, witchgrass, yellow nutsedge
	Broadleaves	Nightshade, carpetweed, galinsoga, pigweed
Eptam (EPTC)	Grasses	Annual bluegrass, crabgrass, barnyardgrass, foxtail, goosegrass, shattercane, witchgrass
	Broadleaves	Annual morningglory, carpetweed, chickweed, lambsquarters, nightshade, purslane
Fusilade DX (fluazifop-P)	Grasses	Bermudagrass, goosegrass, johnson grass, wild proso millet, barnyardgrass, fall panicum, foxtail, crabgrass, witchgrass, volunteer cereals
Goal 2XL (oxyfluorfen)	Grasses	Barnyardgrass, weedy brome, crabgrass, foxtail, goosegrass, seedling johnson grass
	Broadleaves	Evening primrose, pigweed, common groundsel, purslane, black nightshade, shepherdspurse
Gramoxone Inteon (paraquat)	Grasses	Most annual grasses
	Broadleaves	Most annual broadleaves
Karmex, others (diuron)	Grasses	Barnyardgrass, crabgrass, annual bluegrass, foxtail
	Broadleaves	Pigweed, purslane, ragweed, chickweed, mustard, pennycress, velvetleaf

Continued On The Next Page

WEED SUSCEPTIBILITY OF SELECTED HERBICIDES LABELED FOR USE IN VEGETABLE CROPS *(continued)*

Herbicide	Weeds Controlled	
Kerb (pronamide)	Grasses	Barnyardgrass, brome, annual bluegrass, panicum, foxtail, goosegrass, volunteer small grains
	Broadleaves	Carpetweed, chickweed, henbit, knotweed, purslane, lambsquarters, nightshade, morningglory
Tricor (metribuzin)	Grasses	Downy brome, crabgrass, foxtail, seedling johnson grass
	Broadleaves	Pigweed, purslane, ragweed, chickweed, jimsonweed, lambsquarters, pepperweed, shepherdspurse, smartweed, prickly sida
Lorox (linuron)	Grasses	Barnyardgrass, crabgrass, fall panicum, goosegrass
	Broadleaves	Annual morningglory, carpetweed, groundsel, lambsquarters, mustard, cocklebur, pigweed, prickly sida, purslane, smartweed, velvetleaf
Micro-Tech (alachlor)	Grasses	Barnyardgrass, crabgrass, foxtail, goosegrass, fall panicum, witchgrass
	Broadleaves	Carpetweed, pigweed, galinsoga, nightshade, purslane
Poast (sethoxydim)	Grasses	Bermudagrass, goosegrass, johnson grass, quackgrass, wild proso millet, barnyardgrass, fall panicum, foxtail, crabgrass, witchgrass, volunteer cereals
Prefar (bensulide)	Grasses	Crabgrass, foxtail, fall panicum, goosegrass
Prowl (pendimethalin)	Grasses	Barnyardgrass, crabgrass, fall panicum, foxtail
	Broadleaves	Carpetweed, lambsquarters, pigweed, purslane
Pursuit (imazethapyr)	Broadleaves	Nightshade, pigweed, kochia, wild mustard
Roundup (glyphosate)	Grasses	Most annual and perennial grasses; see discussion of reduced tillage systems
	Broadleaves	Most annual broadleaves; see discussion of reduced tillage systems
Sandea (halosulfuron)	Sedges	Yellow nutsedge
	Broadleaves	Cocklebur, common lambsquarters, common ragweed, honeyvine milkweed, kochia, morningglory, nutsedge, pigweed, smartweed, velvetweed, wild mustard
Sinbar (terbacil)	Grasses	Crabgrass, foxtail, seedling johnson grass, barnyardgrass, annual bluegrass
	Broadleaves	Chickweed, lambsquarters, wild mustard, pepperweed, shepherdspurse, dandelion, knotweed, pigweed, purslane, plantain, ragweed, henbit, jimsonweed
Treflan (trifluralin)	Grasses	Annual bluegrass, crabgrass, barnyardgrass, foxtail, seedling johnson grass, goosegrass
	Broadleaves	Carpetweed, chickweed, knotweed, lambsquarters, pigweed, purslane

Disease Management

Vegetable crops can be affected by a number of diseases, often resulting in economic loss by reducing the quality and/or quantity of harvested produce. Managing diseases adds to grower input costs, reducing potential profits. Disease management programs, a necessity for most commercial growers, should maximize yield and quality while remaining cost effective.

Disease management practices and products are generally most effective as part of a preventative program. The rapid progression of plant diseases makes them difficult, if not impossible to control once established. To develop an effective management strategy, it is important to understand the diseases that can affect that crop, as well as the environmental factors that favor disease development.

Timely Diagnosis of Plant Diseases

Accurate and timely diagnosis is a critical step in disease management practice(s). Applying the wrong fungicide or cultural practices because of an incorrect diagnosis will result in poor disease control, wasted product and time, and continued yield losses.

Disease samples can be submitted to a local county Extension office for submission to the UK Plant Disease Diagnostic Lab. County Extension agents can provide assistance in collecting samples and background information needed for accurate diagnoses.

General Principles for Managing Plant Diseases

Most plant diseases are managed using a combination of cultural practices and fungicide applications. For management of most diseases, a single approach is rarely effective.

Exclusion

- Avoid introduction of pathogens into a planting:
- Buy or produce disease-free seeds and transplants.
- Carefully examine foliage, stems, roots, seeds, and bulbs of transplants for symptoms or presence of pathogenic propagules (infective structures such as spores). Only set healthy transplants into the cropping area, rejecting plant material that appears unthrifty or shows disease symptoms.

Planting and cultural practices

- Keep detailed records each growing season to identify problematic and recurring diseases.
- Select disease-resistant or tolerant cultivars, when available, based on site history. Choosing cultivars with resistance or tolerance reduces fungicide use and associated costs.
- Purchase clean seed from reputable dealers; saving seed from a previous crop is not recommended for large scale commercial producers.
- Provide adequate spacing to allow for air circulation. Poor air circulation can result in high humidity within plant canopies, prolonged leaf wetness, and soggy soils that can be conducive to disease development and pathogen spread. Row orientation and soil drainage can also affect plant environments.
- Follow cultural practices that promote plant health to enable plants to better resist diseases and stress-related problems. For example, water plants during drought, fertilize according to soil test results, and mulch (where appropriate) to maintain soil moisture and regulate soil temperatures.

Sanitation

- Employ sound sanitation practices to reduce sources of inoculum (overwintering structures, spores, bacterial cells, and virus particles, etc.) that can initiate disease.
- Eliminate (remove and destroy) diseased plants and plant material from fields.
- Move cull piles off the farm or as far as possible from production fields.
- Remove, disk, or chop crop residues immediately after harvest, followed by deep tillage to reduce populations of pathogens that can overwinter in plant debris.
- Do not compost diseased plant material or contaminated soil because incomplete composting may result in pathogen survival.
- Keep greenhouses clean and sanitize between crops.
- Equipment and tools should be disinfested after coming into contact with diseased plant material or infested soil. Bleach (10% solution), rubbing alcohol (70%), or a commercial sanitizer can be used to disinfest equipment and tools; rinse before storing to help prevent corrosion.
- Control weeds and insects. Certain diseases are spread by insects and may survive between crops in their insect vectors or in weeds. Timely weed and insect pest control is critical in these cases.

Crop rotation

Avoid planting the same crop species or closely related species in the same site. Rotate to a tolerant or resistant plant species or cultivar to reduce pathogen populations. Some pathogens can be reduced or eliminated with short rotations (1 to 2 seasons out of a crop group). However, longer intervals (3+ seasons) are often necessary for persistent pathogens like soilborne pathogens and nematodes.

Crops grouped together below are subject to the same disease and insect problems:

- Corn, sorghum, small grains, grasses
- Chives, garlic, leeks, onions, shallots
- Many herbs, including basil, lavender, oregano, rosemary, sage, peppermint, savory, thyme.
- Beets, Swiss chard, spinach
- Cabbage, cauliflower, kale, collards, Brussels sprouts, broccoli, kohlrabi, turnips, rutabaga, Chinese cabbage, mustard
- Peas, snap beans, lima beans, soybeans, clover, alfalfa

- Carrots, celery, celeriac, cilantro, cumin, dill, parsley, parsnips
- Pumpkins, squash, watermelons, cucumbers, muskmelons
- Endive, salsify, lettuce
- Potatoes, eggplant, tomatoes, peppers, tomatillo, tobacco

Monocots (cool- or warm-season grasses, cereals, corn, sweet corn, rye, and sorghum) are excellent crops to use in rotation with most vegetables.

Unfortunately, rotation is not effective against all diseases and crops. Some soilborne diseases (e.g., Rhizoctonia and Phytophthora diseases) have very wide host ranges and can affect several different groups. In addition, root and bulb crops—while often not related botanically—are susceptible to many of the same soilborne pathogens, so avoid other root crops and botanically related plants in a root/bulb crop rotation. Crop rotation will not impact diseases caused by airborne spores that come in from outside the field.

Fungicides

Timing fungicide applications is critical to their effectiveness. Fungicide applications must be made before infection. In general, fungicides prevent new infections and do not eradicate the pathogen or cure disease once infection has occurred. Fungicides may need to be reapplied at regular intervals due to weathering and to protect new growth.

Fungicides can be classified as contact or systemic. Contact fungicides remain on the surface of plant tissue, and they may be washed off by rain or irrigation. Systemic fungicides are absorbed into plant tissue and can move locally (e.g. from the top side of a leaf to the underside); this is called translaminar movement. Systemic fungicides can also be xylem mobile or fully mobile (xylem and phloem). Systemic fungicides are rainfast.

Fungicide persistence can also be improved using adjuvants. A variety of adjuvants can be combined with most (not all) fungicides, improving spread across plant surfaces, penetration into the plant cuticle, and/or adhesion onto plant surfaces. Read fungicide labels carefully to determine which, if any, adjuvants are recommended.

FRAC Codes

The Fungicide Resistance Action Committee (FRAC) has classified the active ingredients found in fungicides by their mode of action (target site) and assigned them a group number, called the "FRAC code." Fungicides with the same FRAC code have the same mode of action and essentially cause the same challenge to disease-causing organisms, even if they have different product names.

Rotating fungicides with different FRAC codes is an important aspect of preventing pathogens from developing resistance to any one specific fungicide. Avoiding back-to-back applications of fungicides that have very specific modes of action (such as strobilurins [FRAC 11] or sterol biosynthesis inhibitors [FRAC 3]) is especially important. The likelihood of developing resistance to these types of compounds is much greater than for broad spectrum materials (FRAC M) such as chlorothalonil, copper, or mancozeb. Fungicide products that are at risk for development of resistance will list specific resistance management guidelines on their label. Follow all label directions concerning alternating and mixing fungicides.

Use the product's FRAC code to determine how each fungicide fits into a season-long spray program. Careful adherence to resistance-management guidelines (rotating FRAC codes) will go a long way toward preventing or delaying the development of resistance. Refer to the "FRAC Code" table on pages 22-24 for a complete list of fungicides, their modes of action, and chemical classes.

Water Quality

Water quality is an important factor in fungicide performance, particularly the pH of the water source. Some products undergo a chemical degradation called alkaline hydrolysis when the pH is above 7. Likewise, there are fungicides that degrade when added to water with a low pH; these include most copper materials. The target pH for most vegetable fungicide applications is 6.5; buffering is typically needed if outside of a 6.0-7.0 range. Have water tested to avoid such problems, especially when using water from wells or ponds; the pH of these water sources can change through the growing season.

Additives

Adjuvants or surfactants should be used if the product label recommends them to ensure uniform coverage; these materials often include buffering agents. Do not use adjuvants unless the label indicates they are needed. Surfactants are most valuable in applications to cole crops and peppers because of their waxy leaf surfaces.

Time-of-Day

When possible, fungicide applications should be made when the air is still. With high pressure and tiny droplets, drift can be significant with even light breezes. Avoid applications during the 10 AM to 4 PM window of pollinator activity. In some cases, crop damage may result from fungicide applications made during hot, humid, or high-sunlight parts of the day.

Sprayer Configurations for Fungicides

A properly equipped and calibrated spray rig is just as important as the chemicals chosen for disease management. Accurate delivery translates to good coverage, and good coverage is essential for fungicides to perform to their maximum potential. The chemical must therefore be applied precisely to cover all microscopic surfaces of the foliage to protect against infection. Regardless of the type of sprayer used, they will need to be properly calibrated. Because of nozzle wear, recalibrations need to be done often when fungicides are used (see Appendix J).

Ground-operated spray equipment should be set to deliver 25 to 150 gallons per acre at 30 to 200 psi to ensure thorough coverage

of plant surfaces. Higher volumes are typically recommended for mature crops; higher pressures are often necessary for larger leaves or denser plantings. For protective fungicide applications, piston pumps and diaphragm pumps are best, although some roller pumps are also suitable.

Hollow-cone or twin-jet nozzles are preferred for fungicide applications. Two-piece cone nozzles (consisting of core and whirl plate-orifice disc) are best used with high pressures. The core is a fan-shaped insert that shapes the spray pattern; the orifice uses a small hole in a disc to control the volume that passes through at a given pressure. These components come in different sizes that can be used in different combinations to greatly impact delivery and coverage.

Spray nozzles are made from brass, stainless steel, polymers, and ceramic. Brass nozzles are relatively inexpensive but wear out quickly, requiring frequent replacement and recalibration of the rig. Ceramic nozzles have the longest life but can be expensive. Keep in mind that these nozzles won't need to be replaced as often as brass nozzles and will hold calibration longer because of reduced wear. Stainless steel nozzles are less expensive than ceramic nozzles and provide long service life as well.

The type of spray boom needed varies greatly from crop to crop. Ground crops such as melons and most crops early in the season can be sprayed effectively with a broadcast boom sprayer. During application, nozzles should be turned about 15 to 20 degrees towards the direction of travel (front) to achieve a more vigorous spray action and improve coverage. The change in angle reduces immediate contact with leaves (which block delivery) and increases the stirring of leaves/foliage (at high pressure). This aids in the coverage of the undersides of leaves and areas of leaf overlap. Sprayers used on upright crops such as staked tomatoes and peppers, however, should be modified with drop arms and multiple nozzles to achieve thorough coverage.

Air-blast sprayers and motorized backpack sprayers can be used successfully for many vegetable crops. Coverage should be evaluated using water-sensitive papers; as foliage becomes denser, spraying rows from both sides may become necessary with these types of equipment.

Vegetable Seed Treatments

Planting high-quality seeds that have been treated with fungicides will help achieve optimal control of seedling diseases. Most commercially available vegetable seeds are pre-treated with one or more fungicides and possibly an insecticide. Check the product packaging or with the seed dealer to find out what treatments have been applied. Most seed companies also sell untreated seed for use by organic growers or those who wish to apply their own seed treatments.

Growers who prefer to treat their own seed should see Appendix I for specific information on disinfection/disinfestation of vegetable seeds. Read and follow current product labels carefully. The majority of labeled seed treatments are restricted to commercial treatment only due to concerns about applicator exposure during seed treatment and handling. Do not treat seed that has already been treated by the seed company. If unsure how seed has been treated, contact the seed vendor. Never use chemically treated seed for food or feed.

Soil Fumigants for Control of Nematodes and Soilborne Diseases

Fumigation can be used as a management tool in commercial field plantings. However, fumigation is uncommon as a result of cost, regulations, and limited number of commercial applicators who provide the service to small growers. These fumigants, when applied properly, significantly reduce populations of soilborne pathogens and nematodes. Studies, however, have shown that the effect is temporary. Populations often return to damaging levels within a season in sites replanted with susceptible crops. Soil fumigants are dangerous to people and animals and should be used with extreme caution. Fumigation is not permitted for use in high tunnels in Kentucky.

Biopesticides

A number of products derived from plants, microorganisms, or from GRAS (Generally Recognized as Safe) chemistries are labeled for disease control in vegetable crops (see "Biopesticides" table on pages 25 and 26). Some of these products are effective under specific conditions, and others have limited disease-control potential. Many are not as effective as conventional fungicides. The Environmental Protection Agency (EPA), which labels agrichemicals, only evaluates biopesticide safety, but it does not test product efficacy. In addition, some of these "soft" products are not EPA-registered because they do not specifically claim to be pesticidal. These alternative products include living microorganisms (bacteria, viruses, fungi, nematodes, and protozoa), "natural chemicals," plant extracts, etc.

The Biopesticides table lists alternative products and provides some general information on these new materials, but this does not constitute a recommendation. Growers interested in these products should first test them in small-scale trials before changing from a recommended spray program. Many biopesticides are approved for greenhouse use; check product labels.

Post-Harvest Decays

Vegetable crops can suffer significant losses after harvest due to poor environmental conditions and microbes (bacteria and fungi) present in wounds and on produce surfaces. Proper post-harvest handling, precooling, storage, and packaging procedures are all disease-control practices that are essential to successful commercial vegetable production.

Chlorination washes or sprays can be used in reducing pathogen numbers and spread, as well as improving shelf life. The wash-water temperature should be about 10°F warmer than the internal temperature of the product being washed. This avoids microbes from being drawn into the tissues, which occurs when colder water is used.

Although chlorine can be added to wash water in several forms, the water pH must be adjusted so it is in the range of 6.5 to 7.5 to ensure that adequate chlorine is available and active. The following forms of chlorine are used in post-harvest water baths:

- Sodium hypochlorite 5.25% (household bleach)—use 13 to 17 fluid ounces per 100 gallons of water.
- Calcium hypochlorite (Magnum 65%)—use 1 ounce per 100 gallons of water; labeled for most vegetables as a dip and rinse.

For detailed information regarding post-harvest handling, storage, and care of fresh produce, including chlorination procedures, see the "Post-harvest and Food Safety" section of Appendix A.

Disease Management in Greenhouse Vegetable Crops

Sanitation and moisture control are the most important strategies for disease management in the greenhouse. Relatively few fungicides are labeled for use in greenhouses, and a limited number of resistant varieties is available. The table on pages 27 and 28 summarizes the fungicides and bactericides registered for use on greenhouse-grown vegetables (including transplants). Consult product labels for crops covered by each material and for application instructions.

- Disinfect surfaces and equipment using steam (180°F for 30 minutes) or commercial disinfectants to reduce carry-over pathogens.
- Do not produce vegetable transplants in greenhouses with tobacco or ornamental plants in order to avoid virus disease problems.

FUNGICIDE RESISTANCE ACTION COMMITTEE (FRAC) CODES

Product	FRAC Code	Active Ingredient	Chemical Group
These fungicide groupings now appear on most labels. The groupings are based on mode of action of the fungicides. The codes allow users to determine if different fungicides share the same mode of action. This information should be used by growers to prevent/delay the development of resistance by not overusing products with the same mode of action.			
Actigard	21	acibenzolar-S-methyl	SAR inducer
Acrobat	40	dimethomorph	CAA-Fungicides (carboxylic acid amides)
Affirm	19	polyoxin D zinc salt	chitin synthetase inhibitor
Aftershock	11	fluoxastrobin	QoI fungicide
Agri-Mycin 17	25	streptomycin	antibiotic
Ag Streptomycin			
Alude	33	Mono- and dibasic sodium, potassium, and ammonium phosphites	phosphonates
Amtide Propiconazole	3	propiconazole	DMI fungicide
Aproach	11	picoxystrobin	QoI fungicide
Aprovia Top	7/3	benzovindiflupyr + difenoconazole	carboxamide + DMI fungicide
Ariston	M/27	chlorothalonil + cymoxanil	inorganic + cyanoacetamide-oxime
Avaris	3/11	propiconazole + azoxystrobin	DMI + QoI
Badge SC	M	copper hydroxide + copper oxychloride	inorganic
Badge X2			
Basic Copper 53	M	basic copper sulfate	inorganic
Blocker 4F	14	PCNB	aromatic hydrocarbon
Blocker 10G			

(continued)

FRAC CODES *(continued)*

Product	FRAC Code	Active Ingredient	Chemical Group
Botran 75 W	14	dicloran	aromatic hydrocarbon
Botran 5F			
Bravo Ultrex	M	chlorothalonil	chloronitrile
Bravo WeatherStik			
Bravo ZN	M	chlorothalonil + zinc	chloronitrile
Bumper 41.8 EC	3	propiconazole	DMI fungicide
Cabrio	11	pyraclostrobin	QoI fungicide
Cannonball WP	12	fludioxonil	phenylpyrrole
Champ DP	M	copper hydroxide	inorganic
Champ Formula 2 FL			
Champ WG			
Chloronil 720	M	chlorothalonil	chloronitrile
Chlorothalonil 720 SC			
COC DF	M	copper oxychloride	inorganic
COC WP			
C-O-C-S WDG	M	copper oxychloride + basic copper sulfate	inorganic
Copper-Count-N	M	copper-ammonium complex	inorganic
Cueva	M	copper octanoate	inorganic
Cuprofix Ultra 40 Disperss	M	basic copper sulfate	inorganic
Cuprofix MZ Disperss	M	basic copper sulfate + mancozeb	inorganic + dithiocarbamate
Curzate 60 DF	27	cymoxanil	cyanoacetamide-oxime
Dexter Max	M/11	mancozeb + azoxystrobin	dithiocarbamate + QoI fungicide

(continued)

FRAC CODES *(continued)*

Product	FRAC Code	Active Ingredient	Chemical Group
Dithane F-45 Rainshield	M	mancozeb	dithiocarbamate
Dithane M-45			
Echo 720	M	chlorothalonil	chloronitrile
Echo 90 DF	M	chlorothalonil	chloronitrile
Elixir	M/M	mancozeb + chlorothanil	dithiocarbamate + chloronitriles
Elumin	22	ethaboxam	thiazole carboxamide
Emblem	12	fludioxanil	phenylpyrrole
Endura	7	boscalid	carboxamide
Equus 720 SST	M	chlorothalonil	chloronitrile
Equus DF			
Evergol Prime	7	penflufen	SDHI (succinate-dehydrogenase inhibitors)
Evito 480 SC	11	fluoxastrobin	QoI fungicide
Evito T	3/11	tebuconazole + fluoxastrobin	DMI + QoI fungicide
Flint	11	trifloxystrobin	DMI fungicide
Fontelis	7	penthiopyrad	carboxamide
Forum SC	40	dimethomorph	cinnamic acid
Fracture	n/a	BLAD	n/a
Gavel 75 DF	22/M	zoxamide + mancozeb	benzamide + dithiocarbamate
Gatten	U13	flutianil	thiazolidine
Gem	11	trifloxystrobin	QoI fungicide
Harbour	25	streptomycin	antibiotic
Headline	11	pyraclostrobin	QoI fungicide
Headline SC			
Headline AMP	11/2	pyraclostrobin + metconazole	QoI + DMI
Incognito	1	thiophanate-methyl	thiophanate
Initiate 720	M	chlorothalonil	chloronitrile
Inspire Super	3/9	difenoconazole + cyprodinil	DMI + anilinopyrimidine
Iprodione 4L AG	2	iprodione	dicarboximide
Kentan DF	M	copper hydroxide	inorganic
Kenja	7	isofetamid	carboxamide
Kocide 2000	M	copper hydroxide	inorganic
Kocide 3000			
Kocide 4.5 LF			
Kocide DF			
Koverall	M	mancozeb	dithiocarbamate
Luna Experience	7/3	fluopyram + tebuconazole	carboxamide + DMI fungicide
Luna Sensation	7/9	fluopyram + pyrimethanil	carboxamide + anilinopyrimidine
Luna Tranquility	7/9	fluopyram + pyrimethanil	carboxamide + anilinopyrimidine
ManKocide	M	copper hydroxide + mancozeb	inorganic + dithiocarbamate
Manzate Flowable	M	mancozeb	dithiocarbamate
Manzate Pro-Stick			
Manzate Max			
Mastercop	M	copper sulfate pentahydrate	inorganic

(continued)

FRAC CODES *(continued)*

Product	FRAC Code	Active Ingredient	Chemical Group
Mertect 340 F	1	thiabendazole	benzimidazole
MetaStar 2E AG	4	metalaxyl	phenylamide
Meteor	2	iprodione	dicarboximide
Micora	40	mandipropamid	mandelic acid
Miravis Prime	7/12	pydiflumetofen + fludioxonil	carboxamide + phenylpyrrole
Monsoon	3	tebuconazole	DMI fungicide
Mural	11/7	azoxystrobin + benzovindiflupyr	QoI fungicide + SDHI
Muscle	3/M	tebuconazole + chlorothalonil	DMI fungicide + chloronitrile
Nevado 4F	2	iprodione	dicarboximide
Nordox 75 WG	M	cuprous oxide	inorganic
Nu-Cop 3 L	M	copper hydroxide	inorganic
Nu-Cop 50 DF			
Nu-Cop 50 WP			
Nu-Cop 50 HB	M	cupric hydroxide	inorganic
Nufarm T-Methyl 4.5F	1	thiophanate-methyl	thiophanate
Nufarm T-Methyl 70 WSB			
Omega	29	fluazinam	2,6-dinitroaniline
Orondis Gold 200	49	oxathiapiprolin	oxysterol-binding protein modulator
Orondis Gold B	4	mefenoxam	phenylamide
Orondis Opti	M/49	chlorothalonil + oxathiapiprolin	chloronitrile + oxysterol-binding protein modulator
Orondis Opti B	M	chlorothalonil	chloronitrile
Orondis Ultra B	40	mandipropamid	mandelic acid
Orius 3.6F	3	tebuconazole	DMI fungicide
Onset 3.6F			
Pageant Intrinsic	7/11	boscalid + pyraclostrobin	carboxamide + QoI inhibitor
Penncozeb 75 DF	M	mancozeb	dithiocarbamate
Penncozeb 80 WP			
PhD	19	polyoxin D zinc salt	chitin synthetase inhibitor
Presidio	43	fluopicolide	benzamide
Previcur Flex	28	propamocarb	carbamate
Priaxor	7/11	fluxapyroxad + pyraclostrobin	carboxamide + QoI inhibitor
Pristine	7/11	pyraclostrobin + boscalid	QoI fungicide + carboxamide
Procure 480SC	3	triflumizole	DMI fungicide
Proline 480 SC	3	prothioconazole	DMI fungicide
Prolivo	U8	pyriofenone	methanone
Prosaro	3	prothioconazole + tebuconazole	DMI fungicide
Quadris	11	azoxystrobin	QoI fungicide
Quadris Opti	11/M	azoxystrobin + chlorothalonil	QoI fungicide + chloronitrile
Quadris Top	11/3	azoxystrobin + difenoconazole	QoI fungicide + DMI fungicide
Quash	3	metconazole	DMI fungicide

(continued)

FRAC CODES *(continued)*

Product	FRAC Code	Active Ingredient	Chemical Group
Quilt	3/11	azoxystrobin + propiconazole	QoI fungicide + DMI fungicide
Quilt Xcel	11/3	azoxystrobin + difenoconazole	QoI fungicide + DMI fungicide
Quintec	13	quinoxyfen	quinolene
Rally 40 WSP	3	myclobutanil	DMI fungicide
Ranman SC	21	cyazofamid	QiI fungicide
Reason 500 SC	11	fenamidone	QoI fungicide
Redigo 480	3	prothioconazole	DMI fungicide
Revus	40	mandipropamid	mandelic acid
Revus Top	40/3	mandipropamid + difenoconazole	mandelic acid + DMI fungicide
Rhyme	3	flutriafol	DMI fungicide
Ridomil Gold Bravo SC	4/M	mefenoxam + chlorothalonil	phenylamide + chloronitrile
Ridomil Gold Copper	4/M	mefenoxam + copper hydroxide	phenylamide + inorganic
Ridomil Gold GR	4	mefenoxam	phenylamide
Ridomil Gold MZ	4/M	mefenoxam + mancozeb	phenylamide + dithiocarbamate
Ridomil Gold PC GR	4/M	mefenoxam + PCNB	phenylamide + aromatic hydrocarbon
Ridomil Gold SL	4	mefenoxam	phenylamide
Rovral 4 Flowable	2	iprodione	dicarboximide
Scala	9	pyrimethanil	anilinopyrimidine
Shar-Shield PPZ	3	propiconazole	DMI fungicide
Stratego	3/11	propiconazole + trifloxystrobin	DMI fungicide + QoI fungicide
Stratego YLD	3/11	prothioconazole + trifloxystrobin	DMI fungicide + QoI fungicide
Sulfur	M	sulfur	inorganic

(continued)

FRAC CODES *(continued)*

Product	FRAC Code	Active Ingredient	Chemical Group
Switch	9/12	fludioxonil + cyprodinil	phenylpyrrole + anilinopyrimidine
Tanos	11/27	cymoxanil + famoxadone	cyanoacetamide-oxime + QoI fungicide
Tebu-Crop 3.6F	3	tebuconazole	DMI fungicide
Tebustar 3.6L			
Tebuzol 3.6F			
Terramaster	14	etridiazole	aromatic hydrocarbon
Thiophanate-Methyl 85 WDG	1	thiophanate-methyl	thiophanate
Tilt	3	propiconazole	DMI fungicide
Toledo	3	tebuconazole	DMI fungicide
Topaz	3	propiconazole	DMI fungicide
Topsin 4.5 FL	1	thiophanate-methyl	thiophanate
Topsin M 70 WP			
Topsin M WSB			
Torac	39	tolfenpyrad	methanone
Torino	U6	cyflufenamid	phenyl-acetamide
Ultra Flourish	4	mefenoxam	phenylamide
Uniform	4/11	azoxystrobin + mefenoxam	QoI fungicide + PA fungicide
Vibrance	7	sedaxane	SDHI
Velum Prime	7	fluopyram	carboxamide
Vertisan	7	penthiopyrad	carboxamide
Vivando	U8	metrafenone	methanone
Zampro	45/40	ametoctradin + dimethomorph	QxI inhibitor + cinnamic acid
Zing!	M/22	zoxamide + chlorothalonil	benzamide + chloronitrile
Ziram	M	ziram	dithiocarbamate

NON-FUMIGANT NEMATICIDES

Product	Product Amt/A	Application Method/Timing	Crops	Restricted Use	Re-Entry Interval (hrs)
Mocap 15G	13 to 80 lb	preplant broadcast or banded at-plant	beans (succulent), cabbage, cucumber, potato, sweet corn, sweetpotato	Yes	48
Mocap EC	2.4 to 6.9 fl oz /1,000 row-ft	preplant broadcast or banded at-plant	cabbage, potato, sweetpotato	Yes	48
Nemacur 3	2.33 qt	at-plant banded	eggplant	Yes	48
Nimitz	3.5 to 7 pt	preplant incorporated or drip irrigation	cucurbits, tomato, pepper, some cole crops, leafy vegetables	No	12
Velum Prime	6 to 6.84 fl oz	preplant in-furrow, post-emergence (drench, drip irrigation, and foliar)	suppression only on select cole crops, cucurbits, tomato, potato, sweetpotato	No	12
Vydate L	2 to 8 pt	preplant in-furrow, post-emergence (drip irrigation and foliar)	carrot, cucurbits, eggplant, pepper, sweetpotato, tomato	Yes	48

BIOPESTICIDES FOR VEGETABLE DISEASE MANAGEMENT

Product	Active Ingredient	Crops	Target Diseases/Pests	Greenhouse Use	Comments
Actigard	Acibenzolar-S-methyl	chili pepper, cucurbits, lettuce, onion, spinach, tomato	bacterial blights, downy mildew, powdery mildew; crop dependent—refer to label	No	Do not apply to plants stressed by heat, cold, or moisture extremes.
Biofence, Dominus	Allyl isothiocyanate	most vegetables (see label)	nematodes, root diseases	Yes	Read and follow label instructions for best efficacy.
Azaguard, Ecozin, Molt-X	Azadirachtin		nematodes	Yes	OMRI-listed.
Double Nickel	*Bacillus amyloliquefaciens* D747		powdery mildews, fungal leaf spots, root rots	Yes	OMRI-listed. May be applied through drip, as drench or transplant dip, or as foliar spray, depending on the target disease(s).
Stargus, Amplitude	*Bacillus amyloliquefaciens* F747		gray mold, white mold, downy mildew, root rots, Phytophthora, Pythium	Yes	OMRI-listed. May be applied through drip, as drench or transplant dip, or as foliar spray, depending on the target disease(s).
Serifel	*Bacillus amyloliquefaciens* MBI 600		fungal leaf spots, downy mildew, root rots	No	OMRI-listed. Do not use in greenhouse or transplant production. Use preventatively.
LifeGard	*Bacillus mycoides*		bacterial spot and speck, downy mildew, leaf spots, white mold	Yes	OMRI-listed. Use preventatively.
Ballad Plus, Sonata	*Bacillus pumilus* QST2808		Early blight, Late blight, downy mildew, powdery mildew, leaf blights, rust	Yes	OMRI-listed. Ballad Plus can be used on sweet corn only.
Companion	*Bacillus subtilis* GB03		root diseases	Yes	OMRI-listed.
Aviv	*Bacillus subtilis* IAB/BS03		fungal leaf spots, bacterial leaf spots, root rots	Yes	OMRI-listed.
Subtilex NG	*Bacillus subtilis* MBI 600	cucurbits, eggplant, pepper, tomato	root diseases, powdery mildew	Yes	Apply to soil or potting medium; use as a foliar spray for powdery mildew.
Cease, Serenade Max, Serenade ASO, Serenade Optimum, Serenade Soil, Minuet	*Bacillus subtilis* QST713	cole crops, leafy vegetables, legumes, cucurbits, pepper, tomato	downy mildew, powdery mildew, leaf blights	Yes	OMRI-listed.
Leap	*Bacillus thurigiensis* + methyl salicylate	tomato, pepper	bacterial diseases	Yes	Rotate with other chemistries labeled for bacterial disease management.
Fracture	Banda de *Lupinus albus* doce	tomato	powdery mildew, gray mold	Yes	Apply preventatively.
Majestene	*Burkholderia* spp. A396	cucurbits, eggplant, pepper, tomato, potato, sweetpotato, sweet corn	nematodes	Yes	OMRI-listed.

(continued on the next page)

BIOPESTICIDES *(continued)*

Active Ingredient		Crops	Target Diseases/Pests	Greenhouse Use	Comments
Romeo	Cerevisane	most vegetables (see label)	fungal leaf spots, downy mildews	Yes	OMRI-listed.
Contans WG	*Coniothyrium minitans*		Sclerotinia sclerotiorum (white mold, timber rot, drop)	Yes	OMRI-listed. Apply to soil or potting medium.
Pvent	*Gliocladium cantenulatum* J1446		seed rots, root diseases, Botrytis stem canker	Yes	-
SoilGard 12G	*Gliocladium virens* GL-21		seed rots, root diseases	Yes	OMRI-listed. Do not apply in conjunction with chemical fungicides.
ProAct, Messenger	Harpin protein	most vegetables (see label)	foliar diseases	n/a	-
Oxidate, Terracide	Hydrogen dioxide		root diseases, leaf blights	Yes	OxiDate is OMRI-listed.
Oxidate 2.0, TerraClean 5.0	Hydrogen dioxide + peroxyacetic acid		foliar and root diseases	Yes	OxiDate 2.0 is OMRI-listed.
Rendition	Hydrogen peroxide + peroxyacetic acid		foliar and root diseases	No	
Vacciplant	Laminarin		foliar and root diseases	Yes	Greenhouse use pre-transplant only. Use preventatively.
Ennoble	*Muscodor albus* SA-13		soilborne fungal diseases	Yes	OMRI-listed. Preplant soil biofumigant.
DiTera DF	*Myrothecium verrucaria*		nematodes	Yes	OMRI-listed.
Trilogy	Neem oil		foliar diseases	Yes	OMRI-listed. May cause leaf burn; test a small number of plants before spraying entire crop.
Mildew Cure	Oil (cottonseed, corn, and garlic)	pepper, tomato	bacterial spot, speck	Yes	May cause leaf burn; test a small number of plants before spraying entire crop.
Sporatec	Oil (clove, rosemary, thyme)	most vegetables (see label)	powdery mildew, fungal leaf blights	Yes	OMRI-listed. Addition of a spray adjuvant (spreader or penetrant) is recommended.
Oleotrol-M	Oil (soybean)		Botrytis gray mold, downy mildew, powdery mildew	Yes	OMRI-listed. Tank-mix with a spreader-sticker.
MeloCon WG	*Paecilomyces lilacinus*		nematodes	Yes	OMRI-listed.
AgriPhage	Phage		bacterial spot, speck	Yes	-
Alude, Fosphite, Fungi-Phite, Phostrol, ProPhyt, Rampart	Phosphorous compounds		downy mildew, powdery mildew, leaf blights	Yes	-
Affirm, OSO, PhD	Polyoxin D zinc salt	cucurbits, eggplant, tomato, pepper	powdery mildew, leaf spots	Yes	Apply preventatively.

(continued on the next page)

BIOPESTICIDES *(continued)*

Active Ingredient		Crops	Target Diseases/Pests	Greenhouse Use	Comments
Armicarb, Kaligreen, Milstop	Potassium bicarbonate	most vegetables (see label)	powdery mildew, fungal leaf blights	Yes	Kaligreen and Milstop are OMRI-listed. pH of spray solution should not be below 7.0.
M-Pede	Potassium salts of fatty acids		powdery mildew	Yes	Do not mix with surfactants or apply to stressed plants to avoid plant injury.
Sil-MATRIX	Potassium silicate		powdery mildew, Botrytis gray mold	Yes	OMRI-listed. Tank-mix with a non-ionic surfactant for best results.
Howler	*Pseudomonas chloroaphis*		fungal leaf diseases, root rots	Yes	OMRI-listed. Use preventatively.
Regalia	*Reynoutria sachalinensis*		powdery mildew, fungal leaf blights	Yes	OMRI-listed. First application should be made before symptoms appear.
Mycostop	*Streptomyces griseoviridis*		seedling, root, and stem rots	Yes	OMRI-listed. Can be added to potting mix or applied in-furrow to field soil.
Actinovate AG	*Streptomyces lydicus*		seedling, root, and stem rots; foliar blights	Yes	OMRI-listed. Can be used as a soil or foliar treatment.
T-22, RootShield, PlantShield	*Trichoderma harzianum*	cole crops, eggplant, leafy vegetables, pepper, tomato	seedling, root, and stem rots	Yes	OMRI-listed. Can be added to potting mix or applied in-furrow to field soil.
Bio-Tam 2.0	*Trichoderma* spp. strain ICC	cucurbits, leafy greens, pepper, tomato	seedling, root, and stem rots	Yes	OMRI-listed.
Binab	*Trichoderma viride*	most vegetables (see label)	seedling, root, and stem rots	Yes	-
BotryStop	*Ulocladium oudemansii* strain U3		gray mold, white mold	Yes	OMRI-listed.

FUNGICIDES AND BACTERICIDES FOR GREENHOUSE-GROWN VEGETABLES

Product	FRAC Code	Preharvest Interval (days)	Crops	Target Diseases	Comments
Labeled for Greenhouse Use[1]					
Blocker Flowable	14	n/a	beans, broccoli, Brussels sprouts, cabbage, cauliflower, pepper, tomato	Rhizoctonia root and stem rots, clubroot	Transplant production only. Apply as a drench to seedlings in beds or containers.
Botran 75 W	14	10	cucumber, lettuce (leaf), tomato	Botrytis blight and gray mold; white mold (cucumber)	Tomato: direct spray at stems; cucumber and lettuce: apply to foliage. Rates and application restrictions are crop-specific; see label.
Copper fungicides[3]	M	0	most vegetables (see label)	bacterial diseases, foliar blights, powdery mildew	-
Decree	17	0/3[2]	cucumber, tomato, pepper, leafy greens	gray mold (*Botrytis*)	Do not apply in field.
Emblem	12	0/7[2]	most vegetables (see label)	foliar diseases; stem, crown, and root rots	
Fontelis	7	0/1[2]	cucurbits, tomato	Alternaria diseases, Botrytis gray mold, powdery mildew, Sclerotinia diseases, Septoria diseases	-
Luna Tranquility	7/9	1	tomato only	fungal leaf spots	
Mancozeb (Dithane, Manzate, Penncozeb)	M	5/10[2]	most vegetables (see label)	foliar blights, bacterial diseases (+ fixed copper)	-
Micora	40	n/a	cole crops, leafy vegetables, eggplant, pepper, tomato	downy mildew, late blight	Use only on transplants grown for retail sale.
Pageant Intrinsic	11/7	0	tomato	Botrytis gray mold, fungal leaf spots	-

(continued on the next page)

FUNGICIDES AND BACTERICIDES FOR GREENHOUSE-GROWN VEGETABLES *(continued)*

Product	FRAC Code	Preharvest Interval (days)	Crops	Target Diseases	Comments
Previcur Flex[2]	28	5/7	cucurbits, lettuce (leaf), pepper, tomato	damping-off and root rot (*Pythium* spp. and *Phytophthora* spp.)	-
Ranman	21	n/a	basil, tomato	Pythium damping-off, downy mildew (basil)	Transplant production only. Only 1 application is permitted during growing cycle. Treat no later than 1 week before transplanting.
Scala SC	9	1	tomato, cucumber	early blight and Botrytis gray mold	Must be tank-mixed with another Early blight or Botrytis fungicide. Ventilate greenhouse for a minimum of 2 hours after application to avoid plant injury.
Spirato	12	0/7[2]	cole crops, cucurbits, herbs, tomato, pepper, leafy greens	fungal leaf spots	Rotate with a fungicide with a different mode of action.
Switch	9/12	0/7[2]	basil, beans, cole crops, cucurbits, pepper, tomato	fungal leaf diseases: early blight, Botrytis gray mold, and powdery mildew	Do not apply to cherry or grape tomatoes.
Terramaster 4EC	14	3	tomato	Pythium and Phytophthora root rots	Apply in drip irrigation or as a drench.
Terraguard	3	0	tomato and cucumber	powdery mildew	
Trionic	3	0/1[2]	cucumber, lettuce (leaf), tomato	powdery mildews, black spot	
Not Prohibited for Greenhouse Use[1]					
Agri-Mycin 17	25	n/a	pepper and tomato, celery	bacterial leaf spot, bacterial blight	Transplant production only.
Curzate 60DF	27	3	cucurbits, lettuce, tomato	downy mildew, late blight	-
Dexter Max	M/11	5/10[2]	broccoli, cabbage, cucurbits, lettuces, pepper, tomato	fungal leaf spots	Check label for potential compatibility issues.
Gavel	M/22	5	cucurbits, tomato	downy mildew, late blight	-
Inspire Super	3/9	0	cucumber only	Botrytis gray mold, powdery mildew	-
ManKocide	M	5/10[2]	most vegetables (see label)	foliar blights, bacterial diseases (+ fixed copper)	-
Procure	3	0/1[2]	cole crops, cucurbits, leafy greens	powdery mildew	Limited to 2 applications for cole crops and leafy greens; up to 4 applications for cucurbits.
Quadris Top	11/3	0/1[2]	cole crops, cucurbits, tomato	leaf mold, powdery mildew, Alternaria diseases	Do not use for transplant production.
Revus	40	1	beans, cole crops, cucurbits, lettuce, pepper	downy mildews	-
Revus Top	3/40	1	tomato	late blight, fungal leaf spots	-
RIdomil Gold MZ	4/M	5	tomato	late blight	-
Sulfur	M	0	cole crops, cucurbits, pepper, tomato	powdery mildew and fungal leaf spots	Check label for greenhouse compliance.
Tanos	11/27	3	cucurbits, pepper, tomato	downy mildew, late blight	Must be tank-mixed with mancozeb or copper fungicide.
Torino	U6	0	cucurbits	powdery mildew	-
Ziram	M	7	tomato	fungal leaf spots	-

[1] Pesticides may be used in greenhouses and high tunnels if the product label clearly states that greenhouse use is permitted (labeled) for a particular crop. Pesticides whose labels do not explicitly allow or prohibit greenhouse use may also be used as long as that particular pesticide is labeled for the crop to be treated and label instructions are followed—even though clear instructions for greenhouse use do not appear on the label.

[2] Crop dependent, see label.

[3] Greenhouse-approved copper fungicides include Badge X2, Champ DP, Champ Formula 2, Champ WG, Copper-Count-N, Cueva, Cuprofix, Kentan DF, Kocide 2000, Kocide 3000, Kocide DF, MasterCop, Nordox, Nu-Cop 50DF, and Nu-Cop HB. Badge X2, Champ WG, Cueva, Nordox, and Nu-Cop HB are approved for use in organic systems (OMRI-listed).

Asparagus

Lily family (Liliaceae): *Asparagus officinalis*

Planting and Culture

New asparagus plantings can be started as crowns or transplants. Fields to be planted with asparagus should be well drained, fairly level, free from rocks, and relatively weed-free.

Using 10- to 12-week-old transplants that have been started in the greenhouse is a good method for establishing a new planting. One-year-old crowns purchased from a plant producer is the traditional method of planting. Direct seeding into the field is not recommended. Furrows 5 to 6 inches deep are prepared for crowns or transplants. Problems associated with heavy rains filling in the furrows and smothering small transplants or direct-seeded plants make 1-year-old crowns the most reliable method.

One-year-old crowns should be planted in furrows with the buds up and 6 inches below the soil surface. Cover crowns with 1 ½ to 2 inches of soil at the time of planting. Furrows gradually are filled in as the spears begin growing.

Space crowns or transplants 14 to 18 inches apart in the furrow. Furrows should be 5 to 6 feet apart. You will need 5,808 plants per acre at 5-foot row spacing and 4,840 plants per acre at a 6-foot spacing.

Crowns should be planted in March or early April (see Appendix K). Transplanting should be done in late April or early May. See *Commercial Asparagus Production* (HO-66) for additional information.

Fertilizing

Apply fertilizer based on soil test results. Broadcast and disk in before establishing a new planting. Continue to apply fertilizer each year if needed. Apply animal manure or plow under a green manure cover crop before planting. Apply lime if needed to bring the soil pH to 6.5 to 6.8 and to supply calcium, deeply incorporating it prior to planting. Asparagus does not tolerate acid soils. Apply 200 pounds per acre of triple superphosphate (0-46-0) in the bottom of the trench just before planting. This is 2.3 pounds per 100 feet of row at a 5-foot spacing and 2.8 pounds per 100 feet of row at a 6-foot row spacing. This application is in addition to the phosphorus applied based on the soil test. Topdress an annual application of 70 to 75 pounds of nitrogen about two weeks before the end of the harvest season. Soil magnesium should be checked before planting and every three to four years after establishment.

Harvest

Harvest only five to six spears per plant if any the first year. After two years of growth, harvest for about 6 to 8 weeks in the spring in order to allow fern growth to develop for the rest of the season. Harvest spears when 5 to 10 inches long. Harvest during early morning hours and place in cold storage as soon as possible.

Cut asparagus spears to uniform length, tie in 2- to 2 ½-pound bunches and pack them in pyramid crates for the wholesale market.

Ferning out—feathering of the head of the asparagus spear—indicates poor quality with high fiber content. High temperatures will cause the tips of shoots to fern out at a shorter height.

After Harvest

After the final harvest, herbicides can be applied to help keep fern growth free from weed competition late in the season. It is important to keep the plants growing well after harvest until frost. The tops can then be mowed down with a rotary mower in the late winter or early spring before spear emergence.

VARIETIES: Asparagus

Varieties	Comments
Greenox (NJ-1122)	All-male hybrid, excellent yields, high disease resistance
Jersey Giant	All-male hybrid, vigorous plants, rust resistant, *Fusarium* tolerant
Jersey Knight	All-male hybrid, does well on heavier soils, high yielding, high disease tolerance
Jersey Supreme	All-male hybrid, uniform spear size, high disease tolerance
Millennium	Predominately male, Canadian variety, performs well in hot seasons, rust resistant
Porthos (NJ-1025)	All-male hybrid, new, top yielder, disease tolerance
Sequoia (NJ-1113)	New, elite all-male hybrid, top yielding variety, highly disease and rust tolerance
Pacific Purple	New Zealand variety, good for fresh eating, high yielding
Purple Passion	Sweet and tender, excellent taste
Walker Deluxe	All-male hybrid, high yield potential, resistance to rust and Fusarium

FERTILIZER: Asparagus

Soil Test Results (lb/A)		Fertilizer Needed (lb/A)
Phosphorus		**Phosphate (P_2O_5)**
Low	<31	121-240
Medium	31-60	61-120
High	61-80	21-60
Very High	>80	0-20
Potassium		**Potash (K_2O)**
Low	<201	201-300
Medium	201-300	101-200
High	301-450	51-100
Very High	>450	0-50
Nitrogen		**N**
		75

PESTICIDE SAFETY: Asparagus

	Signal[1]	Re-entry (hrs)	Harvest (days)
INSECTICIDES			
Assail 30 SG	C	12	1
Azera	W	12	0
Bt products	C	12	0
Coragen 1.67 SC	-	4	1
Dimethoate 4	W	48	180
Fulfill 50 WDG	C	12	170
Knack 0.86 EC	C	12	7
Malathion 57 EC	W	12	1
Radiant SC	C	4	60
Sevin XLR Plus	C	12	1
Transform 50 WG	D	24	180
Restricted Use			
Lannate 90 SP	DP	48	1
Permethrin 3.2 EC	C	12	1
FUNGICIDES			
Azoxystrobin[2]	C	4	100
Chlorothalonil[2]	C	12	190
Dexter Max	C	24	180
Dexter XCEL	C	24	180
Fixed coppers[2]	W	24/48	0
Elevate	C	12	180
Flint Extra	C	12	180
Mancozeb[2]	C	24	180
Mefenoxam[2]	C	48	1
Metalaxyl[2]	W	48	1
Myclobutanil[2]	W	24	180
Sulfur[2]	C	24	0
Tebuconazole[2]	C	12	180

1 W: Warning, C: Caution, D: Danger; P: Poison
2 Several formulations are marketed. See the general introduction for more details on fungicides.

INSECT CONTROL: Asparagus[1]

Insecticide	Product Amt/A	Seasonal Limit/A	Comments and Other Restrictions
SPEAR TREATMENTS			
Armyworms			
Azera	16-56 fl oz	10 applications	Limit 1 application per day.
Bt products	See labels	-	-
Coragen 1.67 SC	3.5 to 7.5 fl oz	15.4 fl oz	Allow 3 days between applications.
Asparagus Beetles: Only the common asparagus beetle (blue and brown with white spots) injures the plants. Monitor plants in the early afternoon when beetles are active. Treat when 10% of the plants are infested with the beetles.			
Assail 30 SG	2.5 to 5.3 oz	2 applications	Allow 10 days between applications.
Azera	16-56 fl oz	10 applications	Limit 1 application per day.
Malathion 57 EC	1.5 to 2 pt	2 applications	Allow 7 days between applications.
Permethrin 3.2 EC	2 to 4 fl oz	16 fl oz	Allow 7 days between applications.
Sevin XLR Plus	1 qt	3 applications	Allow 3 days between applications.
Cutworms			
Permethrin 3.2 EC	2 to 4 fl oz	16 fl oz	Allow 7 days between applications.
Sevin XLR	1 qt	3 applications	Allow 3 days between applications.
FERN TREATMENTS			
Asparagus Beetles			
Assail 30 SG	2.5 to 5.3 oz	2 applications	Allow 10 days between applications. Controls Japanese beetle.
Azera	16-56 fl oz	10 applications	Limit 1 application per day.
Dimethoate 4	1 pt	2 pt	For post-harvest use only. Allow 14 days between applications.
Malathion 57 EC	1.5 to 2 pt	2 applications	Allow 7 days between applications
Permethrin 3.2 EC	4 fl oz	16 fl oz (3 app.)	Controls Japanese beetle.
Radiant SC	4 to 8 fl oz	24 fl oz	For post-harvest use only.
Sevin XLR	2 qt	5 applications	Controls Japanese beetle. Allow 3 days between applications.

1 Generic products available (Appendix G).

WEED CONTROL: Asparagus

Product Amt/A	lb A.I./A	Comments
ESTABLISHED BEDS ONLY		
0.5 to 1.92 fl oz Aim	0.008 to 0.03 Carfentrazone-ethyl	Post-emergence control of broadleaf weeds. Do not apply within 5 days of harvest. Do not apply more than 3.8 fl oz (0.06 pound a.i.) per acre per season. Do not make applications less than 20 days apart.
3.0 to 7.7 oz Callisto	0.09 to 0.24 mesotrione	Apply prior to spear emergence in spring or post-harvest or both. Can be applied broadcast in spring before spear emergence or banded post-harvest. Do not apply more than 7.7 fl oz/A per season. Use a NIS at 0.25% v/v if weeds are already emerged. Use of an adjuvant post-harvest may cause crop injury.
6.0 oz Chateau WDG	0.19 Flumioxazin	For pre-emergence control of weeds in dormant asparagus. Apply at least 2 weeks prior to asparagus emergence in spring or unacceptable crop injury will result. Apply no more than 6 oz/A for the entire season.
8 to 16 fl oz Clarity	0.25 to 0.5 dicamba	For control of broadleaf weeds. Do not cultivate within 7 days after application. Apply to actively growing weeds in 40 to 60 gal water immediately after a harvest but at least 24 hours before the next harvest. Use high rate for perennial weeds. Can be used in tank-mix with 2,4-D or Roundup for control of Canada thistle or field bindweed. Discard crooked spears after harvest. Maximum of 1 pt/A per year.
8 lb Devrinol 50 DF	4 napropamide	For control of annual grasses and broadleaves. Apply as a surface applied or incorporated treatment in 10 to 50 gal water/A to stands established at least 1 season. Do not allow contact with crop foliage. Apply before crop emergence in the spring and incorporate 1 to 2 inches. Rainfall or irrigation may be used for incorporation.
1.5 to 2 qt Formula 40 3.67L	1.38 to 1.84 2,4-D	For selective post-emergence control of broadleaf weeds only. Apply in 60 gal water/A to actively growing weeds, usually in April or May. If spears are present, treat immediately after cutting. Make no more than 2 applications (spaced at least 1 month apart) during harvest season. For post-harvest application, use drop nozzles to avoid spraying the fern.
2 to 4 lb Karmex XP	1.6 to 3.2 diuron	For pre-emergence control of annual grasses and broadleaf weeds. Apply 1 to 2 lb per acre on light sandy soils and 2 to 4 lb per acre on heavier soils. Apply after disking or chopping fern in the spring at least 4 weeks before spears emerge. A second application may be made at the end of the harvest season if rainfall is expected. Max. rate of 6 lb/A per year. 6 to 8 weeks of residual activity.
16 to 22 fl oz Roundup WeatherMax	0.56 to 0.77 glyphosate-salt	For non-selective post-emergence control of annual and perennial grasses and broadleaf weeds. Use only AMS 1 to 2% v/v. Adding a non-ionic surfactant can reduce weed control effectiveness. Solicam + Roundup tank-mix has been very effective against a broad spectrum of weed species. PHI = 14 days. Min. 30 days before replanting with any non-labeled crop. May be applied following final spring harvest, when all asparagus is cut to ground level over the entire planting, to help control both annual and perennial weeds.
1.5 lb Sinbar 80 WP	1.2 to 1.6 terbacil	For control of annual grasses and broadleaf weeds. Apply before spear emergence. Can be applied immediately after clean cutting.
2.5 to 5 lb Solicam DF	3 to 4 norflurazon	For control of annual grasses and broadleaf weeds and suppression of yellow nutsedge. Allow newly planted fields to become established for 1 season before 1st application. Apply as broadcast pre-emergent in min. 20 gal water/A. Apply in fall after chopping fern or in spring before fern emergence. Use low rate on sandy soils. PHI = 14 days. Apply only once per season.
3 to 4 pt Treflan HFP 4 E	1.5 to 2 trifluralin	For control of annual grasses and broadleaf weeds. Can be applied to dormant asparagus after fern has been removed or after last harvest. For split application, use 1.5 to 2 lb/A each time.
1.33 to 2.67 lb TriCor DF	1 to 2 metribuzin	For control of annual grasses and broadleaf weeds. Apply in 10 to 40 gal water/A before spear emergence. Do not use on young plants during the first growing season. Can also be applied as a split application of pre-emergence (0.67 to 1.33 lb/A) and after final harvest (1.33 to 2.0 lb/A) with a max. rate of 2.67 lb/A per season. PHI = 14 days.

(continued on next page)

WEED CONTROL: Asparagus *(continued)*

Product Amt/A	lb A.I./A	Comments
ESTABLISHED BEDS AND NEW PLANTINGS		
1 to 1.5 pt Fusilade DX	0.25 to 0.38 fluazifop-p	For selective post-emergence control of annual grasses and suppression of perennial grasses. Include 1% v/v crop oil or 0.25% v/v non-ionic surfactant/A. PHI = 1 day. Repeat applications must be at least 14 days apart. Max. rate is 48 fl oz/A per season and 24 fl oz/ application.
2 to 4 pt Gramoxone Inteon	0.69 to 1.38 paraquat salt	For non-selective contact kill of annual grasses and broadleaf weeds and top-kill of perennial weeds. Apply as a band treatment over the row or as broadcast pre-emergence in min. 10 gal water/A. In new seedlings apply before, during, or after planting but before emergence of the crop. In plantings established at least 2 years, apply min. 6 days before crop emergence or after last harvest. Use with non-ionic surfactant 0.25% v/v. Max. 3 applications/season. **Paraquat product labels require applicators to take an EPA-approved training every 3 years to mix, load, and apply paraquat.**
1 to 2 lb Lorox 50 DF	0.5 to 1 linuron	For control of annual grasses and broadleaves. Make 1 application pre-emergence at least 1 day before harvest. If used post-emergence, make 1 to 3 applications of 1 to 2 lb/A on weeds <4 inches tall. At the fern stage, apply 1 application of 4 lb/A as a directed spray to base of ferns. For newly planted crowns, use as pre-emergence application of 2 to 4 lb/A after planting. Activated charcoal as a band over the planted row is needed for protection of the newly planted crowns. For post-emergence, use 1 to 2 applications of 1 to 2 lb/A when ferns are 6 to 18 inches tall and weeds <4 inches tall. Do not exceed 4 lb/A per year.
0.5 to 2.5 pt Poast	0.09 to 0.49 sethoxydim	For control of actively growing grasses only. Use high rate on Johnson grass. Apply over the top of bearing asparagus with min. 1 day before harvest. Max. rate of 2.5 pt/ application and 5 pt/season.
2.4 to 8.2 pt Prowl H2O	1.14 to 3.90 pendimethalin	Not for use on newly seeded beds. Do not apply over the top of emerged spears. On sandy soils do not use more than 2.4 pt per acre. Do not apply more than 8.2 pt in a season. 14 day PHI.
16 to 22 fl oz Roundup WeatherMax 5.5L	0.69 to 0.94 glyphosate-salt	For non-selective post-emergence control of annual and perennial grasses and broadleaf weeds. Use only AMS 1 to 2% v/v. Adding a non-ionic surfactant can reduce weed control effectiveness. Do not apply within a week before first asparagus spears emerge. May be applied after the last harvest and all spears have been removed. If spears have been allowed to regrow, wait until ferns have developed and use a shielded spray in row middles. Solicam + Roundup tank-mix has been very effective against a broad spectrum of weed species. PHI = 14 days. Min. 30 days before replanting with any non-labeled crop.
0.5 to 1.5 oz Sandea 75 DF	0.023 to 0.072 halosulfuron	For weed control of broadleaf weeds and yellow nutsedge. May be applied post-emergence broadcast during the harvesting season in at least 15 gal water/A. After harvest, direct application below the ferns for complete weed coverage and avoid contact with the fern. Max. 2 applications/season and 2 oz/A per season. PHI = 1 day. For first-year transplants, apply at least 6 weeks after fern emergence.
9 to 16 fl oz Select Max	0.07 to 0.14 clethodim	Apply to actively growing grasses. Use NIS at 0.25% v/v. PHI = 1 day. Do not apply more than 16 fl oz/A in a single application and no more than 64 fl oz/A (0.5 lb ai/A) per season. Apply in a volume of at least 10 and no more than 40 gal/A. For repeat applications make on a minimum of a 14-day interval.

DISEASE CONTROL: Asparagus

Product	FRAC Code[1]	PHI[2] (days)	Amt/A	Seasonal Limits/A	Comments
Cercospora Blight, Rust					
Chlorothalonil[4]					There are multiple Bravo formulations and chlorothalonil generics on the market. See label for rates.
Bravo Ultrex	M	190	1.8 to 3.6 lb	11 lb	
Bravo Weather Stik	M	190	2 to 4 pt	12 pt	
Copper, fixed coppers[4, 6]					See label for rates, mixing instructions, and tank-mix precautions.
Dexter Max	M/11	180	2 to 2.2 lb	8.5 lb	Apply to ferns after harvest of spears.
Dexter XCEL	M/11/3	180	48 to 64 oz	192 oz	Apply to ferns after harvest of spears.
Dithane M45 and mancozeb[4]	M		2 lb	8 lb	Apply after harvest of spears. There are multiple Dithane formulations and mancozeb generics on the market. See label for rates.
Rally and myclobutanil[4] generics	3	180	5 oz	6 apps	Rust. Apply after harvest of spears.
Sulfur[4]	M	0			Rust. Phytotoxicity may occur when sulfur is applied when temperatures exceed 90°F.
Toledo and tebuconazole[4] generics	3	180	4 to 6 fl oz	3 apps	Rust.
Fusarium Crown Rot					
Dithane and mancozeb[4] generics	M				Pretreatment of crowns. See label for rate and directions.
Phytophthora Crown/Spear Rot					
Ridomil Gold SL and mefenoxam[4] generics	4	1	1 pt	2 pt	
MetaStar and metalaxyl[3] generics	4	1	2 qt		
Orondis Gold	U15	14	9.6 oz	2 apps	Crown soak, banded spray, or drip.
Stemphylium Purple Spot, Gray Mold					
Elevate	17	180	1.5 lb	4 apps	Gray mold.
Flint Extra	11	180	3.0 to 3.8 oz	11.6 oz	Stemphylium purple spot.
Quadris and azoxystrobin[4] generics	11	100	6.0 to 15.5 fl oz	4 apps	Stemphylium purple spot.

1 Products with numerical FRAC codes must be alternated or tank-mixed with products that have a different FRAC code to discourage resistance development. See product label for maximum number of consecutive applications allowed. Refer to the table on pages 22-24 for more information on FRAC codes.

2 Pre-harvest interval.

3 Per 100 gallons of water.

4 Generic products available (Appendix F). Amounts and seasonal limits per acre are product dependent.

5 Use higher rate when pressure is severe.

6 Fixed coppers labeled in KY include: Badge SC, Badge X2, Basic Copper 53, Champ, Champ WG, ChampION++, C-O-C-S WDG, Cueva, Cuprofix, Cuproxat, Kentan, Kocide 2000, Kocide 3000, Kocide DF, KOP-5, MasterCop, Nordox 75 WG, Nu-Cop 30 HB, Nu-Cop 50DF, Phyton 27, Phyton 35, and Previsto. Rates may vary by product and by crop. Refer to specific product label for this information.

Beans

Pea family (Fabaceae): *Phaseolus vulgarus*—snap bean, *P. lunatus*—Lima bean, *Glycine max*—soybean

Planting and Culture

Begin first plantings after danger of frost and once soil has warmed to 60 to 65°F (see Appendix K). Successive plantings of bush snap beans at two- to three-week intervals may be desirable for roadside markets, U-pick, farmers' markets, and shipping.

Bush Beans. Plant in rows 24 to 30 inches apart. Plant seeds 2 to 3 inches apart in the row and 1 ½ inches deep in a well-prepared seedbed. Also see, "Production with Plasticulture."

Lima Beans. Plant in rows 24 to 30 inches apart for bush lima beans and 5 feet apart for pole lima beans. Space seeds 3 to 5 inches in the row, 1 to 2 inches deep.

Pole Beans. Plant seed in rows and thin plants to 6 to 8 inches apart in the row. Sow seed 1 to 2 inches deep. Space rows 5 feet apart, and prepare a wire trellis for plants to grow on.

Dry Beans (pea-beans). Plant seed in rows 28 inches apart with seed spaced 2 to 3 inches apart in the row and 1 inch deep. The first plantings should be made after danger of the last killing frost in the spring. Beans will not withstand frost and do not do well when planted in cold soils, which make them more susceptible to rotting and slow growth. A seed treatment is highly recommended. Successive plantings of bush beans at two- to three-week intervals can be made until August 15.

Seeding rate is partly determined by variety. Small-seeded varieties require fewer pounds of seed per acre than large-seeded varieties. The average amount of seed to plant is about 80 pounds per acre.

There are no known detrimental effects on plant growth associated with inoculating seed with *Rhizobium* prior to planting. However, there are many different strains of *Rhizobium,* and many factors are involved in determining if it will increase nitrogen fixation and help your crop. There will be no effect if the field has a recent history of being planted with beans, because a large population of *Rhizobium* will already be present in the field.

Production with Plasticulture

Some Kentucky growers producing for roadside stands or farmers' markets have obtained extremely high yields and a cleaner harvest of bush beans and half runners using trellises and black plastic on raised beds with drip irrigation. Holes are punched in the plastic by hand or with a waterwheel setter, and two to three seeds are planted in each hole. Two rows about 15 inches apart are planted on each bed with a spacing of 12 inches between planting holes in the row. A simple trellis can be constructed by stringing horizontal rows of twine between tomato stakes spaced about 8 to 10 feet apart. Horizontal stringing is followed by weaving twine vertically between the top and bottom horizontal lines.

Pole beans require sturdier trellises. High-tensile wires are strung at 6 inches and at 5 feet above the ground. Jute twine is then woven vertically between these two wires.

Fertilizing and Pollination

Snap-bean fertilizer trials in Kentucky indicate that 50 pounds of actual nitrogen per acre and a pH of 6.2 to 6.5 is adequate for good yields. For beans grown on plastic with drip irrigation, 19 to 26 pounds of calcium nitrate per acre can be fertigated weekly.

Zinc deficiency has been a limiting factor in some areas of the state. Where zinc levels are known to be low, up to 20 pounds of elemental zinc or 55 pounds per acre of zinc sulfate should be broadcast prior to seeding (see Appendix B).

If air temperature rises above 90°F during the pollination period, pollen production and growth can be reduced. Unpollinated blossoms will drop off. Blossom drop can be reduced by maintaining adequate soil moisture and by keeping good leaf growth on the vines. Poor pollination also can cause pods to be misshapen. Irrigation at the time of bloom will help ensure good pod set if soils are dry.

Harvesting and Storage

For the best eating quality, harvest green snap beans and pole beans when the bean seed is about one-third developed. Many snap beans are mechanically harvested (once-over harvest). Varieties that produce a concentrated set of pods should be grown where mechanical harvesters are used. Green beans for the fresh wholesale market are packed in bushel baskets or cartons.

Vegetable soybeans (edamame) are picked when the pods are nearly fully grown but before they begin to turn yellow. Shelling is made easier by dropping the pods in a pot of boiling water for 15 to 20 minutes.

Navy and kidney beans should be harvested and handled at the 17 to 18 percent moisture level to prevent splitting and seed-coat damage. Pinto beans should be harvested at around 14 percent moisture.

Green beans are stored at 40° to 45°F and 90 to 95 percent relative humidity.

VARIETIES: Beans

Variety	Use			Seed Color[1]	DTM[2]	Comments
	Fresh Market	Canning	Shipping			
SNAP BEANS, BUSH PLANT TYPE						
Bronco	X	X	X	W	53	Round, 5.5 inches long, dark green pods, high yield potential, resistance to mosaic and seed transmission of bean common mosaic virus.
Tema	X	X		DBr	53	Round pods, resistance to mosaic and seed transmission of bean common mosaic virus.
Colter	X	X	X	W	53	Round pod, early maturing, medium-dark green, good heat set tolerance, high resistance to bean common mosaic virus, curly top virus and rust.
Lewis	X	X	X	W	53	Resistant to bean common mosaic and curly top viruses rust, halo blight, bacterial brown spot.
Hickok	X	X			54	Upright plant; high quality and straight pods; has grown well in both northern and southern U.S. Some resistance to bean common mosaic virus, rust, and bean curly top virus.
Bowie	X		X	W	54	Round pod, dark green, highly tolerant to common bean mosaic virus, beet curly top virus, halo blight; Intermediate resistance to bacterial brown spot.
Orient	X			W	55	Round 4 inch medium green slim pods, specialty bean, very good flavor, highly resistant to common bean mosaic virus, halo blight, intermediate resistance to bacterial brown spot.
Magnum	X		X	LBr	55	Flat, medium light green, 6.9 inches long pods, resistance to mosaic and seed transmission of bean common mosaic virus.
Caprice	X		X	W	56	Round pods, 6 inches, medium green, resistant to bean common mosaic virus, Anthracnose, halo blight, common blight, with some resistance to bacterial brown spot.
BA0958	X		X	W	57	Round pod, bean contains extra fiber to prevent breakage, improve appearance and shelf life, good for machine harvest, tolerant to common bean mosaic virus, intermediate tolerance to brown spot.
Roma II (snap bush Romano)	X			W	58	Resistant to common bean mosaic and NY15 mosaic. Flat pods.
Jade II	X	X	X	W	60	Round pods, high quality, dark green, high yielding, resistant to bean common mosaic virus, intermediate resistance common rust.
SNAP BEANS, POLE TYPE						
Kentucky Blue	X	X	X	W	58	Round, medium green pod, 7 to 10 inches long, excellent flavor; resistant to bean common mosaic virus, rust.
Kentucky Wonder 191	X	X	X	W	65	Round pod; rust resistant.
State Half Runner	X	X		W	60	Some tolerance to common bean mosaic; beans have strings, poor set in heat
Volunteer Half Runner	X	X		W	60	Resistant to common bean mosaic, intermediate resistance to rust, sets better than others in heat
OTHER						
Furano	X				54	Flat 5 ½ inch medium green attractive pods, low fiber, high yielding, highly resistant to common bean mosaic virus
Royal Burgundy	X			B	55	Deep purple snap beans on bush plants.
Maxibel	X			T/B	60	Long, thin, stringless 7 to 8 inches "French beans."
Carson (bush)	X			W	56	Round, yellow wax bean; resistant to bean common mosaic virus, NY15 mosaic, bacterial spot, 5 to 6 inches long.
Fordhook 242 (Lima, bush)		X	X	G	78	Large pod; sets blossom under adverse weather conditions.
VEGETABLE SOYBEANS						
Envy	X			Y/G	75	Earliest vegetable bean; 2 foot tall plant
BeSweet 292	X			Y/G	85	Top commercial variety; powdery mildew resistant.

1 W = white, DBr = dark brown, LBr = light brown, T/B = tan/brown, Y = yellow, G = greenish

2 Days to maturity

FERTILIZER: Beans

Soil Test Results (lb/A)		Fertilizer Needed (lb/A)
Phosphorus		**Phosphate (P_2O_5)**
Low	<31	51-95
Medium	31-60	1-50
High	>60	0
Potassium		**Potash (K_2O)**
Low	<201	51-150
Medium	201-300	1-50
High	>300	0
Nitrogen		**N**
Poor soils		50
Heavily fertilized soils		20-30

PESTICIDE SAFETY: Beans

	Signal[1]	Re-entry (hrs)	Harvest (days)
INSECTICIDES			
Acramite 4SC	C	12	3/7[3]
Admire Pro	C	12	7/21[3]
Assail 30 SG	C	12	7
Avaunt eVo 30 DG	C	12	3/7[3]
Beleaf 50 SG	C	12	7
Blackhawk 36 WG	C	4	3/28
Bt products	C	12	0
Coragen 1.67 SC	-	4	1
Courier 40 SC	W	12	14
Dibrom 8	D	24	1
Dimethoate 4 E	W	48	0
Exirel 0.83 SE	C	12	1/7[3]
Intrepid 2F	C	4	7
Kanemite 15 SC	C	12	7
Knack 0.83 EC	C	12	7
Magister SC	W	12	7
Malathion 8	C	12	1
Miteus 0.42 EC	W	21	1
Movento 2 SC	C	24	1
Orthene 97 S	C	24	1/14[3]
Portal 0.4 EC	W	12	1
Radiant SC	C	4	3/28[3]
Rimon 0.83 EC	W	12	1
Sevin XLR Plus	C	12	3
Sivanto Prime 1.67 SL	C	12	7/21[3]
Transform 50 WG	D	24	7
Trigard 75 WP	C	12	7
Vantacor 5 SC	-	4	1
Verimark 1.67 SC	-	4	AP
Restricted Use			
Agri-Mek 0.7 SC	W	12	7[3]
Asana XL	W	12	3/21[3]
Baythroid XL	W	12	3/7[3]
Brigade 2 EC	W	12	3
Diazinon 50 W	C	24	7
Fastac 0.83 EC	D	12	1/21[3]

(continued)

PESTICIDE SAFETY: Beans *(continued)*

	Signal[1]	Re-entry (hrs)	Harvest (days)
Lannate 90 SP	DP	48	1/14[3]
Mustang Maxx	W	12	1/21[3]
Proaxis 0.5 EC	C	24	7/21[3]
Thimet 20 G	DP	48	60
Warrior II	W	24	7/21[3]
FUNGICIDES[3]			
Aproach	C	12	14
Aprovia Top	C	12	14
Azoxystrobin[2]	C	4	0
Botran	C	12	2
Blocker 10G	C	12	45
Cannonball WP	C	12	7
Chlorothalonil[2]	W	12	7/14[3]
Endura	W	12	7/21[3]
Fixed coppers[2]	W	24/48	0
Fontelis	C	12	0
Headline	W	12	7/30[3]
Iprodione[2]	C	24	0
Kenja	C	12	7/30[3]
Luna Experience	C	12	14
Mefenoxam[2]	C	48	0
Metalaxyl[2]	W	48	0
Omega 500F	W	12	30
PCNB[2]	W	12	0
Priaxor	C	12	7/21[3]
Propiconazole[2]	C	12	3
Propiconazole + Azoxystrobin[2]	W	12	7/14[3]
Quadris Opti	W	12	14
Quadris Top	C	12	14
Quilt	W	12	7/14[3]
Quilt Xcel	W	12	7/14[3]
Ranman	C	12	0
Reason	C	12	3
Sulfur[2]	C	24	0
Switch	C	12	7
Tebuconazole[2]	C	12	7/14[3]
Thiophanate-methyl[2]	C	12	14/28[3]
Trevo Packed	C	24/72	14/28[3]
Vertisan	C	12	21
Snap beans only			
Botran 75 W	C	12	2
Botran 5F	C	12	2
Myclobutanil[3]	W	24	0
Dry beans only			
Muscle	C	12	14
Quadris Opti	W	12	14
Quash	C	12	21
Proline 480 SC	C	48	7

1 W: Warning, C: Caution, D: Danger; P: Poison
2 Several formulations are marketed. See the general introduction for more details on fungicides.
3 Dependent on formulation, type of bean, and application rate; there are specific restrictions on feeding and grazing, so see label.

INSECT CONTROL: Beans[1]

Insecticide	Product Amt/A	Seasonal Limit/A	Comments and Other Restrictions
PREPLANT INCORPORATED			
Cutworms: Eliminate weeds from field margins and plow fields at least 2 weeks before planting to destroy cutworm food sources and egg laying sites.			
Diazinon AG 500	2 to 4 qt	1 application	Incorporate immediately. Also for wireworms.
AT PLANTING			
Aphids, Leafhoppers, Seedcorn Maggots: Seedcorn maggots damage newly planted seeds by feeding on seed contents. Shallow planting in well-prepared seedbeds and adequate soil temperature to promote rapid germination will aid in reducing problems. Heavy cover crops or manure should be plowed early to render fields less attractive for egg laying.			
Admire Pro	7 to 10.5 fl oz	10.5 fl oz	See label for application methods.
Thimet 20 G	4.5 to 7 oz/ 1,000 row-feet	1 application	Place band on each side of furrow.
FOLIAR TREATMENTS			
Grasshoppers			
Asana XL	5.8 to 9.6 fl oz	38.4 fl oz	Do not feed to livestock.
Baythroid XL	2.4 to 3.2 fl oz	6.4 fl oz	Limit 3.2 fl oz per 14-day period. For shelled beans only.
Brigade 2 EC	2.1 to 6.4 fl oz	12.8 fl oz	Allow 3 days between applications. Dried beans only.
Coragen 1.67 SC	2 to 5 fl oz	15.4 fl oz	Allow 3 days between applications.
Dimethoate 4 E	8 to 16 fl oz	32 fl oz	Do not spray during bloom. Allow 14 days between applications.
Mustang Maxx	3.2 to 4 fl oz	24 fl oz	Allow 5 days between applications.
Aphids, Leafhoppers			
Admire Pro	1.2 fl oz	3.6 fl oz	Allow 7 days between applications.
Asana XL	2.9 to 9.6 fl oz	38.4 fl oz	Do not feed to livestock. For leafhoppers only.
Assail 30 SG	2.5 to 5.3 oz	16 oz	Limit 3 applications. Allow 7 days between applications. Not for dried beans.
Baythroid XL	0.8 to 1.6 fl oz	6.4 fl oz	Limit 3.2 fl oz per 14-day period. For shelled beans only.
Beleaf 50 SG	2.8 oz	8.4 oz	Limit 3 applications. Allow 7 days beteeen applications.
Brigade 2 EC	1.6 to 6.4 fl oz	12.8 fl oz	Allow 3 days between applications. Dried beans only.
Dimethoate 4 E	8 to 16 fl oz	32 fl oz	Do not spray during bloom. Allow 14 days between applications.
Lannate 90 SP	0.5 to 1 lb	5 lb	Limit 10 applications.
Movento 2 SC	4 to 5 fl oz	10 fl oz	Allow 7 days between applications. Requires surfactant. For aphids.
Mustang Maxx	2.72 to 4 fl oz	24 fl oz	Allow 5 days between applications.
Orthene 97 S	0.5 to 1 lb	2.12 lb	Allow 3 or 7 days between applications, rate dependent. Not for green beans.
Proaxis 0.5 EC	2.56 to 3.84 fl oz	15.36 fl oz	Allow 5 days between applications.
Sevin XLR Plus	1 qt	6 qt (4 app.)	Leafhoppers only. Not for shelled beans. Allow 7 days between sprays.
Sivanto Prime 1.67 SL	7 to 14 fl oz	28 fl oz	Allow 10 days between applications.
Transform 50 WG	0.75 to 1 oz	8.5 oz	Only apply after petal fall. Allow 14 days between applications. For aphids.
Warrior II	1.28 to 1.92 fl oz	7.68 fl oz	Allow 5 days between applications.
Corn Earworms			
Asana XL	5.8 to 9.6 fl oz	38.4 fl oz	Do not feed to livestock.
Avaunt eVo 30 DG	3.5 to 6 oz	24 oz	Allow 7 days between applications. Limit 4 applications.
Baythroid XL	2.4 to 3.2 fl oz	6.4 fl oz	Limit 3.2 fl oz per 14-day period. For shelled beans only.
Blackhawk 36 WG	2.2 to 3.3 oz	20 oz	Allow 5 days between applications.
Brigade 2 EC	2.1 to 6.4 fl oz	12.8 fl oz	Allow 3 days between applications. Dried beans only.
Coragen 1.67 SC	3.5 to 7.5 fl oz	15.4 fl oz	Allow 3 days between applications.
Exirel 0.83 SE	10 to 20.5 fl oz	61.5 fl oz	Allow 5 days between applications.
Fastac 0.83 EC	2.7 to 3.8 fl oz	11.4 fl oz	Allow 5 days between applications.
Intrepid 2 F	10 to 16 fl oz	64 fl oz	Allow 7 days between applications.
Mustang Maxx	2.72 to 4 fl oz	24 fl oz	Allow 5 days between applications.
Orthene 97 S	0.75 to 1 lb	2.12 lb	Allow 3 or 7 days between applications, rate dependent. Not for green beans.
Proaxis 0.5 EC	2.56 to 3.84 fl oz	15.36 fl oz	Allow 5 days between applications.
Radiant SC	4 to 8 fl oz	12/28 fl oz	Allow 4 days between applications. Seasonal limit based on bean type.
Warrior II	1.28 to 1.92 fl oz	7.68 fl oz	Allow 5 days between applications.

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INSECT CONTROL: Beans[1] *(continued)*

Insecticide	Product Amt/A	Seasonal Limit/A	Comments and Other Restrictions
Cutworms			
Baythroid XL	0.8 to 1.6 fl oz	6.4 fl oz	Limit 3.2 fl oz per 14-day period. For shelled beans only.
Fastac 0.83 EC	1.3 to 3.8 fl oz	11.4 fl oz	Allow 5 days between applications.
Mustang Maxx	1.28 to 4 fl oz	24 fl oz	Allow 5 days between applications.
Orthene 97 S	0.5 to 1 lb	2.12 lb	Allow 3 or 7 days between applications, rate dependent. Not for green beans.
Proaxis 0.5 EC	1.92 to 3.2 fl oz	15.36 fl oz	Allow 5 days between applications.
Warrior II	0.96 to 1.6 fl oz	7.68 fl oz	Allow 5 days between applications.
Japanese Beetles			
Baythroid XL	2.4 to 3.2 fl oz	6.4 fl oz	Limit 3.2 fl oz per 14-day period. For shelled beans only.
Brigade 2 EC	2.1 to 6.4 fl oz	12.8 fl oz	Allow 3 days between applications. Dried beans only.
Fastac 0.83 EC	2.7 to 3.8 fl oz	11.4 fl oz	Allow 5 days between applications.
Mustang Maxx	2.72 to 4 fl oz	24 fl oz	Allow 5 days between applications.
Proaxis 0.5 EC	2.56 to 3.84 fl oz	15.36 fl oz	Allow 5 days between applications.
Sevin XLR Plus	0.5 to 1 qt	6 qt	Not for shelled beans. Limit 4 applications. Allow 7 days between applications.
Warrior II	1.28 to 1.92 fl oz	7.68 fl oz	Allow 5 days between applications.
Mexican Bean Beetles, Bean Leaf Beetles: Treat for Mexican bean beetle if populations exceed 0.5 adults per plant or if egg mass number is greater than 1 per foot of row.			
Asana XL	2.9 to 5.8 fl oz	38.4 fl oz	Do not feed to livestock. Bean leaf beetle only.
Assail 30 SG	2.5 to 5.3 oz	16 fl oz	Limit 3 applications. Allow 7 days between applications. Not for dried beans.
Baythroid XL	2.4 to 3.2 fl oz	6.4 fl oz	Limit 3.2 fl oz per 14-day period. For shelled beans only.
Brigade 2 EC	2.1 to 6.4 fl oz	12.8 fl oz	Bean leaf beetle only. Allow 3 days between applications. Dried beans only.
Dimethoate 4 E	8 to 16 fl oz	2 pt	Do not spray during bloom. Allow 14 days between applications.
Fastac 0.83 EC	2.7 to 3.8 fl oz	11.4 fl oz	Allow 5 days between applications.
Mustang Maxx	2.72 to 4 fl oz	24 fl oz	Allow 5 days between applications.
Orthene 97 S	0.5 to 1 lb	2.12 lb	Allow 3 or 7 days between applications, rate dependent. Not for green beans.
Proaxis 0.5 EC	1.92 to 3.2 fl oz	15.36 fl oz	Allow 5 days between applications.
Rimon 0.83 EC	9 to 12 fl oz	36 fl oz	Allow 7 days between applications.
Sevin XLR Plus	0.5 to 1 qt	6 qt	Not for shelled beans. Limit 4 applications. Allow 7 days between applications.
Warrior II	0.96 to 1.92 fl oz	7.68 fl oz	Allow 5 days between applications.
Spider Mites			
Acramite 4 SC	16 t0 24 fl oz	2 applications	Allow 14 days between applications.
Agri-Mek 0.7 SC	1.75 to 3.5 fl oz	10.5 fl oz	Allow 6 days between applications. Must use non-ionic surfactant.
Brigade 2 EC	5.12 to 6.4 fl oz	12.8 fl oz	Allow 3 days between applications. Dried beans only.
Kanemite 15 SC	31 fl oz	62 fl oz	Allow 14 or 21 days between applications, depending on bean type.
Magister SC	32 to 36 fl oz	36 fl oz	Limit 1 application.
Miteus 0.42 EC	2 pt	4 pt	Allow 14 days between applications. For snap beans only. Two applications only.
Portal 0.4 EC	2 pt	4 pt	Allow 14 days between applications. For snap beans only. Two applications only.
Stink Bugs			
Baythroid XL	1.6 to 2.4 fl oz	6.4 fl oz	Limit 3.2 fl oz per 14-day period. For shelled beans only.
Brigade 2 EC	2.1 to 6.4 fl oz	12.8 fl oz	Allow 3 days between applications. Dried beans only.
Fastac 0.83 EC	3.2 to 3.8 fl oz	11.4 fl oz	Allow 5 days between applications.
Mustang Maxx	3.2 to 4 fl oz	24 fl oz	Allow 5 days between applications.
Proaxis 0.5 EC	2.56 to 3.84 fl oz	15.36 fl oz	Allow 5 days between applications.
Warrior II	1.28 to 1.92 fl oz	7.68 fl oz	Allow 5 days between applications.
Thrips, Whiteflies: Thrips damage to small seedlings is uncommon and plants usually recover without treatment. Although whiteflies are common in beans, they are not usually a serious problem.			
Assail 30 SG	4.5 to 5.3 oz	16 oz	Limit 3 applications. Allow 7 days between applications. Not for dried beans.
Blackhawk 36 WG	2.5 to 3.3 oz	20 oz	Allow 5 days between applications. Use an adjuvant. For thrips.

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INSECT CONTROL: Beans[1] *(continued)*

Insecticide	Product Amt/A	Seasonal Limit/A	Comments and Other Restrictions
Brigade 2 EC	2.1 to 6.4 fl oz	12.8 fl oz	Allow 3 days between applications. Dried beans only.
Courier 3.6 SC	9 to 13.6 fl oz	27.2 fl oz	Allow 14 days between applications. For whiteflies on succulent beans only.
Exirel 0.83 SE	13.5 to 20.5 fl oz	61.5 fl oz	Allow 5 days between applications. Use an adjuvant.
Knack 0.83 EC	8 to 10 fl oz	20 fl oz	Allow 14 days between applications. For eggs and immature stages of whiteflies only.
Miteus 0.42 EC	2 pt	4 pt	Allow 14 days between applications. For whiteflies. For snap beans only. 2 applications only.
Movento 2 SC	4 to 5 fl oz	10 fl oz	Allow 7 days between applications. For whiteflies. Requires surfactant.
Orthene 97 S	0.5 to 1 lb	2.12 lb	Allow 3 or 7 days between applications, rate dependent. Not for green beans. For thrips.
Portal 0.4 EC	2 pt	4 pt	Allow 14 days between applications. For whiteflies. For snap beans only. 2 applications only.
Sivanto Prime 1.67 SL	10.5 to 14 fl oz	28 fl oz	Allow 10 days between applications. For whiteflies.

1 Generic products available (Appendix G).

WEED CONTROL: Beans

Product Amt/A	lb A.I./A	Comments
Lima, Snap Beans		
0.5 to 1.6 fl oz Aim 1.9 EW	0.008 to 0.025 carfentrazone	For contact post-emergence control of annual broadleaf weeds and suppression of annual grasses. Can be applied as a preplant, pre-transplant burndown, or before crop emerges to actively growing weeds up to 4 inches tall. Can also be applied post-emergence as a directed hooded application between crop rows. Use min. 10 gal water/A and crop oil 1% v/v. Max. rate 6.1 fl oz/A. PHI = 0 days.
1 to 2 pt Basagran 4S	0.5 to 1 bentazon	Use post-emergence for control of annual broadleaves and suppression of yellow nutsedge. Do not apply until the first trifoliate bean leaf is fully expanded. Some injury may occur but plants will grow out of it. Do not apply more than 4 pt/A per year. PHI = 30 days.
0.4 to 0.67 pt Command 3ME	0.15 to 0.25 clomazone	Use pre-emergence for suppression of annual grasses and broadleaf weeds. Apply once in min. 10 gal water/A. PHI = 45 days.
1.3 to 1.7 pt Dual II Magnum	1.3 to 1.6 s-metolachlor	For control of most annual grasses and certain broadleaves. Apply preplant surface or incorporated or pre-emergence. Small grains may be planted 4½ months following this treatment. See label for other rotational crops.
2 to 4 pt Gramoxone Inteon	0.69 to 1.38 paraquat salt	For non-selective contact kill of annual grasses and broadleaf weeds and top-kill of perennial weeds. **Paraquat product labels require applicators to take an EPA-approved training every 3 years to mix, load, and apply paraquat.**
2.5 to 3 qt Micro-Tech 4 E	2.5 to 3 alachlor	Lima (green) beans only. For control of annual grasses and broadleaf weeds and yellow nutsedge. Max. 1 application/year or 3 qt/A. Apply preplant incorporated within 7 days before planting or surface application before or after planting.
0.5 to 2.5 pt Poast	0.09 to 0.49 sethoxydim	For control of actively growing grasses only. Use high rate on Johnson grass. PHI = 15 days. Max. rate of 2.5 pt/application and 4 pt/season.
1.5 to 3.0 pt Prowl H2O	0.75 to 1.5	Broadcast and incorporate. Not effective on soils with high organic matter
1.5 to 3.0 oz Pursuit	0.023 to 0.047 imazethapyr	See label for specific bean type. Reduced crop growth, quality, and yield, and/or delayed maturity may result from application to edible legume vegetables
0.75 to 1.5 pt Reflex 2 EC	0.18 to 0.36 fomesafen	For post-emergence control of broadleaves and suppression of grasses, apply broadcast to actively growing weeds. Use COC as adjuvant 0.5 to 1% v/v. Max rate is 1.5 pt/A per season. Do not use hay or straw for animal feed or bedding. Check label for plantback restrictions. Timely cultivation 1 to 3 weeks after applying Reflex may assist weed control. PHI = 45 days.
16 to 22 fl oz Roundup WeatherMax	0.69 to 0.94 glyphosate-salt	For non-selective post-emergence control of annual and perennial grasses and broadleaf weeds. Use only AMS 1 to 2% v/v. Adding a non-ionic surfactant can reduce weed control effectiveness. Min. 30 days before planting any non-labeled crop.
0.5 to 1 oz Sandea 75 DF	0.023 to 0.047 halosulfuron	For control of broadleaf weeds and yellow nutsedge. Apply after planting but before cracking in min. 15 gal water/A. PHI = 30 days. Max. 1 oz/A/crop and 2 oz/A per season.
0.5 to 1 oz Sandea DF + 3.5 to 4.5 pt Eptam 7 E	0.023 to 0.047 halosulfuron + 3 to 4 EPTC	For control of broadleaf weeds, grasses, and yellow nutsedge. Apply and incorporate to a depth of ½ to 2 inches just before planting. Max. rate 1 oz Sandea/season and 7 pt Eptam/season. Do not use Eptam on flat-podded beans except Romano.

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WEED CONTROL: Beans *(continued)*

Product Amt/A	lb A.I./A	Comments
9 to 16 fl oz Select Max	0.07 to 0.13 clethodim	For selected post-emergent control of some grasses. For use on succulent shelled beans only. PHI = 21 days. Use a NIS 0.25% v/v for added control. Limit one application per season.
4.0 to 12.0 fl oz Targa	0.026 to 0.0825 quizalofop	Maximum rate 14 oz per season. 7 day interval minimum. PHI = 15 days.
1 to 1.5 pt Treflan HFP 4 E	0.5 to 0.75 trifluralin	For control of annual grasses and broadleaf weeds. Apply and incorporate in spring before planting or in fall in advance of spring planting.
Dry Beans		
5 to 12 fl oz Assure II 0.88L	0.033 to 0.08 quizalofop	For selective post-emergence control of annual grasses and suppression of perennial grasses. Apply to actively growing grasses in 10 to 15 gal water/A. Include 1% v/v crop oil concentrate or 0.25% v/v non-ionic surfactant. Snap beans: 15-day pre-harvest interval and maximum of 14 oz/A per season. Dry beans: 30-day pre-harvest interval and maximum of 28 oz/A per season.
1 to 2 pt Basagran	0.5 to 1 bentazon	Use post-emergence for control of annual broadleaves and suppression of yellow nutsedge. Do not apply until the first trifoliate bean leaf is fully expanded. Some injury may occur but plants will grow out of it. Do not apply more than 4 pt/A per year.
3.5 pt Eptam 7 E	3 EPTC	For control of annual grasses and broadleaf weeds and suppression of yellow nutsedge. Apply before planting and incorporate into soil 2 to 4 inches immediately. Can be applied as a directed lay-by application to soil at the base of the plants before pods start to form. Gives good nutsedge suppression. Do not use on flat podded beans except for Romano beans.
1.2 to 2.0 pt Gramoxone Inteon	0.4 to 0.67 paraquat salt	For non-selective contact kill of annual grasses and broadleaf weeds and top-kill of perennial weeds. Apply as a leaf desiccant in min. 20 gal water/A. Apply when crop is mature or at least 80% pods are yellowing and mostly ripe. Use with non-ionic surfactant 0.25% v/v. Max. 2 applications/season. PHI = 7 days.
14 to 18 fl oz Outlook 6 EC	0.65 to 0.84 dimethenamid-P	For control of annual grasses and broadleaf weeds and suppression of seedling Johnson grass. Can be applied preplant surface or incorporated, pre-emergence or post-emergence to dry beans at 1-3 trifoliate stage. PHI = 70 days.
0.5 to 2.5 pt Poast	0.09 to 0.49 sethoxydim	For control of actively growing grasses only. Use high rate on Johnson grass. PHI = 30 days. Max. rate of 2.5 pt/application and 4 pt/season.
1.5 to 3.0 pt Prowl H2O	0.75 to 1.5 pendimethalin	Broadcast and incorporate. Not effective on soils with high organic matter.
4 fl oz Raptor 1EC	0.031 imazamox	For control of annual grasses and broadleaf weeds. Some varieties are sensitive and injury can occur. Apply post-emergence to actively growing dry beans with at least 1 fully expanded trifoliate leaf. Max. 1 application/season.
0.75 to 1.5 pt Reflex 2 EC	0.18 to 0.36 fomesafen	For post-emergence control of broadleaves and suppression of grasses, apply broadcast to actively growing weeds. Use COC as adjuvant 0.5 to 1% v/v. Max rate is 1.5 pt/A per season. Do not use hay or straw for animal feed or bedding. Check label for plantback restrictions. Timely cultivation 1 to 3 weeks after applying Reflex may assist weed control. PHI = 45 days.
16 to 22 fl oz Roundup WeatherMax 5.5L	0.69 to 0.94 glyphosate-salt	For non-selective post-emergence control of annual and perennial grasses and broadleaf weeds. Use only AMS 1 to 2% v/v. Adding a non-ionic surfactant can reduce weed control effectiveness. Min. 30 days before planting any non-labeled crop.
0.5 to 0.66 oz Permit 75 DF	0.023 to 0.031 halosulfuron	For control of broadleaf weeds and yellow nutsedge. Apply broadcast after planting but before cracking in min. 15 gal water/A. PHI = 30 days. Max. of 0.66 oz/A per crop and 2 oz/A per season.
0.5 to 0.66 oz Permit DF + 3.5 to 4.5 pt Eptam 7 E	0.023 to 0.03 halosulfuron + 3 to 4 EPTC	For control of broadleaf weeds, grasses, and yellow nutsedge. Apply and incorporate to a depth of ½ to 2 inches just before planting. Max. rate 2⁄3 oz Permit/season and 7 pt Eptam/season. Do not use Eptam on flat-podded beans except Romano.
9 to 32 fl oz Select Max	0.07 to 0.24 clethodim	For selected post-emergent control of some grasses. For use on succulent shelled beans only. PHI = 30 days. Use a NIS 0.25% v/v for added control. Limit 64 fl oz per season.
7.5 to 11.5 lb Sonalan 10G	0.75 to 1.15 ethalfluralin	For pre-emergence control of annual grasses and broadleaves. Apply and incorporate before planting.
4.0 to 12.0 fl oz Targa	0.026 to 0.08 quizalofop p-ethyl	For selective control of annual grasses and suppression of perennial grasses. Maximum rate 28 oz per season. 7 day interval minimum. PHI = 30 days.
1 to 2 pt Treflan HFP 4 E	0.5 to 1 trifluralin	For control of annual grasses and broadleaf weeds. Apply and incorporate in spring before planting or in fall in advance of spring planting.

DISEASE CONTROL: Beans

Product	FRAC Code[1]	PHI[2] (days)	Amt/A	Seasonal Limits/A	Comments
Anthracnose					
Aproach	11	14	6 to 12 fl oz[5]	24 fl oz	Dry beans only.
Chlorothalonil[4]					There are multiple Bravo formulations and chlorothalonil generics on the market. See label for rates.
Bravo Ultrex	M	7	1.25 to 1.8 lb	7.3 lb	
Bravo Weather Stik	M	7	1.375 to 2 pt	8 pt	
Copper, fixed coppers[6]	M				See label for rates, mixing instructions, and tank-mix precautions. Some products are approved for greenhouse use.
Fontelis	7	0	14 to 30 fl oz[5]	72 fl oz	
Headline and pyraclostrobin[4] generics	11	7/30	6 to 9 fl oz[5]	2 apps	See label for PHI. Observe extended PHI.
Priaxor	7/11	7/21	4 to 8 fl oz[5]	2 apps	See label for PHI. Observe extended PHI.
Quilt Xcel and propiconazole + azoxystrobin[4] generics	3/11	7/14	10.5 to 14 fl oz	42 fl oz	See label for PHI.
Quadris and azoxystrobin[4] generics	11	0/14	6 to 15.5 lb	90 fl oz	See label for PHI.
Quadris Opti	11/M	14	1.6 to 2.4 pt		Dry beans only.
Quilt Xcel and propiconazole + azoxystrobin[4] generics	11/3	7/14	10.5 to 14 fl oz	42 fl oz	See label for PHI.
Topsin M and thiophanate-methyl[4] generics	1	14/28	1 to 2 lb	5 app	See label for PHI. May cause leaf crinkling or increased greening of leaves. There are multiple Topsin formulations and thiophanate methyl generics. See label for rates.
Bacterial Blights (i.e. Halo Blight, Common Blight, Brown Spot)					
Copper, fixed coppers[6]	M				See label for rates, mixing instructions, and tank-mix precautions. Some products are approved for greenhouse use.
Gray Mold, White Mold					
Botran 75 W	14	2	2.25 to 4 lb	n/a	Snap beans only for control of white mold. Use low rate for bush varieties, high rate for pole varieties.
Botran 5F	14	2	1.3 to 1.6 qt	5.2 qt	
Cannonball WP and fludioxonil[4] generics	12	7	7 oz	28 oz	For white mold, make first application at 10-20% bloom.
Chlorothalonil[4]					Snap beans only. PHI is 7 days.
Bravo Ultrex	M	7	2.7 lb	10.9 lb	
Bravo WeatherStik	M	7	3 pt	12 pt	There are multiple Bravo formulations and chlorothalonil generics on the market. See label for rates.
Cueva	M	0	0.5 to 2 gal	n/a	OMRI-listed. Mix in 100 gallons of water, use 50 to 100 gal/A of solution. Apply before 25% bloom for white mold.
Endura and boscalid[4] generics	7	7/21	8 to 11 oz	2 apps	PHI is 7 days for snap (succulent) beans, 21 days for dry beans.
Fontelis	7	0	14 to 30 fl oz[5]	72 fl oz	
Rovral and iprodione[4] generics	2	0	1.5 to 2 pt	2 apps	Apply no later than full bloom.
Kenja 400SC	7	7/30	17 oz	2 apps	
Omega 500F	29	30	0.5 to 0.85 pt	1.75 pt	
Priaxor	7/11	7/21	6 to 8 fl oz[5]	2 apps	
Proline 480 SC	3	7	4.3 to 5.7 fl oz	3 apps	Dry beans only for control of white mold.

(continued on next page)

DISEASE CONTROL: Beans *(continued)*

Product	FRAC Code[1]	PHI[2] (days)	Amt/A	Seasonal Limits/A	Comments
Quadris and azoxystrobin[4] generics	11	0/14	6 to 15.5 lb	90 fl oz	See label for PHI.
Quash	3	21	4 fl oz	8 fl oz	Dry beans only, for white mold management.
Switch 62.5WG	9/12	7	11 to 14 oz	56 oz	
Topsin M and thiophanate-methyl[4] generics	1	14/28	1 to 2 lb	5 app	See label for PHI. May cause leaf crinkling or increased greening of leaves. There are multiple Topsin formulations and thiophanate methyl generics. See label for rates.
Vertisan	7	21	14 to 20 fl oz[5]	41 fl oz	Observe pre harvest interval.
Rhizoctonia Web Blight, Pod Rot					
Quadris and azoxystrobin[4] generics	11	0/14	0.4 to 0.8 fl oz/ 1000 row ft	90 fl oz	Pre- and post-harvest planting in furrow or as banded application.
Quadris Opti	11/M	14	1.6 to 2.4 pt		Dry beans.
Quilt Xcel and propiconazole + azoxystrobin[4] generics	3/11	7/14	10.5 to 14 fl oz	42 fl oz	See label for PHI.
Rally and myclobutanil[4] generics	3	0	4 to 5 oz	1.25 lb	Snap beans only, Rhizoctonia pod rot. Apply as pods begin to develop; continue every 7 to 10 days.
Tilt, and propiconazole[4] generics	3	7	4 fl oz	12 fl oz	May cause leaf crinkling or increased greening of leaves.
Vertisan	7	21	14 to 20 fl oz[5]	41 fl oz	Observe pre harvest interval.
Rust					
Aproach	11	14	6 to 12 fl oz[5]	24 fl oz	Dry beans only.
Chlorothalonil[4]					May be used on snap or dry beans for rust. There are multiple Bravo formulations and chlorothalonil generics on the market. See label for rates.
Bravo Ultrex	M	7	1.25 to 1.8 lb	4 apps	
Bravo WeatherStik	M	7	1.375 to 2 pt	8 pt	
Fontelis	7	0	14 to 30 fl oz[5]	72 fl oz	
Headline and pyraclostrobin[4] generics	11	7/30	6 to 9 fl oz[5]	2 apps	See label for PHI. Observe extended PHI.
Toledo, and tebuconazole[4] generics	3	7/14	4 to 6 fl oz	12 to 24 fl oz	See label for rates for fresh and dry beans.
Luna Experience	7/3	14	8 to 12.8 fl oz	25.6 fl oz	
Priaxor	7/11	7/21	4 to 8 fl oz[5]	2 apps	
Proline 480 SC	3	7	5.7 fl oz	3 apps	Dry beans only.
Quadris and azoxystrobin[4] generics	11	0/14	6 to 15.5 lb	90 fl oz	See label for PHI.
Quadris Opti	11/M	14	1.6 to 2.4 pt		Dry beans.
Quadris Top	11/3	14	12 to 14 fl oz		
Quilt Xcel and propiconazole + azoxystrobin[4] generics	3/11	7/14	10.5 to 14 fl oz	42 fl oz	14 day PHI for dry beans.
Rally and myclobutanil[4] generics	3	0	4 to 5 oz	1.25 lb	Snap beans only.
Sulfur[4]	M	0			Rust. Phytotoxicity may occur if applications are made when temperatures exceed 90°F.
Vertisan	7	21	14 to 20 fl oz[5]	41 fl oz	Apply before disease onset. Observe pre harvest interval.

(continued on next page)

DISEASE CONTROL: Beans *(continued)*

Product	FRAC Code[1]	PHI[2] (days)	Amt/A	Seasonal Limits/A	Comments
Pythium Damping-off, Seedling Diseases, Root Rot, Cottony Leak					
MetaStar and metalaxyl[4] generics	4	0	2 to 4 pt	1 app	Apply pre- or post-planting. See label for application detail. Metastar can be tank-mixed with Terraclor to provide additional protection against *Rhizoctonia*.
Ranman	21	0	2.75 fl oz	16.5 fl oz	Cottony leak. Also Phytophthora blight, downy mildew.
Reason	11	3	5.5 to 8.2 fl oz	24.6 fl oz	Cottony leak only.
Ridomil Gold and mefenoxam[4] generics	4	0	0.5 to 1 pt	1 pt	Apply pre- or post-planting. See label for application detail.
Ridomil Gold PC GR	4/M	0	12 oz[3]	1 app	For preplant application only. Adjust equipment so that granules are mixed with soil before covering seed. Also provides control of *Rhizoctonia*.
Rhizoctonia Damping-off, Seedling Diseases, Stem/Root Rot					
Blocker 4F/10G	14	45	2.2 to 3.3 fl oz[3]	1 app	Use as an In-furrow spray at planting. Actual rate is dependent on row spacing; see label for directions.
Headline, and pyraclostrobin[4] generics	11	7/30	0.1 to 0.8 fl oz[3]	1 app	Use as an In-furrow spray at planting; see label for directions.
Quadris and azoxystrobin[4] generics	11	0/14	0.4 to 0.8 fl oz/ 1000 row ft	90 fl oz	Pre- and post-harvest planting in furrow or as banded application.
Quilt Xcel and propiconazole + azoxystrobin[4] generics	3/11	7/14	10.5 to 14 fl oz	42 fl oz	See label for PHI.

1 Products with numerical FRAC codes must be alternated or tank-mixed with products that have a different FRAC code to discourage resistance development. See product label for maximum number of consecutive applications allowed. Refer to the table on pages 22-24 for more information on FRAC codes.
2 Pre-harvest interval.
3 Per 1,000 row-feet.
4 Generic products available (Appendix F). Amounts and seasonal limits per acre are product dependent.
5 Use higher rate when pressure is severe.
6 Fixed coppers labeled in KY include: Badge SC, Badge X2, Basic Copper 53, Champ, Champ WG, ChampION++, C-O-C-S WDG, Cueva, Cuprofix, Cuproxat, Kentan, Kocide 2000, Kocide 3000, Kocide DF, KOP-5, MasterCop, Nordox 75 WG, Nu-Cop 30 HB, Nu-Cop 50DF, Phyton 27, Phyton 35, and Previsto. Rates may vary by product and by crop. Refer to specific product label for this information.

Cole Crops

Mustard family (Brassicaceae): *Brassica* (broccoli, Brussels sprouts, cabbage, cauliflower, Chinese cabbage, kohlrabi)

Planting and Culture

The ground for spring cole crops should be plowed in the fall in order to have crops ready for the early market. Cabbage should be transplanted to the field by mid-March in most parts of Kentucky; broccoli and Brussels sprouts should be in the field by the middle of April for the spring crop (see Appendix K). Avoid poorly drained fields. A good firm seedbed should be prepared by disking. Cole crops do well on ground that has been in tobacco. Fescue sod ground is also good if plowed early in the fall and allowed to decompose.

Cauliflower does not do well as a spring crop in Kentucky. Cabbage, broccoli, and cauliflower all do well as fall crops. Cabbage and cauliflower should be transplanted by early August at the latest, whereas broccoli can be transplanted as late as mid-August. Growers may want to select shorter maturing varieties for late summer plantings. Be aware that days-to-maturity for most cole crops is based on days from transplant. Cauliflower does well when transplanted around July 15 to 20 for a fall crop. Irrigation is often critical for establishing the fall crop.

Use transplants for early market. Sort plants by size to have uniformity in the field. This is helpful at harvest time. A tobacco setter can be used to transplant. Space cabbage plants 12 to 14 inches in the row with rows spaced 36 inches apart. A plant population of 14,000 plants per acre is desirable. Brussels sprouts and cauliflower should be spaced 18 to 20 inches apart in the row with rows 36 inches apart. Broccoli should be spaced 12 to 14 inches apart to keep heads from becoming too large. A 10-inch spacing and double rows 20 inches apart are used for smaller, bunching-size broccoli heads.

A starter fertilizer dissolved in water and applied around the root system during transplanting is recommended. Use 3 pounds of starter in 50 gallons of water, and apply half a pint per plant. Some insecticides can be added to starter solution to control soil insects (see "Insect Control" table).

Fertilizing

Get a soil test and follow the recommendations. Lime should be applied if needed to bring the pH to around 6.5. Cole crops are heavy users of sulfur; soils prone to deficiencies can be amended by using one of the many sulfur-containing fertilizers to supply 10 to 20 pounds actual sulfur per acre. Boron deficiencies have appeared in cabbage in several Kentucky counties. The addition of 2 pounds per acre of actual boron is recommended where cabbage is to be planted (see Appendix B).

Cold Tolerance, Harvesting, and Storage

The cold tolerance of cole crops varies somewhat with the weather conditions preceding the cold period. These minimum temperatures are usually tolerated by cole crops in the fall:

Broccoli*	22-23°F
Brussels Sprouts	20°F
Cabbage	17-18°F
Cauliflower	22-24°F

**Certain varieties may be damaged at 25°F.*

Broccoli heads should be cut before any yellow petals show. Cut the heads with 6 to 8 inches of the stem attached. Later maturing lateral stalks should be cut in a similar manner. Broccoli is sold to the wholesale fresh market in cartons holding 14 bunches with two to three heads to the bunch.

Brussels sprouts should be harvested when they are 1 to 1 ¼ inches in diameter. The lower leaves of the plant should first be broken away and the sprouts cut off close to the stem with a sharp knife.

Fresh market cabbage should be cut when heads are firm. Cut 2 ½- to 3 ½-pound heads low enough to leave two to three loose wrapper leaves. Cabbage is usually marketed in 50-pound boxes or bags with 16 to 18 heads per bag. Allow 3 to 4 extra pounds for shrinkage. For the slaw market cabbage, cut 4- to 8-pound heads, remove wrapper leaves, and put in 20-bushel bins.

Cauliflower should have the leaves pulled around the developing curd when the curd is about the size of a quarter. The head will then be ready to harvest in about a week to 10 days. When tying the curds, use rubber bands of different colors to represent different tying dates. Tie high enough so there is adequate air circulation around the heads, which will help reduce "riciness" and molding of the head. Tying the leaves up around the developing curd results in a white head. Heads should be cut before they become "ricy" in appearance. High temperatures may cause riciness to the head, with very poor quality.

Cauliflower is packed in cartons containing nine to 12 firmly wrapped heads. Store cole crops at 32°F and 90 to 95 percent relative humidity.

VARIETIES: Pak Choi, Chinese Cabbage, Kohlrabi

	DTM[4]	Comments
Pak Choi[1]		
Joi Choi (hybrid)	47	Slow bolting, very uniform.
Chinese Cabbage[2]		
Blues	57	Excellent for spring or fall, tolerant to virus, downy mildew, white spot, Alternaria leaf spot and bacterial soft rot—Napa type.
Yuki	62	Early slow bolting similar to China Express—Napa type.
Jade Pagoda (hybrid)	65	Excellent for spring crop—Michili type. Slow bolting.
Kohlrabi[3]		
Winner (hybrid)	45	Early maturing; slow to lose fine texture.
Kossak	80	Large, excellent taste, no fiber development, stores well.
Kolibri	45	Excellent purple color and taste

1 B. rapa, Chinensis group
2 B. rapa, Pekinensis group
3 B. oleracea, Gongylodes group
4 Days to maturity from seeding.

VARIETIES: Cabbage[1]

	DTM[2]	Head Size (lb)	Yellows Resistant	Black Rot Tolerant	Tipburn Tolerant
Green					
Artost	68	4	X		
Blue Vantage	72	4	X	X	X
Atlantis	72	4	X	X	
Blue Dynasty	75	4	X	X	X
Bronco	78	4	X	x	X
Cecile	80	3.5	X	X	X
Ramada	83	4	X	X	X
Cheers	85	5	X	X	
Storage No. 4	95	4-8	X		
Red					
Red Globe (Scarlet King)	70	4			
Red Dynasty	72	3.5-5		x	
Rio Grande Red	73	4.5			
Rondale	75	4	X		X
Super Red 80	83	3.5			X
Savoy					
Savoy Ace Improved	73	3.5	X		
Savoy King	80	4.5			X

1 Capitata group (all are hybrids)
2 Days to maturity when transplanted

VARIETIES: Broccoli, Brussels Sprouts, Cauliflower

Note: see "Greens" chapter for broccoli raab varieties.

Variety *(all are hybrids)*	DTM[4]	Comments
BROCCOLI[1]		
Packman	48	Early, production, good for spring and early fall.
Eastern Crown	55-81	Compact heads, small bead size
Emerald Crown	55-81	Uniformly green heads, small bead size
Green Magic	60	Large, blue-green heads; downy mildew tolerant.
Millennium	60-85	Compact uniformly green heads, small bead size, high yielding
Emerald Star	63-85	Compact heads, high yielding
Premium Crop	65	Medium head, tight bead, for farmers market sales.
Arcadia	70	Spring or fall crop; large, blue-green tight-beaded heads; downy mildew tolerant.
Marathon	75	Large blue-green heads; excellent for bunching or crown cuts; downy mildew tolerant; very cold tolerant, good for early spring production.
BRUSSELS SPROUTS[2]		
Jade Cross, E Strain	85	Top recommendation for KY; plants grow to about 2 feet tall; medium-sized closely-spaced sprouts, low bacterial leaf spot incidence.
Dimitri	105	Plant topping not needed, 1-1.5 inch round sprouts, long stems with widely-spaced sprouts, low bacterial leaf spot incidence; harvest when leaves begin to break off.
CAULIFLOWER[3]		
Snow Crown	55	Early maturing; very uniform head development; Up to 8 inch diameter heads.
Steady	67	Early maturing, domed heads, self-wrapping tendencies.
Freedom	67	Heat tolerant, wrapper leaves, self-blanching
Aquarius	70	Fall crop, heat tolerant, dense smooth firm round heads, good curd cover.
Argos	70	Round very white heads, good curd quality, concentrated harvest, medium heat tolerance, good leaf cover for self-blanching, but still requires tying.
Flamenco	71	Fancy dense heads, widely adapted, for fall production, good wrapper leaves.
White Sails	75	Excellent fall crop, attractive.
Synergy	75	Fall crop, globe shaped heads, dense firm white curds, good leaf cover.
Casper	76	Self-blanching, nice white curd color, very low level of head riciness or fuzziness
Graffiti	74	Purple heads, used fresh, will turn a deep green when cooked.

1 Italica group
2 Gemmifera group
3 Botrytis group
4 Days to maturity when transplanted.

FERTILIZER: Cole Crops

Soil Test Results (lb/A)		Fertilizer Needed (lb/A)
Phosphorus		**Phosphate (P_2O_5)**
Low	<31	121-180
Medium	31-60	61-120
High	61-80	31-60
Very High	>80	0-30
Potassium		**Potash (K_2O)**
Low	<201	101-150
Medium	201-300	51-100
High	301-450	1-50
Very High	>450	0
Nitrogen		**N**

Broadcast and plow under 50 lb N/A. Sidedress with 50 lb N/A when heads begin forming. A second sidedressing of 50 lb of N/A two weeks later should also be applied. Alternatively begin fertigating when heads begin forming with 10 to 15 lb of nitrogen per acre weekly using a total of 100 lb of nitrogen per acre. Delaying N application may cause cabbage heads to burst. Too high levels of N may result in greater internal tipburn of cabbage. Calcium nitrate should be used where tipburn has been a problem. High nitrogen levels cause hollow stem in broccoli. Usually 100 lb total nitrogen is sufficient for broccoli.

PESTICIDE SAFETY: Cole Crops

	Signal[1]	Re-entry (hrs)	Harvest (days)
INSECTICIDES			
Actara 25 WP	C	12	0
Admire Pro	C	12	7/21[5]
Assail 30 SG	C	12	7
Avaunt eVo 30 DG	C	12	3
Belay 2.13 SC	C	12	7/21[5]
Beleaf 50 SG	C	12	0
Bt products	C	12	0
Coragen 1.67 SC	-	4	3
Courier 40 SC	W	12	1
Dimethoate 4 E	W	48	7
Exirel 0.83 SE	C	4	1
Fulfill 50 WDG	C	12	7
Harvanta 50 SL	C	4	1
Intrepid 2 F	C	4	1
Malathion 8	C	12	3/7[5]
Movento 2 SC	C	24	1
Oberon 2 SC	C	12	7
Platinum 2 SC	C	12	30
PQZ 1.87 SC	C	12	1
Radiant SC	C	4	1
Requiem 25 EC	C	4	0
Rimon 0.83 EC	W	12	7
Scorpion 3.5 SL	C	12	1/21[5]
Sevin XLR Plus	W	12	3/14[5]
Sivanto Prime 1.67 SC	C	4	1/21[5]
Torac 1.29 EC	W	12	1
Venom 70 SG	C	12	1/21[5]
Verimark 1.67 SC	-	4	AP[2]
Versys 0.83 EC	C	12	0
Restricted Use			
Asana XL	W	12	3
Baythroid XL	W	12	0

(continued)

PESTICIDE SAFETY: Cole Crops *(continued)*

	Signal[1]	Re-entry (hrs)	Harvest (days)
Brigade 2 EC	W	12	7
Capture LFR	W	12	AP[2]
Danitol 2.4 EC	W	24	7
Diazinon AG500	C	24	7/10/21[5]
Diazinon 50 W	C	24	7/10/21[5]
Fastac 0.83 EC	D	12	1
Lannate 90 SP	DP	48	1/3/10[5]
Mustang Maxx	W	12	1
Permethrin 3.2 EC	C	12	1
Proaxis 0.5 EC	C	24	1
Proclaim 5 WDG	C	48	7
Warrior II	W	24	1
FUNGICIDES[3]			
Actigard 50 WG	C	12	7
Azoxystrobin[4]	C	4	0
Blocker 10G/4F	C	12	0
Cabrio EG	C	12	0
Chlorothalonil[4]	D	48	7
Dexter Max	C	24	7
Emblem	C	12	7
Endura	W	12	0
Fixed coppers[4]	D	24/48	0
Flint Extra	C	12	0
Fluazinam[4]	W	12	7/50[5]
Fontelis	C	12	0
Forum SC	C	12	7
Inspire Super	C	12	7
Iprodione[4]	W	12	0
Luna Sensation	C	12	0
Mancozeb[4]	C	24	7
ManKocide	D	48	7
Mefenoxam[4]	W	48	0/7[5]
Metalaxyl[4]	W	48	0
Orondis Ultra A	C	4	0
Orondis Ultra B	C	4	0
Priaxor	C	12	3
Presidio	C	12	2
Procure 480 SC	C	12	1
Quadris	C	4	0
Quadris Top	C	12	1
Ranman	C	12	0
Reason 500 SC	C	12	2
Revus	C	4	1
Rhyme	W	12	7
Sulfur[4]	C	24	0
Switch 62.5 WG	C	12	7
Topguard	C	12	7
Trionic	C	12	1
Terraclor	W	12	0
Zampro	C	12	0

1 W: Warning, C: Caution, D: Danger; P: Poison
2 AP: At planting.
3 None of these fungicides is labeled on all Cole crops, so check labels carefully.
4 Several formulations are marketed. See the general introduction for more details on fungicides.
5 PHI depends on crop type and application method.

INSECT CONTROL: Cole Crops[1,2,3]

Insecticide	Product Amt/A	Seasonal Limit/A	Comments and Other Restrictions
To prevent or reduce insect problems, destroy crop remnants immediately after harvest. When growing both spring and fall cole crops, allow for a 2- to 3-week period during midsummer without a cole crop. Always use a spreader/sticker to increase coverage on cole crops.			
PREPLANT INCORPORATED			
Cutworms, Root Maggots: Eliminate weeds from field margins and plow fields at least 2 weeks before planting to destroy cutworm food sources and egg laying sites.			
Capture LFR	3.4 to 6.8 fl oz	1 application	Apply as a band over the furrow or in-furrow.
Diazinon 50 W	4 to 6 lb	1 application	Incorporate immediately in top 3-4 inches of soil.
TRANSPLANT WATER OR DRENCH APPLICATION			
Root Maggots			
Diazinon AG 500	0.25 to 0.5 pt/50 gal	1 application	Use 200 to 300 gals of water per acre.
SOIL APPLICATION			
Aphids: Do not use a foliar spray of Actara, Belay, Venom, Provado, or Assail following a soil application of Admire, Belay, Platinum, or Venom.			
Admire Pro	4.4 to 10.5 fl oz	10.5 fl oz	Use as a 2 inch band during bedding, an in-furrow spray, a post-seeding drench, or a sidedress after plants are established.
Belay 2.13 SC	9 to 12 fl oz	12 fl oz	Limit one application.
Platinum 2 SC	5 to 11 fl oz	11 fl oz	See label for soil application methods.
Sivanto Prime 1.67SC	21 to 28 fl oz	28 fl oz	
Vemon 70 SG	5 to 7.5 oz	12 fl oz	-
Verimark 1.67 SC	6.75 to 13.5 fl oz	61.5 fl oz	Aids in caterpillar control.
FOLIAR TREATMENTS			
Aphids, Harlequin Bugs, Stink Bugs, Flea Beetles			
Actara 25 W	1.5 to 3 oz	11 oz	Allow 7 days between applications.
Admire Pro	1.3 fl oz	6.5 fl oz	Allow 5 days between applications. For aphids and flea beetles.
Assail 30 SG	2 to 4 oz	20 oz	Limit 5 applications. Allow 7 days between applications.
Belay 2.13 SC	3 to 4 fl oz	12 fl oz	Allow 10 days between applications.
Beleaf 50 SG	2 to 2.8 oz	8.4 oz	Allow 7 days between applications. For aphids only.
Brigade 2 EC	2.1 to 6.4 fl oz	32 fl oz	Allow 7 days between applications.
Danitol 2.4 EC	10.67 to 16 fl oz	42.6 fl oz	Allow 7 days between applications.
Dimethoate 4 E	0.5 to 1 pt	3 pt	Aphids only. Not for use on Chinese cabbage or Brussels sprouts.
Exirel 0.83 SE	13.5 to 20.5 fl oz	61.5 fl oz	Allow 5 days between applications. For aphids and flea beetles only.
Fastac 0.83 EC	2.2 to 3.8 fl oz	11.4 fl oz	Allow 7 days between applications. For flea beetles and harlequin bug.
Fulfill 50 WDG	2.75 oz	5.5 oz	Aphids only. Allow 7 days between applications.
Malathion 8	1.25 pt	2 applications	Aphids and flea beetles only. Allow 7 days between applications.
Movento 2 SC	4 to 5 fl oz	10 fl oz	Allow 7 days between applications. For aphids only. Requires surfactant.
Mustang Maxx	3.2 to 4 fl oz	24 fl oz	Allow 7 days between applications.
PQZ 1.87 SC	2.4 to 3.2 fl oz	4.8 fl oz	Limit 2 applications. Allow 7 days between applications.
Scorpion 35 SL	2 to 7 fl oz	10.5 fl oz	Allow 7 days between applications.
Sevin XLR Plus	0.5 to 2 qt	6 qt	Not for aphids. Allow 7 days between applications. Use within 30 days of transplanting.
Sivanto Prime 1.67SC	7 to 14 fl oz	28 fl oz	Allow 7 days between applications.
Torac 1.29 EC	17 to 21 fl oz	42 fl oz	Allow 14 days between applications. Limit 2 applications. Aphids and flea beetles only.
Venom 70 SG	1 to 4 oz	6 oz	Allow 7 days between sprays. Flea beetle only.
Versys 0.83 EC	1.5 fl oz	14 fl oz	Allow 7 days between applications.
Warrior II	1.28 to 1.92 fl oz	15.36 fl oz	Stink bugs and flea beetles only.

(continued on next page)

INSECT CONTROL: Cole Crops[1,2,3] *(continued)*

Insecticide	Product Amt/A	Seasonal Limit/A	Comments and Other Restrictions
Beet Armyworms: These are infrequent but serious pests of cole crops in Kentucky.			
Avaunt eVo 30 DG	3.5 oz	14 oz	Allow 3 days between applications.
Coragen 1.67 SC	3.5 to 7.5 fl oz	15.4 fl oz	Soil or foliar, see label for limitations. Allow 3 days between applications.
Exirel 0.83 SE	7 to 13.5 fl oz	61.5 fl oz	Allow 5 days between applications.
Harvanta 50 SL	10.9 to 16.4 fl oz	49.2 fl oz	Allow 7 days between applications.
Intrepid 2 F	4 to 10 fl oz	64 fl oz	-
Proclaim 5 WDG	2.4 to 4.8 oz	19.2 oz	Allow 7 days between applications.
Rimon 0.83 EC	6 to 12 fl oz	24 fl oz	Target small larvae.
Cabbage Loopers, Yellowstriped Armyworm: Treat when 20% of the plants are infested with looper larvae during the cotyledon stage, when 15% of the plants are infested up to the cupping stage, and when 5% of the plants are infested from cupping until harvest.			
Asana XL	5.8 to 9.6 fl oz	76.8 fl oz	Not for use on Brussels sprouts.
Avaunt eVo 30 DG	2.5 to 3.5 oz	14 oz	Allow 3 days between applications.
Baythroid XL	1.6 to 2.4 fl oz	12.8 fl oz	Limit 3.2 fl oz per 7-day period.
Brigade 2 EC	2.1 to 6.4 fl oz	32 fl oz	Allow 7 days between applications.
Bt products	See labels	-	-
Coragen 1.67 SC	3.5 to 7.5 fl oz	15.4 fl oz	Soil or foliar, see label for limitations. Allow 3 days between applications.
Danitol 2.4 EC	10.67 to 16 fl oz	42.6 fl oz	Allow 7 days between applications.
Fastac 0.83 EC	3.2 to 3.8 fl oz	11.4 fl oz	Allow 7 days between applications.
Exirel 0.83 SE	10 to 17 fl oz	61.5 fl oz	Allow 5 days between applications.
Intrepid 2 F	4 to 10 fl oz	64 fl oz	-
Malathion 8	1.25 pt	2 applications	Allow 7 days between applications.
Mustang Maxx	3.2 to 4 fl oz	24 fl oz	Allow 7 days between applications.
Permethrin 3.2 EC	2 to 4 fl oz	16 fl oz	For broccoli, cauliflower, Brussels sprouts, and Chinese broccoli.
	2 to 8 fl oz	16 fl oz	For cabbage and Chinese cabbage only.
Proaxis 0.5 EC	1.92 to 3.2 fl oz	30.72 fl oz	-
Proclaim 5 WDG	3.2 to 4.8 oz	19.2 oz	Allow 7 days between applications.
Radiant SC	5 to 10 fl oz	34 fl oz	Allow 4 days between applications.
Rimon 0.83 EC	6 to 12 fl oz	24 fl oz	Target small larvae.
Warrior II	0.96 to 1.6 fl oz	15.36 fl oz	-
Cross-Striped Cabbageworms, Imported Cabbageworms: Treat when 20% of the plants are infested with any of these larvae during the cotyledon stage, when 15% of the plants are infested up to the cupping stage, and when 5% of the plants are infested from cupping until harvest.			
Avaunt eVo 30 DG	2.5 to 3.5 oz	14 oz	Allow 3 days between applications.
Baythroid XL	1.6 to 2.4 fl oz	12.8 fl oz	Limit 3.2 fl oz per 7-day period.
Brigade 2 EC	2.1 to 6.4 fl oz	32 fl oz	Allow 7 days between applications.
Bt products	See labels	-	-
Coragen 1.67 SC	3.5 to 7.5 fl oz	15.4 fl oz	Soil or foliar, see label for limitations. Allow 3 days between applications.
Danitol 2.4 EC	10.67 to 16 fl oz	42.6 fl oz	Allow 7 days between applications.
Fastac 0.83 EC	2.2 to 3.8 fl oz	11.4 fl oz	Allow 7 days between applications.
Exirel 0.83 SE	7 to 13.5 fl oz	61.5 fl oz	Allow 5 days between applications.
Intrepid 2 F	4 to 10 fl oz	64 fl oz	-
Malathion 8	1.25 pt	2 applications	Allow 7 days between applications.
Mustang Maxx	2.24 to 4 fl oz	24 fl oz	Allow 7 days between applications.
Permethrin 3.2 EC	2 to 4 fl oz	16 fl oz	For broccoli, cauliflower, Brussels sprouts, and Chinese broccoli.
	2 to 8 fl oz	16 fl oz	For cabbage and Chinese cabbage only.
Proaxis 0.5 EC	1.92 to 3.2 fl oz	30.72 fl oz	-
Proclaim 5 WDG	2.4 to 4.8 oz	19.2 oz	Allow 7 days between applications.
Radiant SC	5 to 10 fl oz	34 fl oz	Allow 4 days between applications.
Rimon 0.83 EC	6 to 12 fl oz	24 fl oz	Target small larvae.
Sevin XLR Plus	1 to 2 qt	6 qt	Allow 7 days between applications. Use within 30 days of transplanting.
Warrior II	0.96 to 1.6 fl oz	15.36 fl oz	-

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INSECT CONTROL: Cole Crops[1,2,3] *(continued)*

Insecticide	Product Amt/A	Seasonal Limit/A	Comments and Other Restrictions
Cutworms: Eliminate weeds from field margins and plow fields at least 2 weeks before planting to destroy cutworm food sources and egg laying sites.			
Asana XL	5.8 to 9.6 fl oz	76.8 fl oz	Not for use on Brussels sprouts.
Baythroid XL	0.8 to 1.6 fl oz	12.8 fl oz	Limit 3.2 fl oz per 7-day period.
Fastac 0.83 EC	2.2 to 3.8 fl oz	11.4 fl oz	Allow 7 days between applications.
Mustang Maxx	2.24 to 4 fl oz	24 fl oz	Allow 7 days between applications.
Proaxis 0.5 EC	1.92 to 3.2 fl oz	30.72 fl oz	-
Warrior II	0.96 to 1.6 fl oz	15.36 fl oz	-
Diamondback Moth Larvae: Diamondback moth larvae are able to rapidly develop resistance to most major classes of insecticides. Do not tank-mix insecticides with the same mode of action and frequently rotate among insecticides with different modes of action to discourage resistance. Treat when 20% of the plants are infested with diamondback larvae during the cotyledon stage, when 15% of the plants are infested up to the cupping stage, and when 5% of the plants are infested from cupping until harvest. IRAC Codes: Insecticides followed by the same number share the same mode of action.			
Avaunt eVo 30 DG (22)	3.5 oz	14 oz	Allow 3 days between applications.
Bt products (11B2)	See labels	-	-
Coragen 1.67 SC (28)	3.5 to 7.5 fl oz	15.4 fl oz	Soil or foliar, see label for limitations. Allow 3 days between applications.
Exirel 0.83 SE	7 to 13.5 fl oz	61.5 fl oz	Allow 5 days between applications.
Harvanta 50 SL (28)	10.9 to 16.4 fl oz	49.2 fl oz	Allow 7 days between applications.
Proaxis 0.5 EC (3)	2.56 to 3.84 fl oz	30.72 fl oz	-
Proclaim 5 WDG (6)	2.4 to 4.8 oz	19.2 oz	Allow 7 days between applications.
Radiant SC (5)	5 to 10 fl oz	34 fl oz	Allow 4 days between applications.
Rimon 0.83 EC (15)	6 to 12 fl oz	24 fl oz	Target small larvae.
Sevin XLR Plus (1A)	1 to 2 qt	6 qt	Allow 7 days between applications. Use within 30 days of transplanting.
Torac 1.29 EC (21A)	17 to 21 fl oz	42 fl oz	Allow 14 days between applications. Limit 2 applications.
Root Maggots			
Diazinon 50 W	1 to 1.5 lb per 200 to 300 gal water	-	Direct spray at base of plants. May result in stand reduction due to stress at transplanting.

1 See Kentucky Cabbage Insect Pest Management Scout Manual (IPM-11) for additional information on cabbage pests and their control.
2 See An IPM Scouting Guide for Common Problems of Cole Crops in Kentucky (ID-216) for photos of pests.
3 Generic products available (Appendix G).

WEED CONTROL: Cole Crops

Product Amt/A	lb A.I./A	Comments
1.0 to 2.0 fl oz Aim 2 EC	0.008 to 0.025 carfentrazone	Apply no later than one day before transplanting, or seven days before seeding. See label for rate for crop oil or nonionic surfactant. Coverage is essential for good weed control. See label for more information.
0.67 to 1.3 pt Command 3ME	0.25 to 0.5 clomazone	Cabbage only—not labeled on Chinese vegetables. Apply before transplanting and incorporate to a depth of 1 inch. Use a min. 10 gal water/A. Do not replant treated field with any crops inconsistent with rotational guidelines. PHI = 45 days.
6 to 10 lb Dacthal W-75	4.5 to 7.5 DCPA	For pre-emergence control of annual grasses and broadleaves. Apply at seeding or transplanting. Can be broadcast over transplants. Can be preplant incorporated.
2 to 4 lb Devrinol 50 DF	1 to 2 napropamide	Not labeled on Chinese vegetables. For control of annual grasses and broadleaf weeds. Apply to weed-free soil and incorporate 1 inch before seeding or transplanting or irrigate within 24 hours of application to soak soil to a depth of 2 to 4 inches. Do not plant rotational crops that are not specified on the label until 12 months after last Devrinol application. Most effective in combination with Goal.
0.5 to 1.3 pt Dual Magnum	0.48 to 1.27 s-metolachlor	See the "Dual Magnum 24(c) Label" section on page 15.

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WEED CONTROL: Cole Crops *(continued)*

Product Amt/A	lb A.I./A	Comments
1 to 2 pt Goal 2XL	0.25 to 0.5 oxyfluorfen	For pre-emergence and post-emergence control of certain annual grasses and most broadleaves. Apply to soil after final tillage but before transplanting. Do not use on direct seeded cole crops. If plants contact treated soil, some foliar burn may occur but plants generally outgrow symptoms. Do not use post-transplant. Do not use on Brussels sprouts. Max. rate is 2 pt/A.
2.0 to 4.0 pt Gramoxone Inteon	0.69 to 1.38 paraquat salt	For non-selective contact kill of annual grasses and broadleaf weeds and top-kill of perennial weeds. Apply preplant, pre-emergence, or before transplanting in min. 10 gal water/A. Apply banded or broadcast. Use higher rate for heavy weed infestations. Use non-ionic surfactant 0.25% v/v. **Paraquat product labels require applicators to take an EPA-approved training every 3 years to mix, load, and apply paraquat.**
5 to 6 qt Prefar 4 E	5 to 6 bensulide	For control of grasses and broadleaf weeds. Apply preplant and incorporate to 1 to 2 inch depth. Apply pre-emergence only if it can be watered in within 36 hours. Max. rate of 6 qt/season.
0.5 to 1.5 pt Poast	0.09 to 0.28 sethoxydim	For control of actively growing grasses only. Rate for Chinese Brassica vegetables is 0.5 to 1.5 pt. Use higher rate on Johnson grass. PHI = 30 days. Max. rate of 1.5 pt/application and 3 pt/season.
16 to 22 fl oz Roundup WeatherMax 5.5L	0.69 to 0.94 glyphosate-salt	For non-selective post-emergence control of annual and perennial grasses and broadleaf weeds. Use only AMS 1 to 2% v/v. Adding a non-ionic surfactant can reduce weed control effectiveness. Min. 30 days before planting any non-labeled crop.
9 to 16 fl oz Select Max	0.07 to 0.12 clethodim	For selective post-emergence of actively growing annual grasses and suppression of perennial grasses. Add crop oil 1% v/v. Max. 16 fl oz/application. Min. 14 days between applications. PHI = 30 days.
3 to 12 fl oz Spartan 4F	0.09 to 0.38 sulfentrazone	Processing and transplanted cabbage only. Apply 60 days prior to transplanting and allow rain to move into soil for early preplant application. For preplant incorporation apply as a broadcast and incorporate to depths no greater than 2 inches. May be applied in row middles only of transplanted cabbage up to 72 hours after transplant.
0.25 to 0.5 pt Stinger	.09 to 0.187 clopyralid	Post-emergent control of broadleaf weeds. Do not exceed maximum yearly rate of 0.5 pt.
1.25 to 2 pt Treflan HFP 4 E	0.6 to 1 trifluralin	For control of annual grasses and broadleaf weeds. Apply and incorporate in spring before transplanting. Check label for direct seeded cole crops. Rate for Chinese Brassica vegetables is 1 to 1.5 pt.

DISEASE CONTROL: Cole Crops

Product	FRAC Code[1]	PHI[2] (days)	Amt/A	Seasonal Limits/A	Comments
Alternaria Leaf Spot					
Cabrio and pyraclostrobin[4] generics	11	0	12 to 16 oz[5]	4 apps	
Chlorothalonil[4]					There are multiple Bravo formulations and chlorothalonil generics on the market. See label for rates.
Bravo Ultrex	M	7	1.4 lb	14.5 lb	
Bravo Weather Stik	M	7	1.5 pt	11.7 pt	
Dexter Max	M/11	7	2 to 2.25 lb	13.7 lb	Use at least 10 gal/A spray volume.
Endura	7	0	6 to 9 oz	2 apps	
Copper, fixed coppers[6]	M				See label for rates, mixing instructions, and tank-mix precautions. Some products are approved for greenhouse use.
Dithane M45 and mancozeb[4] generics	M	7	2 lb		There are multiple Dithane formulations and mancozeb generics on the market. See label for rates.
Flint Extra	11	0	3.0 to 3.8 oz	7.6 oz	
Fontelis	7	0	14 to 30 fl oz[5]	72 fl oz	
Inspire Super	3/9	7	16 to 20 fl oz	80 fl oz	
Luna Sensation	7/11	0	5.0 to 7.6 fl oz	15.3 fl oz	
ManKocide	M	7	1 to 3 lb	8.8 lb	Broccoli & cabbage only.
Omega 500F	29	7	15.35 fl oz	5.75 pt	
Priaxor	7/11	3	6 to 8.2 fl oz	3 apps	
Procure 480 SC	3	1	6 to 8 fl oz[5]	18 fl oz	Black spot (*Alternaria* spp.) only.

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DISEASE CONTROL: Cole Crops *(continued)*

Product	FRAC Code[1]	PHI[2] (days)	Amt/A	Seasonal Limits/A	Comments
Quadris and azoxystrobin[4] generics	11	0	6 to 15.5 fl oz[5]	3 foliar apps	
Quadris Top	11/3	1	12 to 14 fl oz[5]	56 fl oz	
Reason 500 SC	11	2	8.2 fl oz	24.6 fl oz	
Rhyme	3	7	5 to 7 fl oz	4 apps	
Switch 62.5 WG	9/12	7	11 to 14 oz	56 oz	
Topguard EQ	3/11	7	5.0 to 8.0 fl oz	4 apps	Observe season limits for group 3 and group 11 fungicides.
Trionic	3	1	6 to 8 fl oz	2 apps	
Black Leg					
Cabrio and pyraclostrobin[4] generics	11	0	12 to 16 oz[5]	4 apps	
Priaxor	7/11	3	6 to 8.2 fl oz	3 apps	
Rovral and iprodione[4] generics	2	0	2 pt	2 apps	Broccoli only. Apply after thinning as a directed spray targeting the base of the plant and adjacent soil surface; make a 2nd application no later than the day of harvest.
Black Rot (*Xanthamonas*)					
Actigard	21	7	0.5 to 1 oz	4 apps	Suppression only. Apply 7 to 10 days after thinning and make up to three additional applications. Apply in a minimum of 20 gal/A of water. May be applied through drip irrigation. May cause phytotoxicity and yield reduction. Do not apply to stressed or injured plants.
Copper and fixed coppers[6]	M				See label for rates, mixing instructions, and tank-mix precautions. Some products are approved for greenhouse use.
Clubroot					
Blocker 10G	14	0	5.15 lb/1,000 linear feet of row	225 lb	Banded or broadcast pre-transplant treatment.
Blocker 4F	14	0		1 app	Apply at transplanting in furrow or band application. See label for rates and application instructions.
Omega 500 and fluazinam[4] generics	29	7/50		1 app	Apply before or at transplanting, in furrow or band application. See label for rates and application instructions.
Ranman	21	0		1 app	Apply before or at transplanting. See label for rates and application instructions.
Damping-off (*Rhizoctonia*), Wirestem					
Blocker 4F	14	0	2.8 to 3.8 gal	1 app	May be applied as a plant drench or banded spray. See label for specific applications instructions.
Blocker 10G	14	0			
Damping-off (*Pythium*)					
MetaStar and metalaxyl[4] generics	4	0		1 app	Preplant or post plant incorporation, broadcast or banded. Can be applied by drip irrigation. See label for rates and specific application instructions. May be tank mixed with Terraclor for control of club root.
Presidio	43	2	3 to 4 fl oz	12 fl oz	Can be applied as a drench or through drip irrigation at planting; soil-directed applications can be made during the season.
Ridomil Gold and mefenoxam[4] generics	4	0		1 app	Preplant or at planting, broadcast or banded. Can be applied by drip irrigation. See label for rates and specific application instructions.

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DISEASE CONTROL: Cole Crops *(continued)*

Product	FRAC Code[1]	PHI[2] (days)	Amt/A	Seasonal Limits/A	Comments
Downy Mildew					
Actigard	21	7	0.5 to 1 oz	4 apps	Apply 7 to 10 days after thinning and make up to three additional applications every 7 days. May be applied through drip irrigation. May cause phytotoxicity and yield reduction. Do not apply to stressed or injured plants.
Cabrio and pyraclostrobin[4] generics	11	0	12 to 16 oz[5]	4 apps	
Chlorothalonil[4]					There are multiple Bravo formulations and chlorothalonil generics on the market. See label for rates.
Bravo Ultrex	M	7	1.4 lb	14.5 lb	
Bravo WeatherStik	M	7	1.5 pt	16 pt	
Copper, fixed coppers[6]					See label for rates, mixing instructions, and tank-mix precautions. Some products are approved for greenhouse use.
Dithane M45 and mancozeb[4]	M	7	1.5 lb	12.8 lb	Broccoli and cabbage only. There are multiple Dithane formulations and mancozeb generics on the market. See label for rates.
Forum	40	7	6 fl oz	30 fl oz	Tank-mix with another fungicide NOT in FRAC Group 40.
Luna Sensation	7/11	0	7.6 fl oz	15.3 fl oz	Suppressive only.
Micora	40		5.5 to 8.0 fl oz	2 apps	Transplant production only.
Omega 500 and fluazinam[4] generics	29	7	15.35 fl oz	5.75 pt	Cabbage only.
Orondis Opti	49	7	1.75 to 2.5 pt	10 pt	Do not combine with soil applications of Orondis Gold.
Presidio	43	2	3 to 4 fl oz	4 apps	Apply every 7 to 14 days. Tank-mix with another fungicide NOT in FRAC Group 43.
Quadris and azoxystrobin[4] generics	11	0	6 to 15.5 fl oz[5]	3 foliar apps	
Ranman	21	0	2.75 fl oz	5 apps	Leafy brassicas only. Tank-mix with an organosilicone surfactant.
Reason 500 SC	11	2	5.5 to 8.2 fl oz	24.6 fl oz	
Revus	40	1	8 fl oz	32 fl oz	Use a spreader/penetrant surfactant. Tank-mix with another fungicide NOT in FRAC Group 40.
Ridomil Gold Bravo SC	4/M	7	1.5 pt	4 apps	Do not apply to loosehead Chinese cabbage. Observe seasonal limits for chlorothalonil.
Ridomil Gold and mefenoxam[4] generics	4	7	0.25 to 0.5 pt	1 pt	Tank-mix with another fungicide labeled for downy mildew. Not recommended for fields where downy mildew is already established.
Zampro	40/45	0	14 fl oz	3 apps	
Phytophthora Root Rot, Basal Stem Rot					
Presidio	43	2	3 to 4 fl oz	12 fl oz	Can be applied as a drench or through drip irrigation at planting; soil-directed applications can be made during the season.
Sclerotinia Stem Rot					
Contans	-	0	1 to 4 lb	8 apps	OMRI-listed. Use pre-season and incorporate into soil. See label for specific instructions.
Cueva	M	0	0.5 to 2 gal	n/a	OMRI-listed. Mix in 100 gallons of water, use 50 to 100 gal/A of solution.
Endura	7	0	6 to 9 oz	2 apps	
Fontelis	7	0	16 to 30 fl oz[5]	72 fl oz	
Luna Sensation	7/11	0	7.6 fl oz	15.3 fl oz	

1 Products with numerical FRAC codes must be alternated or tank-mixed with products that have a different FRAC code to discourage resistance development. See product label for maximum number of consecutive applications allowed. Refer to the table on pages 22-24 for more information on FRAC codes.
2 Pre-harvest interval.
3 Per 100 gal of water.
4 Generic products available (Appendix F). Amounts and seasonal limits per acre are product dependent.
5 Use higher rate when pressure is severe.
6 Fixed coppers labeled in KY include: Badge SC, Badge X2, Basic Copper 53, Champ, Champ WG, ChampION++, C-O-C-S WDG, Cueva, Cuprofix, Cuproxat, Kentan, Kocide 2000, Kocide 3000, Kocide DF, KOP-5, MasterCop, Nordox 75 WG, Nu-Cop 30 HB, Nu-Cop 50DF, Phyton 27, Phyton 35, and Previsto. Rates may vary by product and by crop. Refer to specific product label for this information.

Sweet Corn

Grass family (Poaceae): *Zea mays* subsp. *mays*

Types and Isolation Requirements

An array of high-sugar sweet corn types are found in the most recent seed company catalogs. Varieties are often grouped under abbreviations for the types of genes they carry for sweetness (*su, se, sh2*, etc.) or under various trade names (TripleSweet™, Xtra Tender™, Sweet Generation™, etc.) that contribute to the confusion. Various types of sweet corn are strikingly different in terms of sweetness, eating quality, and suitability for mechanical harvest and shipping. Consider carefully which types are best suited to your marketing situation. Different types also have different isolation requirements.

Regardless of the type, the variety should have a tight husk cover over the ear tip to help keep out birds, sap beetles, and corn earworms.

Traditional or standard sweet corn (*su*) varieties are characterized by their creamy corn flavor and mild sugars; these sugars quickly convert to starch so these varieties are best consumed soon after harvest. Obviously, they are most suitable for local sales.

Sugary enhanced (*se)* varieties have tender kernels and a creamy texture like standard varieties but have up to twice as much sugar. Consequently, they will remain sweet longer than standard sweet corn. Sugary enhanced varieties are very popular at farmers' markets and for local sales.

Supersweet or shrunken-2 varieties (*sh* or *sh2*) all have shrunken, wrinkled/shriveled seeds. They have a high sugar content as well as slower conversion of sugar to starch. This means they will remain sweeter much longer than other corn types. Supersweets also have kernels that hold up much better when mechanically harvested; however, these tougher kernels do not have the creamy texture and flavor of standard or sugary enhanced corn varieties. Most sweet corn varieties sold for processing and through wholesale market channels are supersweets.

Augmented supersweets are new and improved supersweet varieties that have tender kernels like *se* varieties while retaining the added sweetness and longer shelf life of supersweets. Ears of these varieties contain only a single type of kernel. These varieties are sold under several trade names ('Xtra Tender™,' 'Gourmet Sweet™,' 'MultiSweet™,' 'HQ,' 'shQ,' etc.).

Synergistic varieties are sold under several trade names, including 'TripleSweet™,' 'Sweet Generation™,' 'Sweet Breed™,' 'Table Sweet™,' and 'seQ.' Ideally, they have the seed vigor of standard varieties, the flavor and eating quality of *se* varieties, and the high sugar and long shelf life of *sh2* varieties. Most synergistics combine the best characteristics of sugary enhanced and supersweet varieties with seed vigor that is most similar to *se* types. What distinguishes this group is that *different types of kernels occur on the same ear*; that is, most of these varieties have ears with ¾ sugary enhanced (*se*) type kernels and ¼ supersweet (*sh2*) kernels. These varieties may not have as long a shelf life as true supersweets and may not be suitable for mechanical harvest. The genetic combinations in these varieties differ widely, and growers should try them on a small scale prior to growing large acreages.

Genetically modified or transgenic sweet corn varieties are available that express a toxin from the insect-killing bacteria *Bacillus thuringiensis* (Bt). Bt toxins help control worms feeding on sweet corn and can result in considerable reductions in pesticide usage, especially late in the season. Any of the previously described sweet corn types can be modified in this way. Current transgenic sweet corn varieties are sold under the trade name 'Attribute™,' 'Performance Series™', or 'Attribute II™.' Recent studies have shown that the 'Attirbute I™' and 'Performance Series™' varieties may have significant corn earworm damage in some situations without the use of additional control measures. While Bt toxins are harmless to humans, some wholesale and retail buyers will not accept transgenic products. *Transgenic varieties also are not allowed in organic production.*

Isolation Requirements

All sweet corn types must be isolated from field corn or popcorn to prevent cross pollination and loss of sweetness. A separation (isolation) distance of 700 feet will give complete isolation of white, yellow, or high-sugar varieties but may be impractical. A distance of 250 feet will result in some contamination but not enough to affect quality. Isolation can also be maintained by a 10- to 14-day difference in maturities of different types, although isolation by distance is more effective.

The different types of sweet corn described in the "Varieties" table can be placed in either of two major groups in terms of their isolation requirements. While each type within one of these groups may benefit from isolation from other types in the same group, the resulting cross pollination will not produce field corn kernels. *Cross pollination between the two groups, however, will produce a percentage of unacceptable kernels*. These lists

SWEET CORN ISOLATION GROUPS

Group 1	Standard varieties (su)
	Sugary enhanced (se)
	Synergistics
	Sweet Breed
	Table Sweet
	TripleSweet
	seQ, HQ
Group 2	Supersweets (sh-2)
	Augmented supersweets
	Crisp N Sweet
	Gourmet Sweet
	MultiSweet
	SummerSweet
	shQ

may not include all the trade names currently available.

Planting and Culture

Sweet corn will do well in all areas of Kentucky, but well-drained soils are essential for good results. Fescue sod is ideal prior to sweet corn production. Sweet corn makes a good rotational crop for other vegetable crops. A well-prepared seedbed is critical for successful seed germination and good stands. Disking the soil three to four times before planting will help in preparing a good seedbed. Plowing should be done several weeks in advance of planting to allow the ground to settle and the grass to decompose. Ten to 15 pounds of seed will usually be required to plant an acre. Plant seed in rows 30 to 40 inches apart with plants spaced 8 to 10 inches apart in the row. If plants are spaced closer, thin to 8 inches within row spacing. Ears will be smaller if planted too close together.

For best results, sweet corn seed should be planted after the soil temperature has reached 60°F. In most parts of Kentucky, the earliest plantings can be made from April 20 to May 1 (see Appendix K). The harvest period for sweet corn can be extended by planting early, midseason, and late-maturing varieties or by making successive plantings at weekly intervals. Late-planted sweet corn will have more insect and disease problems. Cultivars with tolerance or resistance to leaf blights and viruses should be selected when planting in June, especially in river bottoms and humid areas in the state (see "Varieties" table).

Seed-germination percentages of some supersweet varieties (or other varieties with shrunken seed) can be poor to fair, particularly under cold soil conditions. Make sure the soil is warmer than 60°F before planting these varieties. The germination of sugary enhanced corn is much better than that of shrunken types but not quite as good as standard sweet corn. At present, use standard varieties for very early plantings intended for early markets. Most high sugar corn varieties are also more attractive to insects, birds, groundhogs, and raccoons and more susceptible to heat and drought stresses than standard sweet corn.

Irrigation is usually required to ensure high quality in both standard and high-sugar corn types. While solid set sprinkler systems and traveling guns are still in use, it is also relatively easy to irrigate (and fertigate) sweet corn simply by running drip irrigation lines down the rows on bare ground with lines placed no more than about 4 inches from the plants.

Production with Plasticulture

A number of Kentucky growers have successfully grown transplanted sweet corn on plastic mulch with drip irrigation. This system enables earlier harvests, resulting in considerably higher market prices. Typically seeds are sown in 128 cell trays with two seeds per cell. Transplants should be planted between 14 and 18 days after seeding. It is critical that corn transplants not be held over too long in the greenhouse, as this results in permanent stunting of the plants in the field. Also, *do not use early-maturing varieties (earlier than 75 days) as these will tend to tassel prematurely, resulting in stunted plants with non-marketable ears*. Growers may want to consider multiple seeding times in case unfavorable weather prevents transplanting in a timely fashion. Typically seed is inexpensive compared to the cost of using the plasticulture system.

Black plastic mulch on raised beds is most often used for transplanted corn. One popular system uses double rows (two rows per bed) with 12 inches between transplants in the row and about 18 to 20 inches between the two rows. In the latter system two seeds are sown in each cell of the plug trays; therefore, each hill will contain two plants in the field. Some growers have also direct seeded sweet corn under clear plastic and then cut the plastic open after the seedlings emerged. Using clear plastic, however, has resulted in problems with weed seed germination under the plastic.

Fertilizing

Make all lime and fertilizer applications based on soil test results. Sweet corn tolerates some soil acidity and can be grown in soils ranging in pH from 5.5 to 6.8; however, lime should be applied to bring the pH to 6.5 for best results. Where sweet corn is planted on sod ground, apply at least half of the fertilizer broadcast and plow down. The remaining fertilizer can be applied broadcast just before planting and disked in. If banding equipment is available, fertilizer may be banded 2 to 3 inches to the side of seed and 2 to 3 inches deeper than the seed. The total amount of fertilizer that is banded should not exceed 45 pounds per acre (total of N and K, to avoid root burn from salts). Sidedress with 50 pounds of actual nitrogen (N) when plants are about knee high. High-sugar varieties (supersweets, sugary enhanced, and others) benefit from an additional late sidedressing of nitrogen to keep the husks dark green.

With plasticulture systems, apply all P and K and half to two-thirds of the nitrogen prior to planting. The remaining nitrogen requirement can be divided up into equal doses and fertigated weekly.

Sweet corn grown on high pH soils that are also very high in available phosphorus may show zinc deficiency in some years. However, many other factors, including weather conditions and cool soil temperatures, affect availability of soil zinc, making it difficult to predict a response to added zinc for a specific growing season. Zinc should be broadcast at 30 pounds per acre (90 pounds of zinc sulfate) or banded at 6 pounds per acre (17 pounds of zinc sulfate). A broadcast application should last from four to six years, whereas a band application should be made annually for six to eight years (see Appendix B).

Harvesting and Handling

Corn should be harvested at the milk stage of maturity for best quality. Sweet corn is usually marketed as five dozen ear units in bags or crates. Harvest in the early morning while

the air is still cool. If the temperature of the ears is high when harvested, field heat should be removed by plunging them in ice water. To maintain top quality, sweet corn must be cooled to as near to 32°F as possible. This prevents sugars from changing to starch. Crated corn can be cooled in ice water from about 86°F to around 41°F in about 80 minutes. Hydrocoolers are often used by larger producers for this purpose. Vacuum cooling is a much faster procedure but involves more expensive equipment. Store sweet corn at 32°F and 90 to 95 percent relative humidity. The type of sweet corn grown also has a great impact on sweetness and shelf life.

VARIETIES: Sweet Corn and Ornamental Corn

Variety	DTM[1]	Color[2]	Comments
STANDARD SWEET CORN (SU)			
Merit	80	Y	Rust and northern corn leaf blight resistance, long ears.
Silver Queen	95	W	Rust resistant, one of the most popular sweet corn varieties.
SUGAR ENHANCED (SE) AND SYNERGISTICS (SEQ)			
Profit	70	BC	Attractive husks and ears, intermediate resistance to northern corn leaf blight, common rust and Stewart's wilt.
Temptation	72	BC	Good for early spring plantings, good yields.
Kristine	75	BC	Resistance to rust and southern corn leaf blight
Essence	78	BC	Attractive husk, short flags, very sweet kernels, high yield, intermediate resistance to northern corn leaf blight, common rust and Stewart's wilt.
Montauk	79	BC	Resistance to Stewart's wilt and northern corn leaf blight
Providence	80	BC	Good strong mid-season variety, rust resistant
Incredible RM	85	Y	Resistant to Stewart's wilt, rust, northern corn leaf blight, and maize dwarf mosaic virus, good husk coverage, excellent flavor.
Mirage	78	W	Attractive husk, and 7.9 inch ear, shucks easily, intermediate resistance to northern corn leaf blight, common rust and Stewart's wilt.
Mattapoisett	80	W	Attractive husk, 8 inch ears, long flags, intermediate resistance to northern corn leaf blight, common rust and Stewart's wilt.
Silver King	82	W	Attractive husk and 7.6 inch ear, long flags, snaps from plant easily, intermediate resistance to northern corn leaf blight, common rust and Stewart's wilt.

(continued)

VARIETIES: Sweet Corn and Ornamental Corn *(continued)*

Variety	DTM[1]	Color[2]	Comments
Argent R/M	83	W	Resistance to rust, Stewart's wilt, maize dwarf mosaic virus, and northern corn leaf blight.
SUPERSWEETS (SH2 AND AUGMENTED SUPERSWEETS)			
AP 426	58	BC	Excellent husk cover, glossy 8 inch ear, high yield for early maturity.
Anthem XR	72	BC	Attractive husk, good yield, intermediate resistance to northern corn leaf blight and common rust.
Awesome	76	BC	Resistance to Stewart's wilt, good early type for shipping and farmers markets.
Munition	78	W	Attractive husks and 7.5 inch ears, good disease resistance and very high yield.
Obsession	79	BC	Resistance to rust, Stewart's wilt, and northern corn leaf blight, excellent husk cover, tip fill, and yield.
GENETICALLY MODIFIED[3]			
Obsession II (sh2)	79	BC	Resistance to rust, Stewart's wilt, and northern corn leaf blight, excellent husk cover, tip fill, and yield, Performance Series hybrid tolerant to Roundup brand herbicides with above and below ground insect control.
BSS 0977 (sh2)	79	BC	Resistance to rust, Stewart's wilt and northern corn leaf blight, Attribute® insect protection.
Aspire	80	Y	Attribute II trait stack, attractive husk, 8 inch ear snaps from husk easily, very sweet kernels.
Passion II (sh2)	80	Y	Resistance to rust, Stewart's wilt and northern corn leaf blight, Performance Series hybrid tolerant to Roundup brand herbicides with above and below ground insect control.
WH 0809 (se)	80	W	Resistance to rust and southern corn leaf blight, Attribute® insect protection.
BC 0805 (se)	83	BC	Resistance to rust, Attribute® insect protection.
ORNAMENTAL CORN[4]			
Earth Tones Dent	90		Colors are soft earth tones, 8 to 10 inch ears.
Green and Gold Dent	95-100		Bright yellow and green kernels, 8 to 10 inch ears.
Mini Blue	100		Shiny blue kernels, 2 to 4 inch ears, good stalks, popcorn.
Mini Pink,	100		Shiny pink kernels, 2 to 4 inch ears, good stalks, popcorn.

(continued)

VARIETIES: Sweet Corn and Ornamental Corn *(continued)*

Variety	DTM[1]	Color[2]	Comments
Autumn Explosion	102		Multicolored flint corn, 8 to 9 inch ears, 25% red husks.
Indian Fingers	110		Multicolored, 3.5 inch ears, small shiny kernels.
Pod Corn	110		Highly ornamental and variable with husks around each kernel.

1 Days to maturity
2 Y = yellow; W = white; BC = bicolor
3Growers should check current regulations for marketing and labeling of transgenic or "genetically modified" crops before planting; "Attribute" sweet corn seed may also have minimum purchase requirements.
4See HO-81, Ornamental Corn Production in Kentucky, for production and more detailed variety information.

FERTILIZER: Sweet Corn

Soil Test Results (lb/A)		**Fertilizer Needed (lb/A)**
Phosphorus		**Phosphate (P_2O_5)**
Low	<31	121-180
Medium	31-60	61-120
High	61-80	1-60
Very High	>80	0
Potassium		**Potash (K_2O)**
Low	<201	151-200
Medium	201-300	101-150
High	>300	100
Nitrogen		**N**

Apply 80 to 100 lb actual nitrogen (N)/A preplant; apply at least 40 to 50 lb N/A as sidedressing when plants are knee high.

PESTICIDE SAFETY: Sweet Corn

	Signal[1]	Re-entry (hrs)	Harvest (days)[2]
INSECTICIDES			
Assail 30 SG	C	12	1/7
Avaunt eVo 30 DG	C	12	3
Blackhawk 36 WG	C	4	1/7/28[4]
Bt products	C	12	0
Coragen 1.67 SC	-	4	1
Intrepid 2 F	C	4	3
Intrepid Edge	C	4	3/21[4]
Malathion 8	C	12	5
Oberon 2 SC	C	12	5
Radiant SC	C	4	1
Rimon 0.83 EC	W	12	1
Sevin XLR Plus	W	12	2
Sivanto Prime 1.67 SL	C	4	7
Transform 50 WG	D	24	7
Vantacor 5 SC	-	4	7

(continued)

PESTICIDE SAFETY: Sweet Corn *(continued)*

	Signal[1]	Re-entry (hrs)	Harvest (days)[2]
Restricted Use			
Agri-Mek 0.7 SC	W	12	7
Asana XL	W	12	1
Aztec HC	W	48	AP
Baythroid XL	W	12	0
Besiege 0.835 CS	W	24	[1]
Brigade 2 EC	W	12	1/30[4]
Counter 20 G	DP	48	AP
Diazinon AG500	C	24	7
Fastac 0.83 EC	D	12	3
Elevest 2.22 SC			
Force 3 G	C	0	AP
Lannate 90 SP	DP	48	0
Mocap 15 G	W	48	AP
Mustang Maxx	W	12	3
Permethrin 3.2 EC	C	12	3
Pounce 1.5 G	C	12	1
Proaxis 0.5 EC	C	24	1
SmartChoice HC	W	48	AP
Thimet 20 G	DP	48	AP
Warrior II	W	24	1
FUNGICIDES			
Aftershock	C	12	7
Aproach	C	12	7
Azoxystrobin[3]	C	4	7
Dexter Max	C	24	7
Dexter XCEL	C	19 days	7/49
Elatus	C	12	7
Evito 480/Evito T	C	12	7
Fixed coppers[3,5]	D	24/48	0
Headline	W	12	7
Headline SC	W	12	7
Headline AMP	W	12	7
Mancozeb[3]	C	24	7
Miravis Neo	W	12	14
Muscle ADV	C	12	14/21/36
Priaxor	C	12	7
Propiconazole[3]	W	24	14
Propiconazole + Azoxystrobin[3]	W	12	14
Prosaro	C	12	7
Quilt	C	24	14
Quilt Xcel	W	12	14
Stratego	W	12	14
Stratego YLD	C	48	0
Tebuconazole[3]	W	19 days	7
Vertisan	W	12	7
Fresh market only			
Chlorothalonil[3]	D	48	14

1 W: Warning, C: Caution, D: Danger; P: Poison
2 AP: At planting, ST: Seed treatment.
3 Several formulations are marketed. See the general introduction for more details on fungicides.
4 Dependent on application type, see label.
5 Re-entry period varies by product. See label for more information.

INSECT CONTROL: Sweet Corn[1,2,3]

Insecticide	Product Amt/A	Seasonal Limit/A	Comments and Other Restrictions
PLANTING TIME			
Seedcorn Maggots, Rootworms, Seedcorn Beetles: Corn rootworms are a potential pest where corn is grown year after year in the same field.			
Aztec 2.1 G	6.7 oz/1,000 row-feet		Band, T-band or furrow.
Aztec 4.67 G	3 oz/1,000 row-feet		Band, T-band or furrow.
Brigade 2 EC	0.3 fl oz/1,000 row-feet		Spray as T-band over open furrow.
Counter 20 G	4.5 to 6 oz/1,000 row-feet		Band or furrow.
Force 3 G	4 to 5 oz/1,000 row-feet		T-band controls cutworms as well.
Mocap 15 G	8 oz/1,000 row-feet		Band only. Rootworm control.
Thimet 20 G	4.5 to 6 oz/1,000 row-feet		Band only. Rootworm control.
FOLIAR TREATMENTS			
Armyworms			
Asana XL	5.8 to 9.6 fl oz	96 fl oz	-
Baythroid XL	1.6 to 2.8 fl oz	28 fl oz	Limit 2.8 fl oz per 2-day interval.
Blackhawk 36 WG	1.67 to 3.3 oz	20 oz	-
Brigade 2 EC	2.1 to 6.4 fl oz	12.8 fl oz	Do not graze livestock for 1 day.
Coragen 1.67 SC	3.5 to 7.5 fl oz	15.4 fl oz	Limit 4 applications.
Fastac 0.83EC	2.8 to 3.8 fl oz	11.4 fl oz	Allow 3 to 5 days between applications.
Intrepid 2 F	4 to 16 fl oz	64 fl oz	-
Lannate 90 SP	0.25 to 0.5 lb	7 lb	-
Mustang Maxx	2.8 to 4 fl oz	24 fl oz	Allow 3 to 5 days between applications.
Radiant SC	3 to 6 fl oz	36 fl oz	Allow 2 days between applications.
Rimon 0.83 EC	6 to 12 fl oz	60 fl oz	Allow 7 days between applications.
Sevin XLR Plus	1 to 2 qt	16 qt	Allow 3 days between applications.
Warrior II	1.28 to 1.92 fl oz	30.7 fl oz	Allow 3 to 5 days between applications.
Corn Earworms: Corn earworm is the key insect pest attacking sweet corn. Egg laying occurs only while silks are still green, and sprays need to be repeated at 2- to 7-day intervals while silks are green. Time of planting, intensity of moth flight, and temperature will affect spray intervals. Pheromone traps are available for monitoring this pest and determining spray intervals. Pyrethroid insecticides are not as effective as in the past when used later in the sweet corn season.			
Asana XL	5.8 to 9.6 fl oz	96 fl oz	-
Baythroid XL	1.6 to 2.8 fl oz	11.2 fl oz	Limit 2.8 fl oz per 7-day interval.
Besiege 0.835 CS	6 to 10 fl oz	31 fl oz	Allow at least 1 day between applications.
Blackhawk 36 WG	2.2 to 3.3 oz	20 oz	-
Brigade 2 EC	2.1 to 6.4 fl oz	12.8 fl oz	Do not graze livestock for 1 day.
Coragen 1.67 SC	3.5 to 7.5 fl oz	15.4 fl oz	Limit 4 applications.
Fastac 0.83EC	2.8 to 3.8 fl oz	11.4 fl oz	Allow 3 to 5 days between applications.
Intrepid Edge	8 to 12 fl oz	51 fl oz	Limit 6 applications. Allow 2 days between applications.
Lannate 90 SP	0.25 to 0.5 lb	7 lb	-
Mustang Maxx	2.8 to 4 fl oz	24 fl oz	Allow 3 to 5 days between applications.
Permethrin 3.2 EC	4 to 8 fl oz	32 fl oz	Allow 3 days between applications.
Proaxis 0.5 EC	2.56 to 3.84 fl oz	15.36 fl oz	Allow 3 to 5 days between applications.
Radiant SC	3 to 6 fl oz	36 fl oz	Allow 2 days between applications.
Rimon 0.83 EC	6 to 12 fl oz	60 fl oz	Allow 7 days between applications. Mix with an adulticide to improve control.
Warrior II	1.28 to 1.92 fl oz	30.7 fl oz	-
Corn Leaf Aphids			
Asana XL	5.8 to 9.6 fl oz	96 fl oz	-
Assail 30 SG	2.1 to 2.9 oz	11.2 oz	Limit 2 applications. Allow 7 days between applications.
Sivanto Prime 1.67 SL	7 to 14 fl oz	28 fl oz	Allow 7 days between applications.
Transform 50 WG	0.75 to 1 oz	3 oz	Limit 2 applications. Allow 14 days between applications.
Cutworms: Eliminate weeds from field margins and plow fields at least 2 weeks before planting to destroy cutworm food sources and egg laying sites.			
Asana XL	5.8 to 9.6 fl oz	96 fl oz	-
Baythroid XL	0.8 to 1.6 fl oz	11.2 fl oz	Limit 2.8 fl oz per 7-day interval.
Brigade 2 EC	2.1 to 6.4 fl oz	12.8 fl oz	Do not graze livestock for 1 day.
Fastac 0.83EC	2.2 to 3.8 fl oz	11.4 fl oz	Allow 3 to 5 days between applications.
Mustang Maxx	2.24 to 4 fl oz	24 fl oz	Allow 3 to 5 days between applications.

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INSECT CONTROL: Sweet Corn[1,2,3] *(continued)*

Insecticide	Product Amt/A	Seasonal Limit/A	Comments and Other Restrictions
Permethrin 3.2 EC	4 to 8 fl oz	32 fl oz	Allow 3 days between applications.
Warrior II	1.28 to 1.92 fl oz	30.7 fl oz	Allow 3 to 5 days between applications.
European Corn Borer, Southwestern Corn Borer: Treat if more than 15% of the whorls are infested with live larvae. Pheromone traps are available to monitor this pest. Corn borer control is frequently necessary when tassels begin to emerge from the whorl.			
Asana XL	5.8 to 9.6 fl oz	96 fl oz	
Avaunt eVo 30 DG	2.5 to 3.5 oz	14 oz	Allow 3 days between applications. Until tassel push only. For European corn borer.
Baythroid XL	1.6 to 2.8 fl oz	11.2 fl oz	Limit 2.8 fl oz per 7-day interval.
Blackhawk 36 WG	1.67 to 3.3 oz	20 oz	-
Bt products	See labels		-
Brigade 2 EC	2.1 to 6.4 fl oz	12.8 fl oz	Do not graze livestock for 1 day.
Coragen 1.67 SC	3.5 to 7.5 fl oz	15.4 fl oz	Limit 4 applications.
Fastac 0.83EC	2.2 to 3.8 fl oz	11.4 fl oz	Allow 3 to 5 days between applications.
Intrepid 2 F	4 to 8 fl oz	64 fl oz	-
Lannate 90 SP	0.25 to 0.5 lb	7 lb	-
Mustang Maxx	2.8 to 4 fl oz	24 fl oz	Allow 3 to 5 days between applications.
Permethrin 3.2 EC	4 to 8 fl oz	32 fl oz	Allow 3 days between applications.
Proaxis 0.5 EC	2.56 to 3.84 fl oz	15.36 fl oz	Allow 3 to 5 days between applications. For Southwestern corn borer.
Radiant SC	3 to 6 fl oz	36 fl oz	Allow 2 days between applications. For Southwestern corn borer.
Rimon 0.83 EC	6 to 12 fl oz	60 fl oz	Allow 7 days between applications. For European corn borer.
Warrior II	1.28 to 1.92 fl oz	30.7 fl oz	Allow 3 to 5 days between applications.
Fall Armyworms: can be a serious pest only of sweet corn planted after June 1. Treat if more than 10% of the whorls are infested with live larvae. Pheromone traps are available to monitor this pest.			
Avaunt eVo 30 DG	2.5 to 3.5 oz	14 oz	Allow 3 days between applications. Until tassel push only.
Blackhawk 36 WG	1.67 to 3.3 oz	20 oz	-
Bt products	See labels	-	-
Coragen 1.67 SC	3.5 to 7.5 fl oz	15.4 fl oz	Limit 4 applications.
Lannate 90 SP	0.25 to 0.5 lb	7 lb	-
Radiant SC	3 to 6 fl oz	36 fl oz	Allow 2 days between applications.
Flea Beetles			
Asana XL	5.8 to 9.6 fl oz	96 fl oz	-
Assail 30 SG	4 to 5.3 oz	11.2 oz	Limit 2 applications. Allow 7 days between applications.
Brigade 2 EC	2.1 to 6.4 fl oz	12.8 fl oz	Do not graze livestock for 1 day.
Fastac 0.83EC	2.2 to 3.8 fl oz	11.4 fl oz	Allow 3 to 5 days between applications.
Mustang Maxx	2.24 to 4 fl oz	24 fl oz	Allow 3 to 5 days between applications.
Permethrin 3.2 EC	4 to 8 fl oz	32 fl oz	Allow 3 days between applications.
Proaxis 0.5 EC	2.56 to 3.84 fl oz	15.36 fl oz	Allow 3 to 5 days between applications.
Sevin XLR Plus	1 to 2 qt	16 qt	Allow 3 days between applications.
Warrior II	1.28 to 1.92 fl oz	30.7 fl oz	Allow 3 to 5 days between applications.
Corn Rootworm Beetles, Grasshoppers, Japanese Beetle, Sap Beetle: Select sweet corn cultivars with good tip coverage. Treat when necessary.			
Asana XL	5.8 to 9.6 fl oz	96 fl oz	-
Assail 30 SG	4 to 5.3 oz	11.2 oz	Limit 2 applications. Allow 7 days between applications.
Baythroid XL	1.6 to 2.8 fl oz	11.2 fl oz	Limit 2.8 fl oz per 7-day interval.
Brigade 2 EC	2.1 to 6.4 fl oz	12.8 fl oz	Do not graze livestock for 1 day.
Fastac 0.83EC	2.2 to 3.8 fl oz	11.4 fl oz	Allow 3 to 5 days between applications.
Mustang Maxx	2.24 to 4 fl oz	24 fl oz	Allow 3 to 5 days between applications.
Permethrin 3.2 EC	4 to 8 fl oz	32 fl oz	Allow 3 days between applications.
Proaxis 0.5 EC	2.56 to 3.84 fl oz	15.36 fl oz	Allow 3 to 5 days between applications.
Sevin XLR Plus	1 to 2 qt	16 qt	Allow 3 days between applications.
Warrior II	1.28 to 1.92 fl oz	30.7 fl oz	Allow 3 to 5 days between applications.
Stink Bugs			
Baythroid XL	1.6 to 2.8 fl oz	11.2 fl oz	Limit 2.8 fl oz per 2-day interval.

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INSECT CONTROL: Sweet Corn[1,2,3] *(continued)*

Insecticide	Product Amt/A	Seasonal Limit/A	Comments and Other Restrictions
Besiege 0.835 CS	6 to 10 fl oz	31 fl oz	Allow at least 1 day between applications. Limit 4 applications.
Brigade 2 EC	2.1 to 6.4 fl oz	12.8 fl oz	Do not graze livestock for 1 day.
Lannate 90 SP	0.5 lb	7 lb	Limit 28 applications. Allow at least 1 day between applications.
Warrior II	1.28 to 1.92 fl oz	30.7 fl oz	Allow 3 to 5 days between applications.

1 See also Kentucky Insect Integrated Pest Management Scout Manual (IPM-10) for more information on sweet corn pests and their control.
2 See An IPM Scouting Guide for Common Problems of Sweet Corn in Kentucky (ID-184) for photos of pests.
3 Generic products available (Appendix G).

WEED CONTROL: Sweet Corn

Product Amt/A	lb A.I./A	Comments
2 to 4 pt Aatrex 4L	1 to 2 atrazine	For control of annual grasses and broadleaf weeds. Apply after planting but before weeds are 1 inch tall. Best in combination with alachlor or s-metolachlor. Do not plant any crop but corn for 18 months if using 1 lb or more atrazine because of residual injury. Do not use atrazine exclusively because resistance has occurred in certain weed species. Restricted use pesticide.
0.33 to 1.33 oz Accent 75 DF	0.015 to 0.06 nicosulfuron	For post-emergence control of grasses and broadleaves. Apply broadcast or with drop nozzles (post-direct) when corn up to 12 inches tall or V5 leaf stage. For corn 12 to 18 inches tall, apply only as post-direct. Max. 1 application/season.
0.5 to 1.6 fl oz Aim 1.9 EW	0.008 to 0.025 carfentrazone	For contact post-emergence control of annual broadleaf weeds and suppression of annual grasses. Can be applied as a preplant, pre-transplant burndown, or before crop emerges to actively growing weeds up to 4 inches tall. Can also be applied post-emergence as a directed hooded application between crop rows to corn with 8 to 14 leaf collars stage. Use min. 10 gal water/A and crop oil 1% v/v. Max. rate 2 fl oz/A.
1 to 2 pt Basagran	0.5 to 1 bentazon	Use post-emergence for control of annual broadleaves and suppression of yellow nutsedge. Use 2 applications for nutsedge control. Best if tank-mixed with other corn herbicides. Do not graze treated corn before 12 days after application.
2.1 to 2.58 qt Bicep II Magnum	1.6 to 2 atrazine + 1.2 to 1.56 s-metolachlor	Apply preplant or pre-emergence for control of most annual grasses and broadleaves. Do not use if small grains are to be planted the same year or if vegetable crops or tobacco are to be planted the following year. Conduct a soil test analysis for atrazine residue before the second year planting. May be applied at 1.3 to 2.58 qt/A in min. 15 gal water as a post-emergence directed treatment on weeds < 2 leaf stage.
3 to 3.75 qt Bullet 4 F or Lariat 4 F	3 to 3.75 alachlor + atrazine	For control of many annual grasses and broadleaves. Apply to soil surface immediately after planting. See label for further directions and restrictions. Max. rate is 6.4 qt/A per year or 2 applications/year.
3 to 7.7 fl oz Callisto 4L	0.09 to 0.24 mesotrione	For pre-emergence (6 to 7.7 fl oz/A) and post-emergence (3 fl oz/A) control of annual broadleaves. Rainfall within 7 to 10 days is needed for activation. If no rain, a rotary hoe is suggested. Do not cultivate 7 days before or after application. Do not tank-mix with organophosphate or carbamate insecticide or with a grass herbicide.
4 pt Camix 3.67 E	1.84 s-metolachlor + mesotrione	For pre-emergence control of annual grasses and broadleaves. Camix may be applied up to 14 days before planting or as a broadcast application before corn emerges.
12 to 20 oz Define DF	0.45 to 0.75 Flufenacet	For pre-emergent control of many annual grasses and some broadleaf weeds. May be applied preplant surface or incorporated or early post-emergence.
1.3 to 1.7 pt Dual II Magnum 7.6 E	1.3 to 1.6 s-metolachlor	For control of most annual grasses and certain broadleaf weeds and suppression of yellow nutsedge. Apply preplant surface or incorporated, pre-emergence, post-emergence, or lay-by. See label for specific rates. Better control of seedling Johnson grass with higher rates. Small grains may be planted 4½ months following treatment. See label for other rotational crop restrictions.
6 to 7.5 pt Expert 9.45 E	6 to 10 atrazine + s-metolachlor + glyphosate	For pre-emergence control of grasses and broadleaves. Good coverage is essential for best results. Sprinkler irrigate a minimum of 2 hours after, but within 2 days of application. Apply ½ to 1 inch of water. If irrigation is not possible and rain does not occur within 2 days after application, weed control may be decreased.
5.4 to 6.6 pt Fultime 4 E	2.7 to 3.3 acetochlor + atrazine	For pre-emergence control of grasses and broadleaves. Apply preplant, pre-emergence incorporated or non-incorporated. Max. 1 application/season. 0.5 inch water can be used to incorporate the herbicide.

(continued on next page)

WEED CONTROL: Sweet Corn *(continued)*

Product Amt/A	lb A.I./A	Comments
2.0 to 4.0 pt Gramoxone Inteon	0.69 to 1.38 paraquat salt	For non-selective contact kill of annual grasses and broadleaf weeds and top-kill of perennial weeds. Apply before, during, or after planting but before crop emergence banded or broadcast. Use higher rate for heavy weed infestations. Add non-ionic surfactant 0.25% v/v. Can be applied post-emergence as a directed spray at 1.0 to 2.0 pt/A on corn at least 10 inches tall with nozzles arranged to spray the bottom 3 inches of the stalk. Shorter corn plants may be injured. **Paraquat product labels require applicators to take an EPA-approved training every 3 years to mix, load, and apply paraquat.**
3 to 4 pt Guardsman Max 5 EC	1.24 to 1.65 atrazine + 0.64 to 0.84 dimethenamid-P	Apply preplant surface or incorporated, pre-emergence, or post-emergence for control of most annual grasses and many broadleaf weeds and suppression of nutsedge. Preplant applications for use in min. tillage or no-tillage (15 to 45 days). If incorporated, apply min. 2 weeks before planting. For pre-emergence, rainfall or irrigation is needed for activation. For early post-emergence, apply to corn up to 12 inches tall.
1.5 to 3 pt Harness	1.3 to 2.6 acetochlor	For pre-emergence control of some grasses and broadleaves. Tank-mix with other herbicides for adequate weed control.
0.75 fl oz Impact 2.8 E	0.016 topramezone	For post-emergence control of broadleaves and grasses. Use MSO at 1 to 1.5% v/v. Max. 1 application/season. PHI = 45 days.
6 pt Lexar 3.7 E	2.7 atrazine + s-metolachlor + mesotrione	For pre-emergence control of broadleaves and grasses. Apply preplant or pre-emergence without incorporation. May be applied up to 14 days before planting. Max. 3.5 qt/season. Irrigation or rainfall is needed within 7 days for best results. PHI = 60 days.
2.5 to 3 qt Micro-Tech 4ME or 3.8 to 4.5 lb Partner 65 WDG	2.3 to 4 alachlor	For control of many annual grasses and broadleaves. Apply as preplant or pre-emergence. Use higher rate for control of lambsquarters, black nightshade, nutsedge, and seedling Johnson grass. Restricted use pesticide. Max. 1 application/year and 4 qt/A per year.
14 to 18 fl oz Outlook 6 E	0.65 to 0.84 dimethenamid-P	For control of annual grasses and broadleaf weeds and suppression of seedling Johnson grass. Can be applied preplant surface or incorporated, pre-emergence or post-emergence to corn up to 12 inches tall. Outlook can be applied through chemigation or mixed with bulk dry fertilizer. Check label for exact rate for your soil type. PHI = 50 days. Max. rate is 21 fl oz/season.
0.67 oz Permit 75 WG or 0.66 to 1 oz Sandea 75 DF	0.031 to 0.046 halosulfuron	For annual broadleaves and yellow nutsedge control. Apply post-emergence broadcast from the spike to lay-by stage. Avoid cultivation within 7days of application. Apply again as directed spray if needed and avoid spraying the plant whorl. Include 0.5% v/v non-ionic surfactant. Not all corn varieties are tested, so use Permit with caution on newly released varieties. Do not apply to 'Jubilee' sweet corn or any corn under stress. Do not use with soil-applied organophosphate insecticides and do not apply any organophosphate insecticide within 7 days before or 3 days after Permit application.
1 oz Priority 62W	0.04 carfentrazone + halosulfuron	For pre-emergence and post-emergence control of broadleaves. Apply post-emergence to actively growing weeds. Multiple applications are allowed, with no time restrictions between applications.
4 pt Princep 4 L	2 simazine	For pre-emergence control of broadleaves and grasses. Apply preplant or pre-emergence with or without incorporation. Read label for rotation restrictions. Max. 1 application/season.
2.4 to 3.6 pt Prowl 3.3 E	1 to 1.49 pendimethalin	For control of annual grasses and broadleaf weeds. For use in conventional tillage only. Plant corn at least 1.5 inches deep. Apply pre-emergence after planting but before crop or weeds emerge. Apply post-emergence to corn 20 to 24 inches tall or when it has 8 visible collars (V8). Max. 1 application/season.
16 to 22 fl oz Roundup WeatherMax 5.5L	0.69 to 0.94 glyphosate-salt	For non-selective post-emergence control of annual and perennial grasses and broadleaf weeds. Use only AMS 1 to 2% v/v. Adding a non-ionic surfactant can reduce weed control effectiveness. Corn must be at least 12 inches tall. Application with hooded sprayers is allowed. Min. 30 days before planting any non-labeled crop. With Roundup Ready varieties only, post emergence applications may be made over the top of corn through the 8 leaf-collar stage (V8) or until corn is 30 inches tall. Drop nozzles are recommended if corn is more than 24 inches tall and must be used if corn is more than 30 inches tall to prevent spraying into whorls. Do not apply to corn more than 30 inches tall if it has reached the reproductive stage. Do not exceed 3.3 qt. per acre prior to crop emergence. Do not exceed 44 fl. oz. per acre in a single application in the crop. Do not exceed 4.1 qt. per acre per growing season from emergence through crop height of 48 inches. Do not exceed 5.3 qt. per acre for all applications.
0.6 to 1.3 pt Starane 1.5L	0.11 to 0.22 fluroxypyr	For post-emergence control of broadleaf weeds. Apply broadcast or band to corn up to 4 leaf collars (V4). After V4 stage, apply only as a directed treatment with drop nozzles. Max. 2 applications or 1.3 pt/A per season. PHI = 31 days. See label for control of volunteer potato vine.

(continued on next page)

WEED CONTROL: Sweet Corn *(continued)*

Product Amt/A	lb A.I./A	Comments
1.5 to 2.5 pt Surpass 6.4 E	1.2 to 2 acetochlor	For pre-emergence control of broadleaves and grasses and yellow nutsedge. Apply and incorporate up to 2 weeks preplant or anytime from 14 to 30 days prior to planting or after planting but prior to corn emergence.
1.6 to 4.0 oz TriCor DF	0.075 to 0.19 metribuzin	Pre-emergent control of grasses and broadleaves, tank-mix with other herbicides for adequate weed control. See label for mix options.
1 to 2 pt Weedar 64 4L	0.5 to 1.0 2,4-D amine salt	For selective post-emergence control of broadleaf weeds. Apply 7 to 14 days preplant at 1 to 2 pt/A. Apply 3 to 5 days after planting but before corn emerges at 2 pt/A. When corn is 8 inches tall, apply over top of corn at 0.5 to 1.0 pt/A to control small weeds. When corn is over 8 inches tall, use a drop nozzle at 0.5 to 1.0 pt/A. Avoid drift to other crops. 2,4-D may injure some supersweet (sh2, SE) cultivars. PHI 45 days on sweet corn.
1.5 to 4.0 oz Zidua	0.0796 to 0.213 pyroxasulfone	Rate ranges based on soil texture. Seed must be planted a minimum of 1 in. deep. PHI=37 days. See label regarding tank mixtures.

DISEASE CONTROL: Sweet Corn

Product	FRAC Code[1]	PHI[2] (days)	Amt/A	Seasonal Limits/A	Comments
Leaf Blights, Gray Leaf Spot, Rust					
Aftershock and fluoxastrobin[4] generics	11	7	2 to 3.8 fl oz	4 apps	
Aproach	11	7	3 to 12 fl oz[4]	36 fl oz	Apply before disease onset.
Chlorothalonil[3]					Not for processing sweet corn.
Bravo Ultrex	M	14	0.7 to 1.8 lb	10.9 lb	There are multiple Bravo formulations and chlorothalonil generics on the market. See label for rates.
Bravo WeatherStik	M	14	0.75 to 2 pt	12 pt	
Dexter Max	M/11	7	1.6 lb	24 lb	
Dexter XCEL	M/3/11	7/49	48 oz	240 oz	Re-entry interval 19 days for sweet corn.
Elatus	11/7	7	5 to 7.3 oz	2 apps	Apply before disease onset. Minimum 14 days between applications. No aerial application.
Copper, fixed coppers[5]	M				Leaf blights only. See label for rates.
Dithane M45 and mancozeb[3] generics	M	7	1.5 lb	12 lb	There are multiple Dithane formulations and mancozeb generics on the market. See label for rates.
Headline	11	7	6 to 12 fl oz	72 fl oz	Use lower rates for rust and gray leaf spot.
Headline SC	11	7	6 to 12 fl oz	72 fl oz	Apply before disease onset. Use lower rates for rust and gray leaf spot.
Headline AMP	11/3	7	10 to 14.4 fl oz	57.6 fl oz	
Miravis Neo	7/3/11	14	13.7 oz	3 apps	
Muscle ADV	M/3	14	1.1 to 1.6 pt	4 apps	Begin applications prior to disease development.
Priaxor	7/11	7	4 to 8 fl oz	16 fl oz	Apply prior to development of disease.
Quadris and azoxystrobin[4] generics	11	7	6 to 15.5 fl oz[4]	6 apps	Use lower rates for rust.
Quilt Xcel and propiconazole + azoxystrobin[3] generics	11/3	14	10.5 to 14 fl oz	56 fl oz	
Prosaro 421SC	3	7	6.5 fl oz	26 fl oz	
Stratego	11/3	14	10 fl oz	30 fl oz	
Stratego YLD	11/3	14	4 to 5 fl oz	20 fl oz	
Tilt and propiconazole[3] generics	3	14	2 to 4 fl oz	16 fl oz	Use higher rates for rust.
Toledo and tebuconazole[3] generics	3	7	4 to 6 fl oz	24 fl oz	
Vertisan	7	7	10 to 24 fl oz	48 fl oz	

1 Products with numerical FRAC codes must be alternated or tank-mixed with products that have a different FRAC code to discourage resistance development. See product label for maximum number of consecutive applications allowed. Refer to the table on pages 22-24 for more information on FRAC codes.
2 Pre-harvest interval.
3 Generic products available (Appendix F). Amounts and seasonal limits per acre are product dependent.
4 Use higher rate when pressure is severe.
5 Fixed coppers labeled in KY include: Badge SC, Badge X2, Basic Copper 53, Champ, Champ WG, ChampION++, C-O-C-S WDG, Cueva, Cuprofix, Cuproxat, Kentan, Kocide 2000, Kocide 3000, Kocide DF, KOP-5, MasterCop, Nordox 75 WG, Nu-Cop 30 HB, Nu-Cop 50DF, Phyton 35, and Previsto. Rates may vary by product and by crop. Refer to specific product label for this information.

Cucurbits (Vining Crops)

Cucumbers, Muskmelons, Squash, Pumpkins, and Watermelons Gourd family (Cucurbitaceae):
Cucumis sativus [cucumber]; Cucumis melo, Reticulatus Group [Muskmelon]; *Citrullus lanatus [Watermelon]*

Planting and Culture

Cucumber

Cucumbers are grown in Kentucky primarily for fresh market (slicing types) rather than for processing (pickling types). Planting and cultural requirements are similar for both. Cucumbers do best in firm, deep, well-prepared seedbeds. Fall plowing is recommended. The soil should be well drained and high in organic matter for best results. Apply 10 tons of manure per acre the previous fall if available. Land that has been in sod is very desirable. The soil should be disked two or three times in early spring to prepare for seeding. Disking helps to eliminate early germinating weed seeds and prepare a fine seedbed. A cultipacker will help prepare a good seedbed. Do not plant cucumbers on land that was treated the previous year with a triazine herbicide such as atrazine, metribuzin, or Karmex.

For hand-harvested pickling or slicing cucumbers, plants can be left to grow on the ground or be trellised. If not trellising, train vines to run lengthwise in the row soon after vining starts. Cultivating in one direction will also help to train plants to run in the row. This training will enable harvesters to pick more easily and quickly, and the plants will not be damaged as seriously. Cultivation should be shallow to prevent root damage. Trellising cucumbers can lead to improved fruit quality because the fruit is not touching the soil. It also helps prevent damage to the vines and more effective control of many diseases and pests (can have better coverage of pesticides, for example). Harvesting can be extended and be more thorough when cucumber vines are trellised because there can be fewer overly large cucumbers (jumbos) and fewer culls. It is easier to see ripe cucumbers on the trellis system compared to on the ground. However, trellising requires a greater investment than growing on the ground. There can be significant cost from erecting the trellis, the labor involved in maintaining plants on the trellis and pruning, and the clean-up at the end of the season. If trellising, place a post every 15 feet and train and prune plants frequently.

Start seed about the first of May in most areas of the state or when designated by the company with which you may be contracting. Continued plantings at one- or two-week intervals can be made to extend the harvest season (see Appendix K).

Slicing cucumbers are usually grown on black plastic with trickle irrigation to increase yields and earliness. Cucumbers can be direct-seeded through plastic mulch using seeders designed for that purpose, or they can be transplanted at about two to three weeks after seeding.

Muskmelon

Muskmelons (cantaloupes) and specialty melons are warm-season crops. They require a relatively long growing season of 80 to 100 days from seeding to marketable fruit. Well-drained, lighter-textured (sandy or sandy loam) soils are considered best for cantaloupes, although medium-textured soils can be just as productive with good management practices. Lighter-textured soils warm up faster than heavier soils. Because of potentially serious disease problems, melons are best grown on land that has not been in vine crops (cantaloupes, watermelons, squash, pumpkins, etc.) for at least three years.

The vining habit of the plant and its large leaves make it especially susceptible to wind damage. Planting cantaloupes between strips of annual rye or some similar, taller-growing plant will provide windbreak protection. In addition, growers can orient rows in the direction of prevailing winds (usually winds blow from the southwest in most parts of Kentucky) so that wind blows down rows rather than across them.

Cantaloupes can be direct-seeded to the field or grown as transplants in the greenhouse or hotbed and transplanted to the field. Generally, 2 pounds of seed is sufficient to direct-seed an acre; one quarter to one half of a pound per acre is sufficient for transplants. Plant the seed one-half to three-quarters of an inch deep after danger of frost is past (see Appendix K).

Transplants produce earlier ripening fruits that will often bring much higher early prices. With transplants, plant the seed three weeks before the plants are to be transplanted to the field. The plants should have two or three true leaves. Plant one or two 72-128 cell plug trays.

It is crucial that plants be protected from cucumber beetle feeding from the day of seedling emergence or from the day of transplanting to reduce the risk of bacterial wilt disease (vectored by the beetles). The insecticide imidacloprid has provided good early season systemic control of cucumber beetles on melons in Kentucky, reducing the potential for bacterial wilt while the plants are small. Although several soil application methods may be used with this product, the post-transplant drench is recommended for best control: a small amount of the imidacloprid solution is applied at the base of each plant immediately after transplanting. With proper calibration, this can be done quickly and accurately using a backpack sprayer with the nozzle removed (see the "Insect Control" table and current label for recommended rates). Imidacloprid should not be used in the setter tank water because of the potential for worker exposure during transplanting.

Specialty Melons

Specialty melons (honeydews, canary, galia, and others) are

excellent items for direct market sales; they are full flavored and far superior to what can be obtained through local supermarkets. These melons are more difficult to grow than cantaloupes and require an extended spray program in Kentucky. Specialty melons are highly susceptible to bacterial wilt, and post-transplant drench application of an imidacloprid insecticide (Admire, etc.—see the "Disease Control" and "Insect Control" tables) is an absolute necessity to achieve success. A season-long weekly preventative fungicide spray schedule for Anthracnose is also critical.

These melons do best when planted around May 1 and transplanted to the field around June 1. This allows harvest to coincide with dry weather late in the season, which increases flavor and sugar content. Specialty melons need slightly wider plant spacing; see "Plant Spacing" (page 64). Some specialty melons, especially galia melons, are prone to magnesium deficiencies, and preventive measures may be required (see page 65). In addition, growers will need to gain some experience with each type to determine exactly when to harvest, as many specialty melons do not "slip" or may not change color at maturity in the same way that muskmelons do. See descriptions in the "Varieties" table for specific harvesting guidelines.

Squash and Pumpkin

Squash and pumpkins produce best on well-drained, fertile soil. The plants produce large, shallow root systems very rapidly in the top 8 to 10 inches of soil, which should be prepared into a firm, well-fertilized seedbed. Squash and pumpkins do well in soils where 10 to 12 tons of well-rotted manure has been applied per acre. To help avoid soilborne disease problems, select fields that have not had other vine crops, tobacco, tomatoes, or peppers for at least three years. Calculate the number of days to harvest to determine when to plant pumpkins for Halloween (see Appendix K). Growers usually harvest pumpkins in mid-September to allow time for marketing.

Some Kentucky growers have successfully grown pumpkins using a no-till system by seeding into stubble of a rye or rye-vetch cover crop that has been killed with herbicide. Pumpkins can be direct-seeded into the mulch with a modified no-till corn planter. This practice can eliminate the need for washing pumpkins prior to marketing, may reduce fruit rots, and makes for an easier/cleaner field for schoolchildren or "pumpkin festival" customers to walk in. No-till has been successful on well-drained soils but may be problematic on heavier soils; problems with rodent feeding have been encountered by some growers using this system.

Having irrigation available for pumpkins will pay big yield and quality dividends in some years. A good irrigation system that can apply 1 to 2 inches of water a week and keep ground temperatures a little cooler will increase yields dramatically and pay for itself in a drought year. Using drip irrigation on pumpkins has made the difference between high profits and total crop failure for some Kentucky pumpkin growers in dry years; the easiest and most effective system employs 8- to 10-mil drip lines without the use of plastic mulch. Supplemental irrigation is critical in dry summers during flowering and fruit setting.

Summer squash (yellow straightnecks, yellow crooknecks, or zucchini types) are usually grown for an early summer market in mid- to late June or for an early fall market when prices begin to rise in September (see Appendix K). Growers producing squash for the late summer/early fall market usually encounter serious virus or fungal disease problems and should plant either a variety with the precocious yellow trait that masks virus symptoms or one of the varieties with conventional or genetically engineered virus resistance. Varieties are also available with resistance to powdery mildew (see "Varieties" table).

Squash and pumpkins are warm-season crops and do not do well until soil and air temperatures are above 60°F. Seed may decay before germinating if planted in cold, wet soil. Black plastic on raised beds with trickle irrigation will speed soil warming in spring squash plantings and can dramatically increase early and total yields. Use white plastic mulch for late squash plantings in July or August. Seed or transplants can be planted through the plastic by hand, with a waterwheel setter or with machinery designed for direct-seeding through plastic.

Squash or pumpkin transplants should be started in the greenhouse in 72-128 cell trays two to three weeks before the anticipated transplanting date. The plants are ready when the first true leaves are fully developed; delays in transplanting can result in stunting of plants in the field.

Watermelon

Lighter-textured soils are considered best for watermelons, although medium-textured soils can be just as productive with good management practices. Watermelons should not be grown on the same ground year after year because of disease problems; they are best grown on land that has not been in tomatoes, peppers, or another vine crop (cantaloupes, squash, pumpkins, etc.) for at least three years.

Watermelon seedlings are often transplanted to the field. This method must be used for seedless watermelons due to their high seed costs and poor germination percentages. If this procedure is followed, the seed should be planted 14 to 21 days before planting to the field (see Appendix K). Transplants should be planted to the field around the time the first true leaf forms. Transplanted melons will mature 10 to 14 days earlier than direct-seeded melons.

Black plastic on raised beds with drip irrigation is commonly used in commercial watermelon production for earlier maturity and higher yields; soils warm up faster in the spring, and weeds will not grow under the mulch. Soil moisture is also retained and nutrient leaching minimized.

Direct-seeding in hills was once the most common method of planting watermelons. The seedbed for planting should be thoroughly prepared to ensure good plant stands. Soil moisture should be adequate throughout the early growing season to produce good plant growth and vigorous blossoms. After fruits reach full size, it is usually best to withhold or reduce irrigation during the ripening season. Sugar content will usually be higher and the melons will have better flavor if moisture levels are not high during ripening. Keep in mind that watermelon plants have deep root systems.

Good weed control is essential for high-quality melons. Melon yields and sugar content can be reduced if weeds are allowed to shade and otherwise compete with the plants. Black plastic helps to control weeds during early growth; however, it is critical to control weeds in the bare ground middles between rows of plastic. Herbicides and/or mechanical cultivation can be effectively used for early-season weed control in these middles.

Special Considerations for Seedless (Triploid) Watermelon Production:

Germination

- The most common reasons for poor germination are overwatering, incorrect watering, poor temperature control, and shallow seed placement.
- For growing transplants, the growing media should be moist but not wet. Check moisture level by squeezing a handful of media. Generally, if water drips from the media, it is too wet.
- Water the media and allow it to dry for 12 to 24 hours. During this time, bring the temperature of the media to 85° to 90°F. Before filling trays and seeding, stir the media to ensure that it is evenly moistened.
- Seeds should be planted between ½ to ¾ inches deep in trays. This planting depth helps prevent germinating seeds from pushing out of the media and maintains better uniformity of moisture around seed.
- Plant seeds with the pointed end (root end) up; this helps prevent the seed coats from sticking to the germinating seedling.
- Place the seeded trays in a germination room or chamber for 48 to 72 hours or until germination begins. The temperature of the room should be held at 85° to 90°F and the relative humidity maintained between 90 and 100 percent.
- Once seedlings have begun to emerge, move trays to the greenhouse. Maintain a temperature of approximately 80° to 85°F until germination is complete.
- During the first week in the greenhouse, water only as needed to keep the planting media moist. Do not overwater, as this may destroy ungerminated seeds.
- Once the seedlings are established, temperature and watering can be adjusted to achieve sturdy plants.

Transplanting and Pollination of Seedless Watermelons

- A pollenizer, which can be a traditional seeded variety or a special pollenizer melon must be present for pollination and fruit set. Good pollination is extremely important for seedless watermelon production. Inadequate pollination results in triangular-shaped fruit, lower quality, and increased incidence of hollow heart.
- A ratio of 2 to 3 seedless plants to one seeded (used as pollenizer) is recommended. Pollenizer varieties can be planted on the edge of beds between the third and fourth seedless plant. When using a seeded melon as a pollenizer which will be harvested, outside rows and every third row in the field should be planted with the seeded variety. Never plant seedless and seeded (pollenizer) varieties in separate adjacent blocks in the field.
- Specific pollenizer varieties generally flower earlier and longer than typical seeded melons. When using a seeded melon as the pollenizer use a main-season variety. Early or late varieties may not provide pollen during the entire season, thus reducing fruit set.
- Specific pollenizer melons will be easily distinguished from your crop. Pollenizer varieties will produce small softball-size melons that are not harvested and easily crushed in the field. When using a diploid (seeded) variety as a pollenizer be sure that it distinguished by shape or color from the seedless melons at harvest and one that is marketable, as it will make up about one third of your total production.
- Specific pollenizer varieties generally flower earlier than the seedless melons they are planted with. However, when using a traditional seeded melon as a pollenizer it should be seeded in the greenhouse one to two weeks earlier than the seedless variety. This schedule ensures good pollination when the seedless variety begins to produce female flowers.

Black Plastic and Irrigation

Black plastic mulch on raised beds with drip irrigation is often used to obtain higher yields and to encourage faster growth and earlier maturity. Drip irrigation increases fruit quality and quantity and allows fertilizer to be injected through the system (fertigation). Plastic mulch can be purchased in roll widths of 3 and 4 feet; the 4-foot-wide film is most suitable for melons.

Bed shapers/plastic mulch layers and waterwheel setters are commercially available to make raised beds, lay plastic and drip lines, and aid in transplanting. A fine seedbed is required for plastic laying by machine; this operation is nearly impossible on cloddy ground. Clods will puncture plastic mulch, making it more vulnerable to wind damage. Machines are also available that enable direct-seeding through plastic mulch.

Plant Spacing

Growers should also plan for spraying, harvesting, and other field operations by leaving an 8- to 9-foot-wide middle, or "skip row,"

after every fourth to sixth bed. The number and placement of these skip rows will depend on the type of sprayer being used.

Cucumbers

Pickling cucumbers are usually machine harvested. If a crop is to be grown for mechanical harvest (once-over harvest), seeding with precision seeders in rows 15 inches apart with seed 2 to 3 inches apart in the row is recommended. Four pounds of seed per acre is required at this close spacing. For hand-harvested pickling or slicing cucumbers grown on bare ground, space rows 4 to 4 ½ feet apart and plant three to four seeds per foot of row. Thin plants to 8 inches between plants in the row. The seed should be planted ¾ to 1 inch deep. Uniform depth of planting is important to get uniform plant growth and maturity. Two pounds of seed will be required per acre. Plasticulture cucumbers are usually grown in double rows with 12 to 18 inches between the two rows and 9 to 12 inches between plants within each row. Beds are usually spaced 5 feet between centers. Only a single plant should be grown in each planting hole.

Muskmelons or Specialty Melons

On plastic, single plants are usually spaced 18 inches apart in the rows on plastic; some growers use two plants per hill spaced 3 feet apart in the row. For direct-seeding in bare ground or into plastic mulch, rows should be 5 to 6 feet apart, with plants thinned to hills 2 to 3 feet apart in the row and two or three plants per hill. Plant specialty melons 3 feet apart in the row with rows 5 to 6 feet apart on black plastic with drip irrigation and fertigation.

Summer Squash

On plastic, single plants are usually transplanted 18 inches apart on beds 5 to 6 feet apart. For direct-seeding in bare ground or into plastic mulch, plant two to three seeds every 18 to 24 inches apart in rows 4 to 6 feet apart. Seed should be planted 1 inch deep.

Pumpkins and Winter Squash

Final plant stands for extra large varieties should be 3 to 4 feet apart in the row with rows 8 to 12 feet apart (24 to 48 square feet per plant). Smaller bush types are spaced 2 to 3 feet apart in the row, with rows 5 to 6 feet apart. Miniature pumpkins can be planted as densely as 1 to 2 feet apart in the row with rows 4 to 6 feet apart. Pumpkins can be transplanted or direct-seeded at the above spacings. Seeds are planted at a depth of 1 to 2 inches. Many seed companies publish charts for appropriate plant spacing for the varieties that they sell.

Watermelon

Spacing on plastic with drip irrigation depends on the variety and the desired melon size. In general, 6 to 8 feet between-row spacings and 3 to 4 feet in-row spacings are used. Use wider spacings to produce larger, heavier melons. Smaller "icebox" watermelons can be spaced more closely with in-row spacings of 2 feet and between-row spacings of 5 to 6 feet. Mini-seedless (also called "palm" or "personal") watermelons are spaced 1 ½ feet apart within rows and 5 to 6 feet between rows to produce the greatest number of melons weighing less than 8 pounds. On bare ground without irrigation, each plant requires about 48 square feet of space for maximum yield of larger-sized melons. In this case, thin plants to about 4 feet apart in the rows with rows spaced 12 feet apart.

Fertilizing

Cucumber

Make fertilizer and lime applications based on soil test results. A soil pH of 6.5 to 6.7 is most desirable for cucumbers. All fertilizer should be broadcast and disked in well before planting. All phosphorus and potassium and a portion of the total nitrogen requirement should be applied before laying plastic when plastic mulch and drip irrigation are used. The remaining N requirement can be fertigated (see "Fertigation" table). When lime is needed before growing cucumbers, apply a dolomitic liming material if available in your area.

Muskmelons

Phosphorus, potassium, and lime applications should be based on soil test results. Maintain the soil pH between 6.5 and 7.0; liming will be necessary if pH falls below 6.5. Because of shallower rooting depth and preplant N applications, muskmelons grown with drip irrigation on plastic mulch may be more susceptible to magnesium deficiency if soil pH is less than 6.5. Preplant and fertigated magnesium applications may be required on low CEC soils; added magnesium may also increase melon sugar contents. See below and Appendix B for further discussion of magnesium and molybdenum deficiencies and recommended application rates.

With plastic mulch and drip irrigation, apply all the lime, P and K and ½ of the total N recommendation before laying plastic. The remaining nitrogen can be divided into equal weekly doses and fertigated as indicated in the "Fertigation" table.

Magnesium deficiencies. Muskmelons have high magnesium requirements. Deficiencies sometimes appear a few weeks before harvest when fruits are rapidly growing in size and weight and when fruit loads are heavy. Typical symptoms are yellowing between the veins (veins remain green) on the oldest leaves (those nearest the crown of the plant). This interveinal discoloration turns brown or tan over time and eventually results in much of the leaf tissue dropping out, leaving a green and white leaf "skeleton." Entire fields are defoliated in severe cases. Magnesium deficiency problems are more likely to occur on light, sandstone-derived soils and in very dry years. Frequent fertigations with calcium or potassium nitrate can make the problem worse by competing with and displacing magnesium in soils. Preventive and/or corrective measures are required, especially on low CEC soils.

In general, we would like to have about 200 pounds per acre of magnesium on soil tests prior to

planting. Magnesium sources include dolomitic lime (12% Mg), epsom salts (= magnesium sulfate, 10 to 16% Mg), magnesium nitrate (6.3% Mg), and magnesium oxide (45 to 55% Mg). Epsom salts and magnesium oxide can be fertigated through the drip system; make weekly applications of 1 to 2 pounds actual magnesium per acre (10 to 20 pounds per acre epsom salts or 2 to 4 pounds per acre magnesium oxide). Application rates may vary with solubility of the materials (check with the manufacturer). Foliar applications of epsom salts are usually not as effective. A better long-term solution is to raise soil test magnesium levels with dolomitic lime prior to planting, although some soils may also require magnesium fertigations throughout the season.

Molybdenum deficiency is usually associated with acid soils. Molybdenum becomes less available to the plant as the pH is lowered. Under lowered pH, manganese and aluminum toxicities may also occur and reduce yields. First symptoms are light yellow spots on the leaves followed by death of the tissue at the margins. Symptoms have also been observed in cantaloupe where black plastic has been used and the preplant nitrogen has not been disked in deep enough. This can result in lowered pH in the top 2 to 3 inches of soil where most of the plant roots are concentrated. Soils should be tested and limed to maintain pH around 6.5 to 7.0. A foliar spray of sodium molybdate usually corrects molybdenum deficiency within two weeks. Apply 1 quart of setter water molybdenum per acre as a foliar spray. This product contains 3.5 ounces actual molybdenum per gallon. Apply no more than 12 ounces actual molybdenum during a five-year period on the same field.

Pumpkins and Squash

Pumpkins and squash can tolerate a fairly broad range in soil pH from 5.5 to 6.8. Apply lime if needed to raise the pH to 6.5. Apply phosphate and potash as required based on soil test results. Potassium and especially phosphorus are likely to accumulate in most Kentucky soils following several years of heavy applications for vegetable crops or tobacco.

Consider the previous crop when deciding how much nitrogen to apply; there will probably be some residual nitrogen following a crop that received heavy doses of nitrogen fertilizer during the previous season. Apply 30 to 50 pounds of nitrogen per acre prior to planting crops to be grown on plastic with drip irrigation. See the "Fertilizer" table for rates for bare ground plantings.

The recommendations in the "Fertigation" table have worked well for growers in Kentucky for summer squash grown on black plastic mulch with drip irrigation. Fertigation should begin about two weeks after transplanting and continue throughout the season. A grower may need to modify the recommendations slightly, depending on duration of harvest, soil type, previous crop, etc.

Calcium nitrate and potassium nitrate are commonly used water-soluble sources of nitrogen for fertigation. The simplest system that has worked well on medium-textured soils in Kentucky uses calcium nitrate or potassium nitrate injected into the drip irrigation water. We recommend that all potassium and phosphorus be applied prior to laying plastic. In areas with very sandy soils, there may be some yield advantage in fertigating some of the potassium. In these cases potassium can be fertigated with a water-soluble muriate of potash (0-0-60) or potassium nitrate (14-0-45).

Watermelons

The soil pH should be maintained between 6.0 and 6.5. Liming will be necessary when the pH is below 6.0. Fertilizer and lime applications should be based on soil test results. With plastic mulch and drip irrigation, apply all the P and K and ½ of the total N recommendation before laying plastic. The remaining nitrogen can be applied in equal weekly doses according to the "Fertigation" table.

Pollination

Cucumber

Provide one hive of bees for each acre of cucumbers to ensure good pollination. This is especially important for high plant populations of gynoecious hybrid varieties grown for once-over mechanical harvesting. Low bee populations result in low fruit set and poor fruit shape.

Muskmelons

Muskmelon have both male and perfect flowers on the same plant. However, the perfect flowers are not capable of self-pollination and must receive pollen from male flowers. Growers with large acreages should provide one to two strong hives of bees for each acre of plants to ensure good pollination. Spraying for insect control should be done late in the day to avoid unnecessary bee kill.

Pumpkins and Squash

The plants have separate male and female flowers on the same plant. Pollen must be transferred from the male flowers to the female flowers by bees in order to get high yields of good quality fruit. If bees are not abundant in the field at flowering time, hives should be placed near the field (but protected from potential spray drift), with at least one strong hive per acre. Special precautions should be taken with insecticide treatments during flower blooming; applications should be delayed until late in the afternoon to prevent killing pollinators.

Some varieties of pumpkins grown under high temperatures (90°F days and 70°F nights) produce female flowers that wither and die before they open. The same thing may happen if pumpkin plants are heavily shaded. In both situations, male flowers develop normally and open on schedule, but few if any female flowers are seen in the field. In some cases female flowers appear but fail to bear fruit because of pollen sterility at high temperatures. The variety 'Howden's Field' is particularly susceptible to these problems.

Watermelons

The plants have male and female flowers that grow separately on

the same plant. Bees must carry pollen from male flower to female flower to ensure good fruit set and development. Wild bees will help provide pollination; however, commercial growers should consider putting bee hives near their fields, but in areas protected from spray drift. One strong hive of bees is generally considered adequate for two acres of watermelons.

Harvesting and Handling

Cucumbers

Picking the first cucumbers that develop when they reach the proper size is very important. If the early crown set is not harvested, production will be greatly reduced. Cucumbers picked by hand should be harvested every other day for best yields and quality. Cucumbers should be handled carefully to prevent bruising and spoilage, especially slicing types sold for fresh market. Cucumbers should never be put in plastic bags or containers where air will be excluded for any period of time. Cucumbers for the fresh, wholesale market are waxed and marketed in 1 ⅑ bushel waxed cartons. Fancy cucumbers should be 2 ⅜ inches in diameter and 6 inches in length. Cucumbers can be held in storage for about two weeks at 45° to 50°F and a relative humidity of 95 percent. Do not store at temperatures below 45°F or chilling injury will result.

Muskmelons

Cantaloupes to be sold locally should be harvested at the full slip stage. The term "full slip" indicates that the vine easily detaches, or slips, from the fruit with a gentle pull. The ground color under the netting starts to turn yellowish at this time. For melons to be shipped and held for some time before marketing, it may be necessary to harvest at "¼ slip" to "half slip" (only ¼ to ½ of the end of the vine detaches from the fruit when gently pulled). In some cases it may be desirable to harvest melons based on subtle color changes in the fruit; check with buyers or co-op managers to determine exactly when to harvest. It may also be necessary to harvest every day or every other day during periods of high temperatures. Honeydew melons do not slip from the stem when ripe, but they do change colors. They usually take on a yellowish-white color and give off a slight aroma when ripe.

Harvest melons in the early morning while the fruit is cool. Care should be taken when walking through the plants to avoid injury to the plants. The plants can be trained during the early stages of development to grow in rows, enabling easier harvest. Temperature of the melon fruit at harvest may be 85° to 95°F or even higher. Cantaloupes benefit greatly from pre-cooling as soon after harvest as possible. Some chain store buyers may purchase only pre-cooled melons. Hydrocooling cantaloupes to a temperature of 55°F is possible. They should be kept at a relative humidity of 95 percent. Grower-shippers have been using forced air cooling at 40° to 42°F in recent years in order to participate in the larger chain store markets.

Summer Squash

Harvest at the proper size for your market and before the skin becomes tough and hard. The skin should still have a glossy appearance and will be ready for harvest from two to five days after flowers have fully opened. It is a good idea for squash pickers to use plastic buckets and wear soft gloves to avoid bruises, scratches, and fingernail punctures. Squash should be cut from the plant, leaving ½ to 1 inch of the stem attached to the fruit. Harvests may be required every other day or even daily during the peak. Always remove over-mature or oversized fruit from the plants to maintain plant vigor and production.

Summer squash is normally sold on the fresh, wholesale market in half-bushel (21 pounds) waxed cardboard cartons or 11/9 (42 to 44 pounds) bushel cartons or wire-bound crates. Produce buyers expect a uniform count of clean fruit in each carton or crate. Squash should be uniform in size to meet the buyer's count and weight requirements; talk to your buyers to become familiar with their requirements before packing the product. The USDA's Agricultural Marketing Service has established grading standards for squash and other vegetables. They are available on the Internet at ams.usda.gov/AMSv1.0/freshmarketvegetablestandards. Squash should be marketed quickly and not stored if possible; if storage is necessary, however, they can be kept for a week at 45° to 50°F and 90 to 95 percent relative humidity. Chilling injury can occur after several days of storage below 50°F.

Pumpkins

They are normally harvested when they reach a deep solid color and the rind is hard. Wholesale buyers may require a large percentage of 15-pound pumpkins and may also specify the number of pumpkins, or "count," per bin. Pumpkins that are picked when they are green and immature will not color up. In emergencies—late maturity, fruit rots occurring, or large insect populations present—it is possible to harvest pumpkins at the mature-green stage, and most of them will color up within a few weeks. At the mature-green stage, the skin has toughened up and cannot be punctured with your fingernail. It is recommended, however, that pumpkins undergo at least some change in color before harvesting.

Cut pumpkins from vines carefully, leaving a 3- to 4-inch stem attached. Pumpkins do not all mature at the same time on the plant but will continue to color up over a period of three to four weeks if diseases and insects are held in check. Sunny weather is especially important in the development of mature fruit with good color.

When harvesting, use a pair of loppers, pruning shears, or a sharp knife to snip the large stem from the plant; this makes for a more attractive stem and also prevents the stem from separating from the fruit. Pumpkins are best harvested when the rind is hard and has good color characteristics typical of the variety. Do not carry a pumpkin by its stem or "handle" since these often break off, reducing the pumpkin's

marketability and its storage life by encouraging decay.

It may be necessary to harvest and hold pumpkins in storage for two to four weeks before they are sold. Do not store on bare ground after harvest. Tobacco barns are usually a good place for storage. Spread out a layer of dry straw or hay and set the pumpkins on it. Keep them dry. Good air circulation will help reduce rotting. Pumpkins should be harvested and stored before temperatures drop to the 30s and 40s.

Although harvests for Halloween usually begin in late September to early October, high temperatures may cause pumpkins to mature in late August and early September. These pumpkins often rot or decay long before they can be marketed. Some rot, caused by injury or seasonal stresses such as drought and/or heat, is unavoidable. Diseases such as powdery or downy mildew, viruses, or gummy stem blight may also cause premature ripening. There are a few precautions that should be taken to minimize the decay of prematurely ripened fruit. Harvest should begin earlier. Get the pumpkins out of the field when they mature early. Pumpkins should be handled carefully to avoid cuts and bruises, which are the major entry points for rotting fungi and bacteria.

A curing period of seven to 10 days at temperatures of 80° to 85°F with relative humidity of 80 to 85 percent has been recommended in the past to heal over surface injuries and allow for further ripening; however, this practice is seldom used, and research has shown that it may not be necessary. It has not been beneficial for several types of squash, including Butternut, and may be detrimental to Acorn squash.

Store pumpkins cool and dry; storage temperatures should be 50° to 55°F with a relative humidity of 50 to 70 percent. The surface of the fruit should be dry. Keep the area as well ventilated as possible and away from any ethylene sources (tomatoes, apples). Ventilation can be provided by placing fruits on pallets or slatted benches, which allow air movement around the fruits. Avoid stacking pumpkins on top of one another. Stacking is a sure way to create bruises, and the pile will only create unwanted heat. It is possible to hold pumpkins for six to eight weeks when held at 50° to 55°F but only for a few weeks at 70°F.

Ornamental pumpkins have virtually no value after Halloween. Plant early enough for the variety you have selected and be careful not to over-fertilize with nitrogen, which can delay maturity. A dry period without irrigation can also result in pumpkins at the wrong stage of maturity at harvest. Green-mature pumpkins can be harvested but are not as likely to color up uniformly.

Avoid temperatures below 50°F, which can cause chilling injury to green-mature pumpkins and will result in poor color and more fruit decay. One possibility is to put green or partially colored pumpkins in a warm greenhouse, which will accelerate the maturing process.

Irrigation and proper post-harvest care are always good investments, especially because supplies may be short after growing seasons that result in orange pumpkins in August or green pumpkins in September.

Pumpkin prices and, therefore, returns per acre, can vary greatly depending on supplies available and the marketing channel used. Higher and more stable prices can be expected from direct sales or even "pumpkin festival" sales, but this market can become saturated with too many growers near a population center. In some cases, smaller growers can help supply the larger festival market grower to obtain prices that may be higher than wholesale. Larger producers and those who do not have time for direct sales will need to find wholesale buyers or, in some cases, sell directly to supermarkets. Wholesale prices are often considerably lower than direct market (retail) prices. Smaller growers should consider joint marketing efforts to attract wholesale buyers. Although consumer demand for pumpkins has expanded considerably in recent years, more growers are getting into production, and some markets may disappear at harvest time. Good production, management, and marketing can result in high profits, especially when supplies are short.

Watermelon

A grower must become familiar with the variety to determine the best stage for harvesting. A dead tendril or curl at the point where the fruit attaches to the vine is not a conclusive indication that the fruit is ready for harvest. "Thumping" the fruit is sometimes used, but only over-ripeness can be determined in this manner.

The best indicator for harvest is the color of the underside of the melon. When 'Crimson Sweet' melons turn yellowish-brown on the bottom surface, for example, they are fully ripe and ready for harvest. The fruits will take on a dull appearance compared to their slick appearance prior to maturity. Determining the proper time to harvest seedless watermelons is generally more difficult than for seeded melons. The death of a tendril usually does not correlate with seedless watermelon ripeness. Melon undercolor is usually the only index of maturity on seedless watermelons, and this color will vary among varieties. Melons should not be left long in the sun, or they may develop sunscald.

Melons should be handled gently to avoid bruising. When loading, melons should not be stacked so high that their weight bruises the bottom fruit. Watermelons should be stored at 50° to 60°F and 90 percent relative humidity.

VARIETIES: Cucumbers

Variety	DTM[1]	Comments
SLICING		
Intimidator	53	Early-maturing, CMV, scab, and angular leaf spot, Good for early and late production, smooth fruit, gynoecious.
Bristol	54	Highly productive, resistance to Anthracnose, angular leaf spot, CMV, scab and zucchini yellow mosaic virus; intermediate resistance to downy mildew and papaya ringspot virus, gynoecious.
Mamba	54	Sets fruit well, resistance to scab; intermediate resistance to Anthracnose, angular leaf spot, CMV, powdery mildew, downy mildew, papaya ringspot virus, watermelon mosaic virus and zucchini yellow mosaic virus.
Speedway	56	Early variety with CMV, powdery mildew, scab, Anthracnose, and angular leaf spot tolerance, gynoecious.
Python	55	Early, very productive, dark green, CMV, scab, Anthracnose, angular and target leaf spot, powdery mildew, gynoecious.
Tasty Green	62	8-10" long slender fruit. Good flavor, similar to a greenhouse burpless cucumber, does well in high tunnels with pollination. For local market, not recommended for wholesale production. Resistant to Anthracnose, angular leaf spot, powdery mildew, downy mildew, CMV scab; monoecious.
Marketmore 76 (open-pollinated)	67	8-9" slender fruit. Scab, powdery mildew, and CMV resistant. For local market, not for commercial production. Monoecious, open-pollinated.
PICKLING		
Calypso	52	1" diameter fruit. Resistant to scab, Anthracnose, powdery mildew, and CMV. Hybrid, gynoecious.

VARIETIES: Melons

Variety	DTM[1]	Use	Quality[3]	Comments
EASTERN CANTALOUPE				
Minerva	77	Local, shipping	E	7 to 8 lb round to oblong with deeper sutures than Athena and heavy netting. Resistance to powdery mildew and *Fusarium* races 0, 1 and 2.
Athena	78	Local, shipping	E	Market standard, 5 to 7 lb melon; sutureless and fine heavy netting, small cavity, firm flesh, resistance to powdery mildew and *Fusarium* races 0, 1 and 2. Looks like a large Western melon.
Aphrodite	80	Local, shipping	E	6 to 8 lb; earlier, larger Athena type, resistance to powdery mildew 1, 2 and *Fusarium* race 0, 1, 2.
Wrangler	80-85	Local	E	4 to 5 lb small Tuscan type cantaloupe with dark green sutures, medium net, excellent flavor.*Fusarium* race 0, 1, 2, and powdery mildew resistance.
Atlantis	82	Local, limited shipping	E	6 to 8 lb Eastern type with refined netting, shallow sutures, high sugar, smooth firm deep orange flesh. Powdery mildew race 1, 2 and *Fusarium* race 1, 2 resistance.
Orange Sherbet	83	Local, shipping	E	6 to 8 lb; very large Tuscan type, oval, densely-netted with shallow sutures, high sugar content. Resistance to powdery mildew race 2 and *Fusarium* race 1, 2.
Tirreno	83	Local	E	2-3 lb netted Tuscan type with deep sutures. Resistance to powdery mildew 1, 2, and 5, *Fusarium* race 1, 2..
SPECIALTY MELONS[2]				
Honey Orange	75	Local	VG	3-4 lb honeydew, cream colored exterior, orange flesh, very sweet.
Arava	77	Local	VG	4 lb galia melon, netted exterior, sweet green flesh, excellent flavor, harvest when just turning yellow, relatively short shelf life. Intermediate resistance to powdery mildew.
San Juan	78	Local	VG	3-5 lb honeydew, pale green flesh, excellent flavor. Resistant to *Fusarium* 0-2, powdery mildew 1,2.
Sensation	80	Local	O	5 to 6 lb gourmet melon, round, medium netted light yellow rind, creamy white interior, harvest when rind begins to turn yellow. Resistant to powdery mildew and *Fusarium* wilt 0-2.
Pixie	80	Local	E	2-3 lb muskmelon X galia melon cross; very firm, very sweet, orange flesh; harvest when rind develops a yellow background.
Tasty Bites	75-80	Local	E	1-2 lb charentais X ananas cross, fully netted cantaloupe exterior, orange crunchy flesh with a nice after taste, harvest at slip. Resistant to *Fusarium* 1-2 and powdery mildew.
Summer Dew	88	Local	E	4 to 6 lb honeydew, green flesh, excellent flavor. Resistant to *Fusarium* 0, 2 and powdery mildew 1, 2.

1 Day to maturity
2All specialty melons in this category are highly susceptible to bacterial wilt; post-transplant drench applications of Admire insecticide together with a good preventative spray program for Anthracnose control are highly recommended.
3VG: Very Good; E: Excellent; O: Outstanding.

VARIETIES: Squash, Pumpkins, Gourds

Variety	DTM	Comments
SQUASH		
Straightneck		
Fortune	39	Precocious yellow trait (py) masks virus symptoms on fruit, downy mildew tolerant; teardrop shape.
Multipik	40	Precocious yellow trait (py) masks virus symptoms on fruit; downy mildew tolerant; teardrop shape.
XPT 1832 III	42	Precocious yellow trait (py) masks virus symptoms on fruit. Genetically engineered resistance to for CMV, WMV, ZYMV.
Conqueror III	41	Genetically engineered resistance to CMV, WMV, ZYMV and intermediate resistance to PRSV.
Lioness	50	G Tolerance to ZYMV, CMV, WMV, PRSV.
Zephyr	54	Bi-color with green blossom end, firm texture; variability in the amount of green on the blossom end
Crookneck		
Prelude II	40	Genetically engineered resistance to 2 viruses (WMV, ZYMV) plus conventional powdery mildew resistance. Full crook.
Destiny III	40	Genetically engineered resistance to 3 viruses (WMV, CMV, ZYMV); similar to Dixie. Semi- to full crook.
Gentry	43	Semi-crook; reduced spines, green stems; open bush plant.
Gold Star	50	Semi-crook; smooth, glossy, uniform shape; intermediate resistance to CMV and powdery mildew.
Zucchini		
Spineless Perfection	44	Spineless, intermediate resistance to downy mildew, WMV and ZYMV.
Green Machine	44	Medium green color with light speckles, cylindrical fruit; intermediate resistance to downy mildew, CMV, WMV and ZYMV.
Tigress	45	Cylindrical, slightly tapered; attractive medium to dark green; tolerant to WMV, ZYMV.
Zucchini Elite	45	Long, slightly curved and tapered fruits.
Cashflow	45	Medium green fruit with a slight taper, tolerant to some races of ZYMV, large plant.
Payroll	45	Reduced spines, attractive medium green fruit; intermediate resistance to downy mildew, WMV and ZYMV.
Other Summer Squashes		
Papaya Pear	45	Yellow pear shaped squash, 3.5 inches, AAS winner
Sunburst	50	Bright yellow scalloped, AAS winner.
Patty Pan	54	White scalloped; plants compact bush type.
Acorn		
Autumn Delight	70	1.5 lb, high yields, uniform appearance, intermediate resistance to powdery mildew.
Tay Belle PM	70	1 to 1.5 lb, powdery mildew tolerant, attractive, dark green exterior, bush type plant, medium orange sweet, tender flesh; excellent taste.
Honey Bear	85	1 to 1.25 lb fruit, excellent taste, intermediate resistance to powdery mildew, AAS winner.
Cream of the Crop	85	1.5 lb, attractive creamy white exterior, cream colored flesh, bush type plant.
Table Ace	85	1.5 lb, dark green exterior, yellow orange flesh, semi-bush plants hold up well, high yielding.
Table Gold	95	1 to 1.5 lb, bright golden exterior, dark orange flesh, semi-bush plant, very attractive and excellent taste.
Ornamental Acorn		
Carnival	85	1 to 1.5 lb, skin flecked with shades of green, gold, and yellow, semi-bush plant.
Heart of Gold	90	1.5 lb, white with dark green mottling and golden flesh, large vine, excellent taste.
Celebration	100	1 lb, cream colored with orange stripes and flecks of green, high sugar content, large vine; intermediate resistance to powdery mildew.
Butternut		
Butterboy	80	Very uniform, and early, slightly smaller than others, compact vine.
Chieftain	80	2 to 2.5 lb, bush type plant; powdery mildew resistance.
Polaris	100	3-4 lb, uniform size an shape, cracking tolerance, large vine.
Waltham Butternut	110	3 to 5 lb; blocky and uniform, large vine.
Buttercup/Kabocha		
Sun Spot	75	2 lb; very attractive, orange fruit with dark orange, fine grained, slightly moist, sweet flesh (buttercup).

(continued on next page)

VARIETIES: Squash, Pumpkins, Gourds *(continued)*

Variety	DTM[1]	Comments
Sweet Mama	85	5 lb; sweet, fine-grained, deep yellow flesh, dark green fruit; excellent taste and high yielding (kabocha).
Delica	90	4 lb; medium-dry, slightly sweet flesh; dark green with gray-green stripes; excellent taste (kabocha)
Special Export	90-95	3 lb; excellent flavor, attractive exterior and interior, excellent eating quality (kabocha).
Burgess Buttercup	90	2 lb; smooth texture; excellent eating quality.
Sunshine	95	4 lb; bright orange skin, nutty, smooth, stringless; very sweet, excellent eating quality (buttercup).
Spaghetti		
Small Wonder	70	2 to 2.5 lb; yellow exterior; large vine
Vegetable Spaghetti	100-105	Large 4 lb fruit, vigorous vine.
Miscellaneous Squash		
La Estrella	70-90	10 lb, Calabash squash, attractive green to tan blotchy exterior, fluorescent orange, moist fine grained flesh.
Bush Delicata	100	1 lb, exterior creamy white with green stripes, powdery mildew tolerance, excellent quality.
Grey Ghost	100	7 lb, attractive grey exterior, yellow orange, moist fine grained flesh, storage squash with ornamental value.
Cushaw Green Stripe	110	15 lb, very productive.
PUMPKINS		
Extra Large		
Atlantic Giant	120	Pink-orange color, world record over 1,000 lb.
Prizewinner	120	50 to 200 lb, orange, attractive; very large with good shape and color for extra large pumpkins, limit to 1 fruit per vine to get maximum size.
Full Moon	120	White color, 60 to 90 lb fruit, 36 x 24 inches.
Large (15-35 lb)		
New Moon	90	30 to 35 lb, white fruit, full vine, heavy fruit, good med-large white pumpkin.
Kratos	100	20-30 lb, round to round-flat, deep ribs, large thick handle, vigorous semi-vine growth habit, intermediate resistance to powdery mildew.
Mustang	100	15 to 18 lb, 10 x 12 inches, excellent powdery mildew resistance, strong handle, light orange color.
Apollo	110	18-32 lb, round to tall, dark orange, medium ribbing, good stem attachment, intermediate powdery mildew resistance.
Autumn Buckskin	110	12 to 18 lb, 7x10 inches, attractive, looks like a large buff colored acorn, large vine, pretty not a jack-o-lantern.
Cronus	115	25-50 lb, dark orange, well-defined ribs, large firmly-attached stem, large vigorous vine, intermediate powdery mildew resistance, high yield. Plant by May 25 to avoid heat and fruit set problems.
Aladdin	115	25 lb, deep orange, good yield potential, nice stems.
Magic Wand	115	15 to 25 lb, dark orange, similar to Magic Lantern with improved handles and a higher powdery mildew tolerance.
Gladiator	115	18 to 28 lb, deep orange, good handles and excellent powdery mildew tolerance, one of the best, good for roadside sales.
Magic Lantern	115	15 to 22 lb, dark orange, large vines, strong, dark green handle, powdery mildew tolerant.
Wolf	120	15 to 20 pound, full aggressive vines, unusually large stems, for roadside sales.
Medium (5-10 lb)		
Magician	90	10 to 15 lb, dark orange, round to tall, powdery mildew tolerant.
Hybrid Pam	90	5 to 7 lb, deep orange.
Cotton Candy	105	6 to 10 lb, white pumpkin, full vine
Lumina	110	7 to 8 lb white pie pumpkin for carving and painting with bright orange flesh; 9-inch diameter. Shape varies from globe to flat globe; not a particularly high yielder and fruit scars easily. Harvest slightly immature to obtain a better white color, otherwise these can turn gray.
Miniature (5 oz-4 lb)		
Casperita	77	½-1 lb, white deeply ribbed fruit; 3 inch diameter, edible and ornamental, semi-bush, intermediate resistance to powdery mildew
Cannon Ball	90	3 to 5 lb, orange to dark orange, round, smooth, long shelf life, solid pumpkin, powdery mildew tolerant.

(continued on next page)

VARIETIES: Squash, Pumpkins, Gourds *(continued)*

Variety	DTM[1]	Comments
Baby Boo	95	5 oz. white deeply ribbed fruit; 3.5 inch diameter, vines large; very productive.
Touch of Autumn	95	3.5 to 4 lb, 6 x 5 inches, very attractive, semi-bush vine type, excellent handles that remain dark green, stores well, powdery mildew tolerant.
Rockafellow	95	Pie type. 2.5 to 3.5 lb, bottom heavy and tall with long handle, powdery mildew tolerant.
Baby Bear	105	Pie type. 1.5 lb, 5 inch diameter, good disease tolerance.
Iron Man	110	3 to 4 lb, 7 to 8 inch diameter, dark orange; long shelf life; hard shell variety that is good for painting; tolerant to powdery mildew.
Lil' Ironsides	115	2 lb, 6 inch diameter, tough, hard, dark orange shell that is not able to be carved, strong stem, large vine, long shelf life.
Jack Sprat	100	Pie type. 2-3 lb, 5 x 6 inches, moderately long vines, medium length stems, uniform dark orange fruit color, delicious savory flavor. Powdery mildew resistance.
Little Giant	105	Pie type. 2-4 lb, 5 x 5 inches, attractive uniform fruit shape and color, attractive stems. Tender, sweet, full-flavored flesh. Most fruit near the plant base. Intermediate resistance to powdery mildew.
ORNAMENTAL GOURDS		
Autumn Wings Large Swan	100	Unique gourd, multiple colors with wings, warts, shaped like a swan gourd.
Autumn Wings Medium	100	Unique gourd, many colors with wings, shape of a spoon gourd.
Autumn Wings Small	100	Unique gourd, many colors with wings, shaped like a swan pear gourd. Potential for shipping.

VARIETIES: Watermelon

Variety	DTM	Size (lb)	Comments[2]
SEEDED			
Tiger Baby	80	10-12	Excellent quality, firm flesh, small seeds; resistant to *Fusarium* race 1.
Sangria	83	20-25	Crimson Sweet rind; elongated; outstanding flavor; fruit blossom end may taper with drought; tolerant to *Fusarium* race 1 and Anthracnose
Estrella	84	20-24	Allsweet rind type, long blocky fruit, bright red flesh, excellent flavor and texture; Intermediated resistance to Anthracnose 1 and *Fusarium* race 1.
Crimson Sweet	85	15-25	Dark and light green striped, blocky fruit; bright red tender sweet flesh; tolerant to *Fusarium* and Anthracnose.
Starbrite	85	21-29	Royal Sweet rind; elongated; very sweet and high yielding; resistant to *Fusarium* race 1 and Anthracnose
Stargazer	85	24-28	Allsweet rind, elongated; excellent quality; uniform; resistance to *Fusarium* and Anthracnose
Royal Sweet	85	20-24	Oblong; bright red flesh, small dark seeds; vigorous, resistant to *Fusarium*—shipper
SEEDLESS			
Melody	80	14-16	Allsweet rind, dark red flesh, intermediate resistance to Anthracnose 1 and *Fusarium* race 1
Fascination	83	16-20	Crimson Sweet rind; firm red flesh with good taste; good yield; resistance to *Fusarium*
Sweet Gem	79	13-16	Black rind; deep red firm flesh
Harvest Moon	90	8-13	Dark green rind with yellow spots. Seedless version of Moon and Stars. Excellent quality and because of the unique appearance it is well suited to farm markets and local production, AAS winner.
Captivation	89	14-17	Crimson Sweet rind with blocky shape. Deep red flesh color of good quality with high yields.
Unbridled	85	18-22	Allsweet rind pattern. Round fruit with crisp red flesh.
Troubadour	87	14-17	Allsweet rind; deep red flesh color of good quality; good yield
Treasure Chest	77	9-15	Jubilee rind; bright yellow flesh color; excellent quality
Revolution	82	16	Royal Sweet rind; elongated; bright red flesh; outstanding flavor; hollow heart tolerant
Ruby	85	14	Medium green dark double striped rind, oval; excellent dark red firm flesh; hollow heart tolerant
Crunchy Red	90	15	Crimson Sweet rind; dark pink flesh, blocky-round shape
Orange Crisp	92	14-18	Round oval shape, orange flesh, leave on vine longer to enhance flesh color.
MINI-SEEDLESS			
Ocelot	84	3-5	Dark tiger stripe rind, round, dark red flesh, excellent texture and taste.
Solitaire	85	6-9	Royal Sweet rind; round, attractive; very tough rind; very firm pink flesh

(continued on next page)

VARIETIES: Watermelon *(continued)*

Variety	DTM	Size (lb)	Comments[2]
POLLENIZER[3]			
Ace			Long vine, low growing, brittle fruit; susceptible to *Fusarium* and Anthracnose
Sidekick			Blooms very early; long vine; slightly more erect; small fruit
Accomplice			Bushy upright habit; consistent male flower production; hardy under early season cool conditions; moderate resistance to *Fusarium*

1 Days to maturity
2Watermelon varieties are often grouped by rind color or pattern; these groups or types are often named for a popular variety with similar characteristics:
All Sweet = medium green rind w/dark green, broad mottled stripes; Jubilee = light green rind with distinct narrow, dark green stripes; Black = solid dark green rind; Crimson Sweet = light green rind w/mottled dark green stripes; Royal Sweet = light green rind w/wide, mottled, dark green stripes.
3Pollenizers are used with seedless melons and planted in-row allowing for seedless melons to be grown in the entire field.

FERTILIZER: Vining Crops

Soil Test Results (lb/A)		Fertilizer Needed (lb/A)			
		Phosphate (P_2O_5)			
Phosphorus		**Cucumber**	**Melons**	**Squash/Pumpkin**	**Watermelon**
Low	<31	241-300	121-180	121-180	180
Medium	31-60	121-240	61-120	61-120	120
High	61-80	1-120	1-60	1-60	60
Very High	>80	0	0	0	0
		Potash (K_2O)			
Potassium		**Cucumber**	**Melons**	**Squash/Pumpkin**	**Watermelon**
Low	<201	201-300	101-150	201-300	150
Medium	201-300	101-200	51-100	101-200	100
High	301-450	51-100	1-50	51-100	50
Very High	>450	50	0	0-50	0

Nitrogen

Cucumbers: Apply 40 to 50 lb of nitrogen (N) per acre just before planting and disk into the soil. Sidedressing or topdressing an additional 30 to 50 lb of N per acre at first bloom is suggested. Rainfall, soil organic matter levels, and previous cropping history of land dictate nitrogen needs. Avoid applying N over tops of plants when foliage is wet. Applying granular fertilizer over the tops of plants when wet may burn the fruit as well as the foliage. A second sidedressing of 40 to 50 lb of N per acre may be necessary with some crops. See the "Fertigation" table (page 73) for slicing cucumbers grown on plastic mulch with drip irrigation.

Melons: Broadcast and disk into the soil 50 lb of N/A before planting. High rates of nitrogen early in the season increase vine growth, delay fruiting, and make pollination more difficult. As plants begin to vine, apply an additional 70 to 100 lb N/A in two sidedressings prior to fruit formation. See the "Fertigation" table (page 74) for fertigating nitrogen.

Squash and Pumpkins: Bare ground plantings: apply 75 to 80 lb N/A broadcast before planting. Apply 100 lb N/A if sod has been plowed under. Sidedress with an additional 50 lb N/A when vines begin to run. Reduce N application when manure is used; excess N may reduce fruit quality.

Summer squash on plastic with drip irrigation: apply 30 to 50 lb N/A preplant together with P and K recommendations. Fertigate an additional 50 to 75 lb N/A (see the "Fertigation" table, page 74).

Watermelon: Apply 50 to 70 lb N/A before planting. This should be broadcast and disked into the soil. As plants begin to vine, apply an additional 50 lb N/A as a sidedress (see the "Fertigation" table, page 74).

FERTIGATION: Vining Crops[1]

CUCUMBERS	
Actual N/week:	7 lb 12 oz/A
Calcium Nitrate	50 lb/A 2 lb 6 oz/1,000 plants

Total amount/season: 120 lb/A

Preplant amount: 50 lb/A

Fertigated amount: 70 lb/A

Growing season: 9 weeks

Fertigation should begin about 2 weeks after seedling emergence or two weeks after transplanting.

The doses for 1,000 plants are based on a plant population of 20,908 plants/A (i.e., beds on 5 foot centers with two rows per bed and single plants spaced 10 inches apart in the row; 12 to 18 inches between the double rows).

For seasons extending beyond 9 weeks, a maintenance dose of 1 to 1.5 lb N/acre/week is adequate.

(continued on next page)

FERTIGATION: Vining Crops[1] *(continued)*

MUSKMELONS, SPECIALTY MELONS		Total amount/season: 120 lb/A
Actual N/week:	8 lb 12 oz/A	Preplant amount: 50 lb/A
Calcium Nitrate	56 lb 7 oz/A 15 lb 9 oz/1,000 plants	Fertigated amount: 70 lb/A Growing season: 8 weeks Fertigation begins about two weeks after transplanting or when vines begin to "run." The doses for 1,000 plants are based on a plant population of 3,630 plants/A (i.e., beds on 6 foot centers with single plants 2 feet apart in the rows). For seasons extending beyond 8 weeks from "running," a maintenance dose of 1 to 1.5 lb N/acre/week is adequate.
SQUASH		Total amount/season: 100 lb/A (moderate rate) 125 lb/A (high rate)
Moderate Rate		Preplant amount: 50 lb/A
Actual N/week:	5 lb/A	Fertigated amount: 50 lb/A (moderate rate) 75 lb/A (high rate) Growing season: 10 weeks Fertigation can begin 14 days after transplanting. The doses for 1,000 plants are based on a plant population of 4,840 plants/A (i.e., rows on 6 foot centers and plants 18 inches apart in the rows). For seasons extending beyond 10 weeks a maintenance does of 1 to 1.5 lb N/acre/week is adequate.
Calcium Nitrate	32 lb/A 7 lb/1,000 plants	
High Rate		
Actual N/week:	7 lb 8 oz/A	
Calcium Nitrate	48 lb/A 10 lb/1,000 plants	
WATERMELONS		Total amount/season: 120 lb/A
Actual N/week:	5 lb/A	Preplant amount: 60 lb/A
Calcium Nitrate	32 lb 4 oz/A 17 lb 12 oz/1,000 plants	Fertigated amount: 60 lb/A Growing season: 12 weeks
Icebox Types		Fertigation begins about 2 weeks after transplanting or when vines begin to "run."
Actual N/week:	5 lb/A	Standard melons: The doses for 1,000 plants are based on plant populations of 1,815 plants/A (i.e., beds on 8 foot centers with single plants 3 feet apart in the rows).
Calcium Nitrate	32 lb 4 oz/A 8 lb 14 oz/1,000 plants	Icebox melons: The doses for 1,000 plants are based on plant populations of 3,630 plants/A (beds on 6 foot centers and plants 2 feet apart in rows). For seasons extending beyond 12 weeks, a maintenance dose of 1 to 1.5 lb N/acre/week is adequate.

1 All recommendations assume starter fertilizer was used.

PESTICIDE SAFETY: Cucurbits

	Signal[1]	Re-entry (hrs)	Harvest (days)	NOT Approved for Use on: Cucumber	Melons	Squash/Pumpkin	Watermelon
INSECTICIDES							
Acramite 50 WS	C	12	3				
Actara 25 W	C	12	0				
Admire Pro	C	12	21				
Assail 30 SG	C	12	0				
Avaunt eVo 30 DG	C	12	3				
Belay 2.13 Sc	C	12	7/21[4]				
Beleaf 50 SG	C	12	0				
Coragen 1.67 SC	-	4	1				
Courier 40 SC	W	12	1				
Dimethoate 4 E	W	48	3	x		x	x
Entrust 2 SC	C	4	3				
Exirel 0.83 SE	C	12	1				
Fulfill 50 DF	C	12	0				
Harvanta 50 SL	C	4	1				
Intrepid 2 F	C	4	3				
Kanemite 15 SC	C	12	1			x	
Knack 0.86 EC	C	12	7				
Magister SC	W	12	3				
Malathion 8	C	24	1		x		x
Oberon 2 SC	C	12	7				
Platinum 2 SC	C	12	30				
Portal 0.4 EC	W	12	3			x	
PQZ 1.87 SC	C	12	1				
Radiant SC	C	4	1/3[4]				
Requiem 25 EC	C	4	0				

(continued)

PESTICIDE SAFETY: Cucurbits (continued)

	Signal[1]	Re-entry (hrs)	Harvest (days)	NOT Approved for Use on: Cucumber	Melons	Squash/Pumpkin	Watermelon
Rimon 0.83 EC	W	12	1				
Scorpion 35 SL	C	12	1/21[4]				
Sefina 0.42 SC	C	12	0				
Sevin XLR Plus	C	12	3				
Sivanto Prime 1.67 SL	C	12	1/21[4]				
Transform 50WG	D	24	1				
Torac 1.29 EC	W	12	1				
Trigard 75 WP	C	12	0				
Venom 70 SG	C	12	1/21[4]				
Verimark 1.67 SC	-	4	1				
Zeal 72 WP	C	12	7				
Restricted Use							
AgriMek 0.7 SC	W	12	7				
Asana XL	W	12	3				
Baythroid XL	W	12	0				
Brigade 2 EC	W	12	3				
Danitol 2.4 EC	W	24	7				
Diazinon AG500	C	24	3	x		x	
Diazinon 50 W	C	24	3	x		x	
Fastac 0.83 EC	D	12	1				
Lannate 90 SP	DP	48	1/3[4]				
Mustang Maxx	W	12	1				
Permethrin 3.2 EC	C	12	0				
Proclaim 5 SG	C	12	7				
Vydate 2 L	DP	48	1				
Warrior II	W	24	1				

PESTICIDE SAFETY: Vining Crops

	Signal[1]	Re-entry (hrs)	Harvest (days)	NOT Approved for Use on: Cucumber	Melons	Winter Squash/Pumpkins	Summer Squash	Watermelon
FUNGICIDES								
Actigard 50 WG	C	12	0					
Aprovia Top	D	12	0					
Ariston	C	12	3					
Azoxystrobin[2]	C	4	1					
Cabrio EG	C	12	0					
Cannonball WG	C	12	14	x		x	x	
Chlorothalonil[2]	D	12	0					
Fixed coppers[2]	D	24/48	0					
Curzate 60 DF	W	12	3					
Dexter Max	C	24	5					
Dexter XCEL	C	12	7					
Elumin	C	12	2					
Endura	W	12	0					
Flint	C	12	0					
Fluazinam[2]	W	12	7/30[3]					
Fluoxastrobin[2]	C	12	1		x			x
Fontelis	C	12	1					
Forum SC	C	12	0					
Gavel 75 DF	C	48	5					
Inspire Super	C	12	7					
Luna Experience	C	12	7					
Luna Sensation	C	12	0					
Mancozeb[2]	C	24	5					
Mandipropamid[2]	C	4	0					
ManKocide	D	24	5					
Merivon	W	12	0					
Metalaxyl[2]	W	48	0					
Miravis Prime	C	12	1					
Muscle	C	12	7					
Orondis Gold	C	4	0					
Orondis Opti	D	12	0					
Orondis Ultra	C	4	0					

(continued)

PESTICIDE SAFETY: Vining Crops *(continued)*

	Signal[1]	Re-entry (hrs)	Harvest (days)	NOT Approved for Use on: Cucumber	Melons	Winter Squash/Pumpkins	Summer Squash	Watermelon
Presidio	C	12	2					
Pristine	C	12	0					
Previcur Flex	C	12	2					
Procure 50 WS	C	12	0					
Proline 480 SC	C	12	7					
Quadris Opti	W	12	1					
Quadris Top	C	12	1					
Quintec	C	12	3	x			x	
Rally 40 WSP	W	24	0					
Ranman	C	12	0					
Reason 500 SC	C	12	14					
Rhyme	W	12	0					x
Ridomil Gold SL	C	48	0					
Ridomil Gold Bravo SC	W	48	0					
Ridomil Gold Copper	D	48	5					
Ridomil Gold MZ	C	48	5			x		
Sovran	C	12	0					
Sulfur[2]	C	24	0					
Switch 62.5 WG	C	12	1					
Tanos	C	12	3					
Tebuconazole[2]	C	12	7					
Thiophanate-methyl[2]	C	12	0					
Topguard	C	12	0		x			
Topguard EQ	C	12	1					
Torac	W	12	1					
Torino	C	4	0					
Uniform	C	0	AP					
Velum Prime	C	12	0					
Vivando	C	12	0					
Zampro	C	12	0					
Zing!	C	12	0					

1 W: Warning, C: Caution, D: Danger; P: Poison
2 Several formulations are marketed. See the general introduction for more details on fungicides.
3 Dependent on application or cucurbit type, see label.

INSECT CONTROL: Cucurbits[1,2]—Cucumber, Melon, Pumpkin, Squash, and Watermelon

Insecticide	Product Amt/A	Seasonal Limit/A	Comments and Other Restrictions
PREPLANT INCORPORATED			
Wireworms, Cutworms: Wireworms are a potential problem for crops following grass or legume-grass sod.			
Diazinon 50 W	6 to 8 lb	8 lb	Incorporate immediately. For melons and watermelons only.
SOIL TREATMENTS			
Aphids, Cucumber Beetles, Whiteflies			
Admire Pro	7 to 10.5 fl oz	10.5 fl oz	See label for application methods.
Belay 2.13 SC	9 to 12 fl oz	12 fl oz	At planting only. See label for application methods. Also helps with squash bug.
Platinum 2 SC	5 to 11 fl oz	11 fl oz	See label for application methods.
Scorpion 35 SL	9 to 10.5 fl oz	21 fl oz	See label for application methods. Also helps with squash bug.
Sivanto Prime 1.67 SL	21 to 28 fl oz	28 fl oz	For aphids, leafhoppers and whiteflies.
Venom 70 SG	5 to 7.5 oz	12 oz	Allow 7 days between applications. Not for cucumber beetles or aphids.
Verimark 1.67 SC	6.75 to 13.5 fl oz	13.5 fl oz	At planting.
FOLIAR TREATMENTS			
Aphids			
Actara 25 WDG	1.5 to 3 oz	11 oz	Allow 5 days between applications.
Assail 30 SG	2.5 to 4 oz	26.5 oz	Limit 5 applications. Allow 5 days between applications.
Belay 2.13 SC	3 to 4 fl oz	12 fl oz	Allow 10 days between applications. Prior to 4th true leaf unfolding.
Beleaf 50 SG	2 to 2.8 oz	8.4 oz	Limit 3 applications at the 2.8 oz/A rate. Allow 7 days between applications.
Brigade 2 EC	2.6 to 6.4 fl oz	19.2 fl oz	Limit 2 applications after bloom. Allow 7 days between applications.
Exirel 0.83 SE	13.5 to 20.5 fl oz	61.5 fl oz	Allow 5 days between applications.
Fulfill 50 DF	2.75 oz	5.5 oz	Allow 7 days between applications.
Malathion 8	1 to 1.75 pt	2 applications	Allow 7 days between applications. For cucumbers, winter and summer squash only. Lower rate for winter squash.
PQZ 1.87 SC	2.4 to 3.2 fl oz	4.8 fl oz	Allow 7 days between applications. Limit 2 applications.
Scorpion 35 SL	2 to 7 fl oz	10.5 fl oz	Allow 7 days between applications. Do not combine with soil applications.
Sefina 0.42 SC	3 fl oz	28 fl oz	Allow 7 days between applications.
Sivanto Prime 1.67 SL	7 to 14 fl oz	28 fl oz	Allow 7 days between applications.
Transform WG	0.75 oz	8.5 oz	Allow 7 days between applications. Limit 4 applications.
Torac 1.29 EC	17 to 21 fl oz	42 fl oz	Allow 14 days between applications. Limit 2 applications.
Venom 70 SG	1 to 4 oz	6 oz	Allow 7 days between applications.
Cucumber Beetles: Key insect pest attacking cucumbers, vector of bacterial wilt. Must begin control when seedlings first emerge. Repeat applications as necessary to maintain control, particularly when plants are small. See Bacterial Wilt. Management can be relaxed when harvest begins.			
Asana XL	5.8 to 9.6 fl oz	48 fl oz	-
Assail 30 SG	2.5 to 5.3 oz	26.5 oz	Limit 5 applications. Allow 5 days between applications.
Belay 2.13 SC	3 to 4 fl oz	12 fl oz	Allow 10 days between applications. Prior to 4th true leaf unfolding
Brigade 2 EC	2.6 to 6.4 fl oz	19.2 fl oz	Limit 2 applications after bloom. Allow 7 days between applications.
Danitol 2.4 EC	10.67 to 16 fl oz	42.67 fl oz	Allow 7 days between applications.
Fastac 0.83 EC	3 to 3.8 fl oz	11.4 fl oz	Allow 7 days between applications.
Harvanta 50 SL	10.9 to 16.4 fl oz	49.2 fl oz	Allow 5 days between applications. Striped cucumber beetle only. Limit 3 applications.
Mustang Maxx	2.8 to 4 fl oz	24 fl oz	Allow 7 days between applications.
Permethrin 3.2 EC	4 to 8 fl oz	32 fl oz	Allow 7 days between applications.
Sevin XLR Plus	1 qt	6 qt	Allow 7 days between applications. Limit 6 applications.
Scorpion 35 SL	2 to 7 fl oz	10.5 fl oz	Allow 7 days between applications. Do not combine with soil applications.
Venom 70 SG	1 to 4 oz	6 oz	Allow 7 days between applications.
Warrior II	1.28 to 1.92 fl oz	11.5 fl oz	Allow 5 days between applications.

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INSECT CONTROL: Cucurbits[1,2] *(continued)*

Insecticide	Product Amt/A	Seasonal Limit/A	Comments and Other Restrictions
Cutworms: Eliminate weeds from field margins and plow fields at least 2 weeks before planting to destroy cutworm food sources and egg laying sites.			
Asana XL	5.8 to 9.6 fl oz	48 fl oz	-
Brigade 2 EC	2.6 to 6.4 fl oz	19.2 fl oz	Limit 2 applications after bloom. Allow 7 days between applications.
Fastac 0.83 EC	1.4 to 3.8 fl oz	11.4 fl oz	Allow 7 days between applications.
Permethrin 3.2 EC	4 to 8 fl oz	32 fl oz	Allow 7 days between applications.
Warrior II	1.28 to 1.92 fl oz	11.5 fl oz	Allow 5 days between applications.
Spider Mites: Regular weed control around the outside perimeter of the field is very important.			
Acramite 50 WS	0.75 to 1 lb	1 lb	Limit 1 application.
AgriMek 0.7 SC	1.75 to 3.5 fl oz	10.25 fl oz	Allow 7 days between applications. Must use non-ionic surfactant.
Brigade 2 EC	5.12 to 6.4 fl oz	19.2 fl oz	Limit 2 applications after bloom. Allow 7 days between applications. For end of season control.
Danitol 2.4 EC	10.67 to 16 fl oz	42.67 fl oz	Allow 7 days between applications. For end of season control.
Kanemite 15 SC	31 fl oz	62 fl oz	Limit 2 applications. Allow 21 days between applications.
Magister SC	24 to 36 fl oz	36 fl oz	Limit 1 application.
Miteus 0.42 EC	2 pt	4 pt	Limit 2 applications. Allow 14 days between applications.
Oberon 2 SC	7 to 8.5 fl oz	25.5 fl oz	Allow 7 days between sprays. Limit 3 applications.
Portal 0.4 EC	2 pt	4 pt	Limit 2 applications. Allow 14 days between applications.
Zeal 2.88 SC	4 to 6 oz	6 oz	Limit 1 application.
Squash Bug: Squash bug is a common pest of squash and pumpkins through feeding and transmission of the bacteria that causes Yellow Vine Decline. It also can transmit the disease to melons and watermelons. Destroy crop residues to reduce overwintering sites for squash bugs.			
Asana XL	5.8 to 9.6 fl oz	48 fl oz	-
Assail 30 SG	5.3 oz	26.5 oz	Limit 5 applications. Allow 5 days between applications.
Brigade 2 EC	2.6 to 6.4 fl oz	19.2 fl oz	Limit 2 applications after bloom. Allow 7 days between applications.
Fastac 0.83 EC	3 to 3.8 fl oz	11.4 fl oz	Allow 7 days between applications.
Mustang Maxx	2.8 to 4 fl oz	24 fl oz	Allow 7 days between applications.
Permethrin 3.2 EC	8 fl oz	32 fl oz	Allow 7 days between applications.
Rimon 0.83 EC	12 fl oz	36 fl oz	Allow 14 days between applications.
Scorpion 35 SL	2 to 7 fl oz	10.5 fl oz	Allow 7 days between applications. Do not combine with soil applications.
Sevin XLR Plus	1 qt	6 qt	Allow 7 days between applications. Limit 6 applications.
Sivanto Prime 1.67 SL	10.5 to 14 fl oz	28 fl oz	Allow 7 days between applications.
Venom 70 SG	1 to 4 oz	6 oz	Allow 7 days between applications.
Warrior II	1.28 to 1.92 fl oz	11.5 fl oz	Allow 5 days between applications.
Squash Vine Borer: Squash vine borer is primarily a pest of squashes and pumpkins. Treat for squash vine borer beginning 3rd week in June and repeat 3 to 5 times at weekly intervals.			
Asana XL	5.8 to 9.6 fl oz	48 fl oz	-
Assail 30 SG	5.3 oz	26.5 oz	Limit 5 applications. Allow 5 days between applications.
Brigade 2 EC	2.6 to 6.4 fl oz	19.2 fl oz	Limit 2 applications after bloom. Allow 7 days between applications.
Fastac 0.83 EC	3 to 3.8 fl oz	11.4 fl oz	Allow 7 days between applications.
Mustang Maxx	2.8 to 4 fl oz	24 fl oz	Allow 7 days between applications.
Permethrin 3.2 EC	4 to 8 fl oz	32 fl oz	Allow 7 days between applications.
Warrior II	1.28 to 1.92 fl oz	11.5 fl oz	Allow 5 days between applications.
Whiteflies			
Actara 25 W	3 to 5.5 oz	11 oz	Allow 5 days between applications.
Assail 30 SG	2.5 to 5.3 oz	26.5 oz	Limit 5 applications. Allow 5 days between applications.
Beleaf 50 SG	2 to 2.8 oz	8.4 oz	Limit 3 applications at the 2.8 oz/A rate. Allow 7 days between applications.
Closer 2 SC	4.25 to 4.5 fl oz	17 fl oz	Limit 4 applications. Allow 7 days between applications.
Courier 40 SC	9 to 13.6 fl oz	27.2 fl oz	Limit 4 applications. Allow 7 days between applications.
Exirel 0.83 SE	13.5 to 20.5 fl oz	61.5 fl oz	Allow 5 days between applications.
Knack 0.86 EC	8 to 10 fl oz	20 fl oz	Limit 2 applications. Allow 14 days between applications.
Magister SC	24 to 36 fl oz	36 fl oz	Limit 1 application.
Oberon 2 SC	7.0 to 8.5 fl oz	25.5 fl oz	Allow 7 days between sprays. Limit 3 applications.

(continued on next page)

INSECT CONTROL: Cucurbits[1,2] *(continued)*

Insecticide	Product Amt/A	Seasonal Limit/A	Comments and Other Restrictions
Portal 0.4 EC	2 pt	4 pt	Limit 2 applications.
PQZ 1.87 Sc	2.4 to 3.2 fl oz	4.8 fl oz	Limit 2 applications. Allow 7 days between applications.
Requiem EC	2 to 3 qt	-	Note chlorothalonil incompatibility.
Rimon 0.83 EC	12 fl oz	36 fl oz	Allow 14 days between applications.
Scorpion 35 SL	2 to 7 fl oz	10.5 fl oz	Allow 7 days between applications. Do not combine with soil applications.
Sefina 0.42 SC	14 fl oz	28 fl oz	Allow 7 days between applications.
Sivanto 1.67 SL	10.5 to 14 fl oz	28 fl oz	Allow 7 days between applications.
Transform WG	2 to 2.25 oz	8.5 oz	Allow 7 days between applications. Limit 4 applications.
Venom 70 SG	1 to 4 oz	6 oz	Allow 7 days between applications.

1 See An IPM Scouting Guide for Common Problems of Cucurbit Crops in Kentucky (ID-91) for photos of pests.
2 Generic products available (Appendix G).

WEED CONTROL: Cucurbits - Cucumber, Melon, Pumpkin, Squash, and Watermelon

Product Amt/A	Lb A.I./A	Comments
The stale seedbed technique for direct seeded vine crops can be very effective in eliminating initial flushes of weeds occurring when soil is disturbed. This technique involves preparing the soil, allowing a flush of weeds to emerge, and then cultivating or applying paraquat before seeding or transplanting the crop. Paraquat will have no residual activity.		
0.5 to 1.6 fl oz Aim 1.9 EW	0.008 to 0.025 carfentrazone	For contact post-emergence control of annual broadleaf weeds and suppression of annual grasses. Do not confuse and use the non-labeled Aim EC formulation. Can be applied as a preplant, pre-transplant burndown, or before crop emerges to actively growing weeds up to 4 inches tall. Can also be applied post-emergence as a directed hooded application between crop rows. Use min. 10 gal water/A and crop oil 1% v/v. Max. rate 6.1 fl oz/A. PHI = 0 days.
0.4 to 1 pt Command 3ME	0.15 to 0.37 clomazone	Not labeled for gourd. For control of annual grasses and small-seeded broadleaves; poor control of pigweed. Apply immediately after seeding. Max. rate for muskmelon and watermelon is 0.67 pt/A. See label for additional instructions and restrictions. Label specifically states not to use on Jack-o-Lantern pumpkins due to unacceptable whitening. PHI = 45 days.
3 to 4.5 pt Curbit 3 E	1.13 to 1.5 ethalfluralin	Not labeled for gourd. For pre-emergence control of annual grasses and broadleaves. Do not use on wet or cloddy soils or before a heavy rain to avoid crop injury. Do not apply over or under hot caps, row covers, or plastic mulch. Do not apply broadcast to transplants. Do not incorporate. Clean cultivate and apply as a banded spray to soil between rows of plastic mulch.
6 to 14 lb Dacthal W-75	4.5 to 10.5 DCPA	Not labeled for pumpkin and some gourds. For pre-emergence control of annual grasses and small-seeded broadleaves. Apply only to crop with 4 to 5 true leaves that is well-established and when growing conditions are favorable. Do not incorporate. Not labeled for transplanted crop.
1.0 to 1.33 pt Dual Magnum	0.95 to 1.27 s-metolachlor	Pumpkin only. For pre-emergence control of select weed species. Leave at least 6 inches of untreated area on either side of hill or row and/or any pumpkin foliage. Direct contact with foliage will result in injury. PHI = 30 days.
2 to 4 pt Gramoxone Inteon	0.69 to 1.38 paraquat salt	For non-selective contact kill of annual grasses and broadleaf weeds and top-kill of perennial weeds. Apply preplant, pre-emergence, or before transplanting in min. 10 gal water/A. Apply banded or broadcast. Use higher rate for heavy weed infestations. Use non-ionic surfactant 0.25% v/v. **Paraquat product labels require applicators to take an EPA-approved training every 3 years to mix, load, and apply paraquat.**
0.5 to 1.5 pt Poast 1.5 E	0.09 to 0.27 sethoxydim	Not labeled for gourd. For control of actively growing grasses only. Use high rate on Johnson grass. PHI = 14 days. Max. rate of 1.5 pt/application and 4.5 pt/season.
5 to 6 qt Prefar 4 E	5 to 6 bensulide	For control of grasses and broadleaf weeds. Apply preplant and incorporate to 1 to 2 inch depth. Apply pre-emergence only if it can be watered in within 36 hours. Max. rate of 6 qt/season.
Reflex	fomesafen	Special Local Need 24(c) label for pumpkin, summer squash, winter squash, watermelon, and watermelon. GROWERS CAN ONLY OBTAIN THIS LABEL BY GOING TO THE SYNGENTA SPONSORED WEBSITE, https://www.syngenta-us.com/labels/indemnified-label-login AND REGISTERING AS A USER. ONCE AT THE WEBSITE, SELECT "PRODUCT", THEN "SPECIAL LABELS" THEN "INDEMNIFIED LABELS". YOU MUST REGISTER ONCE EVERY CALENDAR YEAR, BUT SUBSEQUENT ENTRIES INTO THE SITE DO NOT REQUIRE ADDITIONAL REGISTRATION.
16 to 22 fl oz Roundup WeatherMax 5.5L	0.69 to 0.94 glyphosate-salt	For non-selective post-emergence control of annual and perennial grasses and broadleaf weeds. Use only AMS 1 to 2% v/v. Adding a non-ionic surfactant can reduce weed control effectiveness. Min. 3 days between application and planting and min. 30 days before planting any non-labeled crop.

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WEED CONTROL: Cucurbits - Cucumber, Melon, Pumpkin, Squash, and Watermelon *(continued)*

Product Amt/A	Lb A.I./A	Comments
0.5 to 1 oz Sandea 75 DF	0.023 to 0.047 halosulfuron	For control of broadleaf weeds and yellow nutsedge. Cucumber (30 days PHI), cantaloupe, and honeydew melon (57 days PHI): Can be applied preplant under plastic mulch. Apply after final bed preparation and before laying plastic and transplant 7 days after application. Can also be applied post-transplanting on bare ground. Check label for instructions for direct-seeded and row middle applications. Watermelon and muskmelon (57 days PHI): Apply only in row middles in direct-seeded and transplanted watermelon. If plastic mulch is used, do not spray Sandea on plastic. Check label for crop specific applications.
9 to 16 fl oz Select Max	0.07 to 0.12 clethodim	For selective post-emergence of actively growing annual grasses and suppression of perennial grasses. Add crop oil 1% v/v. Max. 16 fl oz/ application. Min. 14 days between applications. PHI = 14 days.
2 to 4 oz Sinbar 80 WP	0.1 to 0.2 terbacil	Watermelon only. For pre-emergence control of broadleaves and grasses. Apply after seeding but before watermelon emerges. For transplanted watermelons, apply pre-transplant. Sinbar may be used pre-emergence under plastic mulch or to row middles. Sinbar may also be applied broadcast over the plastic mulch prior to transplanting, or prior to punching holes in the plastic mulch for transplanting. Sinbar must be washed off the plastic mulch with a minimum of 0.5 inch rain prior to transplanting. PHI = 70 days.
3 to 6 pt Strategy 2.1E	0.6 to 1.18 ethalfluralin + 0.18 to 0.39 clomazone	Not labeled for gourd. For pre-emergence control of annual grasses and broadleaf weeds. Apply to seeded crop before its emergence or as a banded spray between rows after crop emergence or transplanting. Rainfall (0.5 inch) within 2 days is needed for activation. Do not incorporate. Crop injury may occur under cool temperatures that delay seedling emergence. PHI = 45 days for cucumber. Max. 1 application/year. Use lowest labeled rate for summer squash.
1.25 to 2 pt Treflan HFP 4 E	0.6 to 1 trifluralin	For control of annual grasses and broadleaf weeds. Apply after emergence to plants with 3 to 4 true leaves. Can be applied directed to soil between the rows to older plants but avoid foliage contact. PHI = 30 days for most cucurbits but 60 days for watermelon.

DISEASE CONTROL: Cucurbits—Cucumber, Melon, Squash and Pumpkin, Watermelon

Product	FRAC Code[1]	PHI[2] (days)	Amt/A	Seasonal Limits/A	Comments
Angular Leaf Spot, Bacterial Leaf Spots [C/M/SP]					
Actigard	21	0	0.5 to 1 oz	16 oz	May cause phytotoxicity and yield reduction. Do not apply to stressed or injured plants.
Copper, fixed coppers	M	0			Tank-mix with mancozeb (EBDC fungicides) for maximum effectiveness. See label for rates, mixing instructions, and tank-mix precautions. Some products are approved for greenhouse use.
ManKocide[3]	M	5	2 to 2.5 lb	see footnote	
Tanos	11/27	3	8 to 10 oz	4 apps	Suppression of bacterial fruit blotch. Tanos must be tank-mixed with copper for best results against bacterial disease.
Anthracnose and Alternaria Leaf Blight [C/M/SP/W], Cercospora Leaf Spot [C/M/W]					
Aftershock and fluoxastrobin[4] generics	11	3	3.0 to 5.7 fl oz	4 apps	
Aprovia Top	7/3	0	10.5 to 13.5 oz	53.6 oz	Spreading/penetrating-type adjuvant recommended.
Ariston	M/27	3	1.9 to 3 pt	17.5 pt	May sunburn mature watermelon.
Cabrio and pyraclostrobin[4] generics	11	0	12 to 16 oz[5]	4 apps	
Chlorothalonil[4]					Use higher rates for anthracnose and downy mildew. May cause sunburn on mature watermelon fruit. Do not tank mix or use surfactants for watermelon applications. There are multiple Bravo formulations and chlorothalonil generics on the market. See label for rates.
Bravo Ultrex	M	0	1.4 to 2.7 lb	19 lb	
Bravo WeatherStik	M	0	1.5 to 3 pt	21 pt	
Dexter Max	M/11	5	2.1 to 3.2 lb	4 apps	See label for multiple tank mix limitations.
Copper, fixed coppers	M	0			See label for rates, mixing instructions, and tank-mix precautions. Some products are approved for greenhouse use.
Dexter XCEL	M/11/3	7	64 to 72 oz	4 apps	See label for multiple tank mix limitations.
Endura	7	0	6.5 oz[5]	4 apps	

(continued on next page)

DISEASE CONTROL: Cucurbits—Cucumber, Melon, Squash and Pumpkin, Watermelon *(continued)*

Product	FRAC Code[1]	PHI[2] (days)	Amt/A	Seasonal Limits/A	Comments
Fontelis	7	1	12 to 16 fl oz	67 fl oz	Alternaria leaf blight.
Gavel 75 DF2	22/M	5	1.5 to 2 lb	8 apps	
Inspire Super	3/9	7	16 to 20 fl oz	80 fl oz	
Luna Experience	3/7	7	10 to 17 fl oz	34 fl oz	
Luna Sensation	7/11	0	4.0 to 7.6 fl oz	27.1 fl oz	
Mancozeb[3]					Some cantaloupe varieties are sensitive to Dithane F-45.
Dithane M45	M	5	2 to 3 lb	24 lb	There are multiple Dithane formulations and mancozeb generics on the market. See label for rates.
Dithane F-45	M	5	1.6 to 2.4 qt	8 apps	
ManKocide[3]	M	5	2 to 2.5 lb	see footnote	Use highest rates for Anthracnose.
Merivon	7/11	0	4 to 5.5 fl oz	3 apps	
Mettle	3	0	8.0 fl oz	5 apps	Apply prior to onset of disease; rotate to an alternate FRAC group between applications.
Miravis Prime	7/12	1	9.2 to 11.4 oz	22.8 oz	
Pristine	7/11	0	12.5 to 18.5 oz	4 apps	
Quadris and azoxystrobin[4] generics	11	1	11 to 15.5 fl oz	4 apps	
Quadris Opti	11/M	1	3.2 pt	4 apps	
Quadris Top	11/3	1	12 to 14 fl oz	56 fl oz	
Reason 500 SC	11	14	5.5 fl oz	4 apps	Alternaria leaf blight.
Ridomil Gold Bravo SC	4/M	0	2.5 to 3.25 pt	4 apps	
Switch 62.5 WG	9/12	1	11 to 14 oz	56 oz	Alternaria leaf blight.
Tanos	11/27	3	8 oz	4 apps	Tanos must be tank-mixed with a fungicide from FRAC Code M appropriate for the target disease.
Topsin M and thiophanate-methyl[4] generics	1	0	0.5 lb	5 apps	Anthracnose.
Topguard EQ	3/11	7	5 to 8 fl oz	4 apps	
Zing!	M/22	0	36 fl oz	8 apps	May cause sunburn on watermelon.
Bacterial Wilt [C/M/SP]: No bactericides available. Control of insect vectors is the only recommended practice—refer to the "Insect Control" table.					
Belly Rot, Fruit Rot (*Rhizoctonia*), Rhizoctonia root rot [C, M, S, P, W]					
Aftershock and fluoxastrobin[4] generics	11	1	3 to 5.7 fl oz	4 app	See label for application timing. For root rot, application method and rate may vary.
Quadris Opti	11/M	1	3.2 pt	4 apps	
Quadris Top	11/3	1	12 to 14 fl oz	56 fl oz	
Luna Experience	3/7	7	10 to 17 fl oz	34 fl oz	
Topsin M and thiophanate-methyl[4] generics	1	0	0.5 lb	5 apps	*Rhizoctonia* diseases; will not control *Pythium* or *Phytophthora*.
Topguard EQ	3/11	7	5.0 to 8.0 fl oz	4 apps	
Downy Mildew [C/M/SP/W]					
Actigard	21	0	0.5 to 1 oz	16 oz	May cause phytotoxicity and yield reduction. Do not apply to stressed or injured plants.
Aftershock and fluoxastrobin[4] generics	11	1	3 to 5.7 fl oz	4 app	
Ariston	M/27	3	1.9 to 3 pt	17.5 pt	May sunburn mature watermelon.
Cabrio and pyraclostrobin[4] generics	11	0	8 to 12 oz[5]	4 apps	

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DISEASE CONTROL: Cucurbits—Cucumber, Melon, Squash and Pumpkin, Watermelon *(continued)*

Product	FRAC Code[1]	PHI[2] (days)	Amt/A	Seasonal Limits/A	Comments
Chlorothalonil[4]					Use higher rates for downy mildew and anthracnose.
Bravo Ultrex	M	0	1.4 to 1.8 lb	19 lb	May cause sunburn on mature watermelon fruit. Do not tank mix or use surfactants for watermelon applications.
Bravo Weather Stik	M	0	2 to 3 pt	21 pt	There are multiple Bravo formulations and chlorothalonil generics on the market. See label for rates.
Copper, fixed coppers	M	0			See label for rates, mixing instructions, and tank-mix precautions. Some products are approved for greenhouse use.
Curzate 60 DF	27	3	3.2 oz	9 apps	Must be tank-mixed with a fungicide from FRAC Code M.
Flint Extra	11	0	4 oz	4 apps	
Elumin	22	2	8 oz	2 apps	
Omega 500 and fluazinam[4] generics	29	30	12 to 24 fl oz		Soil drench or foliar application. See label for maximum number of applications. Note extended PHI.
Gavel 75 DF2	22/M	5	1.5 to 2	8 apps	
Mancozeb[4]	M	5			Some cantaloupe varieties are sensitive to Dithane F-45.
Dithane M45 and mancozeb[3] generics	M	5	2 to 3 lb	24 lb	There are multiple Dithane formulations and mancozeb generics on the market. See label for rates.
Dithane F-45	M	5	1.6 to 2.4 qt	8 apps	
ManKocide[3]	M	5	2 to 2.5		
Orondis Opti	49/M	0	1.75 to 2.5 pt	10 pt	Use only one Orondis product per year in the fungicide program. Avoid use on mature watermelons under challenging environmental conditions (see label).
Orondis Ultra	49/40	0	5.5 to 8 oz	32 oz	Use only one Orondis product per year in the fungicide program.
Presidio	43	2	3 to 4 fl oz	12 fl oz	Must be tank-mixed with a fungicide NOT in FRAC Group 43.
Previcur Flex	28	2	0.6 to 1.2 pt	6 pt	Use low rate when tank-mixing with other downy mildew fungicides.
Quadris and azoxystrobin[4] generics	11	1	11 to 15.5 fl oz	4 apps	See label for application timing. For root rot, application method and rate may vary.
Quadris Opti	11/M	1	3.2 pt	4 apps	
Ranman	21	0	2.1 to 2.75 fl oz	6 apps	Tank-mix with an organosilicone surfactant when disease pressure is severe; use an organosilicone or non-ionic surfactant when disease pressure is light-to-moderate.
Reason 500 SC	11	14	5.5 fl oz	22 fl oz	
Tanos	11/27	3	8 oz	4 apps	Tanos must be tank-mixed with a fungicide from FRAC Code M appropriate for the target disease.
Topguard EQ	3/11	7	5 to 8 fl oz	4 apps	
Viathon	3/33	7	4 pt	12 pt	Watermelon.
Zampro	40/45	0	14 fl oz	3 apps	
Zing!	M/22	0	36 fl oz	8 apps	May cause sunburn on watermelon.
Gummy Stem Blight (Black Rot) [C/M/S/P/W]					
Aftershock and fluoxastrobin[4] generics	11	1	3 to 5.7 fl oz	4 apps	
Ariston	M/27	3	3 pt	17.5 pt	May sunburn mature watermelon.
Chlorothalonil[4]					May cause sunburn on mature watermelon fruit. Do not tank mix or use surfactants for watermelon applications.
Bravo Ultrex	M	0	1.4 to 2.7 lb	19 lb	There are multiple Bravo formulations and chlorothalonil generics on the market. See label for rates.
Bravo Weather Stik	M	0	1.5 to 3 pt	21 pt	
Copper, fixed coppers	M	0			See label for rates, mixing instructions, and tank-mix precautions. Some products are approved for greenhouse use.
Dexter Max	M/11	5	2.1 to 3.2 lb	4 apps	See label for multiple tank mix limitations.
Dexter XCEL	M/11/3	7	64 to 72 oz	4 apps	See label for multiple tank mix limitations.
Endura	7	0	6.5 oz	4 apps	

(continued on next page)

DISEASE CONTROL: Cucurbits—Cucumber, Melon, Squash and Pumpkin, Watermelon *(continued)*

Product	FRAC Code[1]	PHI[2] (days)	Amt/A	Seasonal Limits/A	Comments
Fontelis	7	1	12 to 16 fl oz	67 fl oz	Alternaria leaf blight.
Inspire Super	3/9	7	16 to 20 fl oz	80 fl oz	
Luna Experience	3/7	7	10 to 17 fl oz	34 fl oz	
Luna Sensation	7/11	0	4 to 7.6 fl oz	27.1 fl oz	Suppressive only.
Mancozeb[4]					Some cantaloupe varieties are sensitive to Dithane F-45.
Dithane M45 and mancozeb[3] generics	M	5	2 to 3 lb	24 lb	There are multiple Dithane formulations and mancozeb generics on the market. See label for rates.
Dithane F-45	M	5	1.6 to 2.4 qt	8 apps	
ManKocide[3]	M	5	2 to 2.5 lb	see footnote	
Merivon	7/11	0	4 to 5.5 fl oz	3 apps	
Mettle	3	0	8.0 fl oz	5 apps	Suppression only.
Miravis Prime	7/12	1	9.2 to 11.4 oz	22.8 oz	
Muscle ADV	3/M	7	2.1 pt	6.4 pt	Test for phytotoxicity on watermelon.
Omega 500 and fluazinam[4] generics	29	30	12 to 24 fl oz		Soil drench or foliar application. See label for maximum number of applications. Note extended PHI.
Pristine	7/11	0	12.5 to 18.5 oz	4 apps	
Proline 480SC	3	7	5.7 fl oz	17.1 fl oz	
Quadris and azoxystrobin[4] generics	11	1	11 to 15.5 fl oz	4 apps	
Quadris Top	11/3	1	12 to 14 fl oz	56 fl oz	
Rhyme	3	0	5 to 7 fl oz	28 fl oz	Powdery mildew, gummy stem blight. Also may be drip administered for charcoal rot suppression.
Ridomil Gold Bravo	4/M	0	2 to 3 lb	4 apps	Avoid late-season applications.
Sovran	11	0	3.2 to 4.8 oz	4 apps	
Toledo and tebuconazole[4] generics	3	7	8 fl oz	24 fl oz	Also powdery mildew.
Topguard EQ	3/11	7	5 to 8 fl oz	4 apps	
Topsin M and thiophanate-methyl[4] generics	1	0	0.5 lb	5 apps	
Viathon	3/33	7	4 pt	12 pt	Watermelon.
Plectosporium (Microdochium; Plectosphaerella) Blight [CSP]					
Aftershock and fluoxastrobin[4] generics	11	1	3 to 5.7 fl oz	4 apps	
Cabrio and pyraclostrobin[4] generics	11	0	12 to 16 oz[5]	4 apps	
Dexter Max	M/11	5	2.1 to 3.2 lb	4 apps	See label for multiple tank mix limitations.
Dexter XCEL	M/11/3	7	64 to 72 oz	4 apps	See label for multiple tank mix limitations.
Flint Extra	11	0	1.5 to 2.0 oz	16 oz	
Inspire Super	3/9	7	16 to 20 fl oz	80 fl oz	
Mancozeb[4]					Some cantaloupe varieties are sensitive to Dithane F-45.
Dithane M45 and mancozeb[3] generics	M	5	2 to 3 lb	24 lb	There are multiple Dithane formulations and mancozeb generics on the market. See label for rates.
Dithane F-45	M	5	1.6 to 2.4 qt	8 apps	
Merivon	7/11	0	4 to 5.5 fl oz	3 apps	
Quadris and azoxystrobin[4] generics	11	1	11 to 15.5 fl oz	4 apps	

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DISEASE CONTROL: Cucurbits—Cucumber, Melon, Squash and Pumpkin, Watermelon *(continued)*

Product	FRAC Code[1]	PHI[2] (days)	Amt/A	Seasonal Limits/A	Comments
Quadris Top	11/3	1	12 to 14 fl oz	56 fl oz	
Topguard EQ	3/11	7	5 to 8 fl oz	4 apps	
Phytophthora Blight [C/M/SP/W]					
Elumin	22	2	8 oz	2 apps	Can be applied via drip irrigation or as a soil-directed spray.
Forum SC	40	0	6 fl oz	5 apps	Must be tank-mixed with a protectant fungicide.
Omega 500 and fluazinam[4] generics	29	30	12 to 24 fl oz		Soil drench or foliar application. See label for maximum number of applications. Note extended PHI.
Orondis Gold	49	0	4.8 to 9.6 fl oz	19.2 fl oz	Use only one Orondis product per year in the fungicide program.
Orondis Ultra	49/40	0	5.5 to 8 oz	32 oz	Use only one Orondis product per year in the fungicide program.
Presidio	43	2	3 to 4 fl oz	12 fl oz	Must be tank-mixed with a fungicide NOT in FRAC Group 43.
Ranman	21	0	2.75 fl oz	6 apps	Tank-mix with an organosilicone surfactant when disease pressure is severe; use an organosilicone or non-ionic surfactant when disease pressure is light-to-moderate.
Revus	40	0	8 fl oz	32 fl oz	Use a spreader/penetrant surfactant. Must be tank-mixed with a fungicide NOT in FRAC Group 40.
Tanos	11/27	3	8 to 10 oz	4 apps	Tanos must be tank-mixed with a fixed copper plus mancozeb fungicide.
Zampro	40/45	0	14 fl oz	3 apps	
Powdery Mildew [C/M/SP/W]					
Actigard	21	0	0.5 to 1 oz	16 oz	May cause phytotoxicity and yield reduction. Do not apply to stressed or injured plants.
Aftershock and fluoxastrobin[4] generics	11	1	3 to 5.7 fl oz	4 apps	
Ariston	M/27	3	3 pt	17.5 pt	May sunburn mature watermelon.
Chlorothalonil[4]					May cause sunburn on mature watermelon fruit. Do not tank mix or use surfactants for watermelon applications. There are multiple Bravo formulations and chlorothalonil generics on the market. See label for rates.
Bravo Ultrex	M	0	1.4 to 2.7 lb	19 lb	
Bravo Weather Stik	M	0	1.5 to 3 pt	21 pt	
Copper, fixed coppers[4]	M	0			See label for rates, mixing instructions, and tank-mix precautions. Some products are approved for greenhouse use.
Dexter Max	M/11	5	2.1 to 3.2 lb	4 apps	See label for multiple tank mix limitations.
Dexter XCEL	11	3	3 to 5.7 fl oz	4 apps	
Flint Extra	11	0	1.5 to 2 oz	16 oz	
Fontelis	7	1	12 to 16 fl oz	67 fl oz	
Luna Experience	7/3	7	6 to 17 fl oz	34 fl oz	
Luna Sensation	7/11	0	4 to 7.6 fl oz	27.1 fl oz	
Merivon	7/11	0	4 to 5.5 fl oz	3 apps	
Mettle	3	0	8 fl oz	5 apps	
Miravis Prime	7/12	1	9.2 to 11.4 oz	22.8 oz	
Muscle ADV	3/M	7	1.1 to 1.6 pt	6.4 pt	Test for phytotoxicity on watermelon.
Pristine	7/11	0	12.5 to 18.5 oz[5]	4 apps	
Procure 50 WS	3	0	4 to 8 oz	40 oz	
Proline 480SC	3	7	5.7 fl oz	17.1 fl oz	
Quadris Opti	11/M	1	3.2 pt	4 apps	
Quadris Top	11/3	1	12 to 14 fl oz	56 fl oz	
Quintec	13	3	4 to 6 fl oz		Muskmelon, gourd, pumpkin, watermelon, and winter squash only.
Rally 40 WSP	3	0	2.5 to 5 oz	1.5 lb	

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DISEASE CONTROL: Cucurbits—Cucumber, Melon, Squash and Pumpkin, Watermelon *(continued)*

Product	FRAC Code[1]	PHI[2] (days)	Amt/A	Seasonal Limits/A	Comments
Rhyme	3	0	5 to 7 fl oz	28 fl oz	Powdery mildew, gummy stem blight. Also may be drip administered for charcoal rot suppression.
Sovran	11	0	3.2 to 4.8 oz	4 apps	
Sulfur[4]	M				Phytotoxicity may occur when sulfur is applied when temperatures exceed 90ºF.
Toledo and tebuconazole[4] generics	3	7	4 to 6 fl oz	24 fl oz	Use lowest listed rate of surfactant to improve coverage.
Topguard	3	0	10 to 14 fl oz	56 fl oz	Powdery mildew, gummy stem blight.
Topguard EQ	3/11	7	5 to 8 fl oz	4 apps	
Topsin M and thiophanate-methyl[4] generics	1	0	0.5 lb	5 apps	
Torac	39	1	21 oz	2 apps	Also an insecticide.
Torino	U6	0	3.4 fl oz	2 apps	
Trionic	3	1	4 to 8 fl oz	4 apps or 24 fl oz	Powdery mildew.
Velum Prime	7	0	6.5 to 6.84 oz	2 apps	Also suppresses nematodes. Drip-administered applications are effective against powdery mildew.
Viathon	3/33	7	2 to 3 pt	12 pt	Watermelon only.
Vivando	U8	0	15.4 fl oz	3 apps	Do not mix with horticultural oils and alternate with a different FRAC code.
Pythium Damping-off and Cottony Leak [C/M/SP/W]					
MetaStar and metalaxyl[4] generics	4	0	4 to 8 pts	1 app	Preplant or at planting. May be applied through drip irrigation.
Previcur Flex	28	2	1.2 pt	6 pt	Pythium root rot, seedling diseases only. Field and greenhouse use; may be applied through drench or drip irrigation.
Ridomil Gold SL	4	0	1 to 2 pt	1 app	Preplant or at planting. May be applied through drip irrigation.
Scab [C/M/SP/W]					
Actigard	21	0	0.5 to 1 oz	16 oz	May cause phytotoxicity and yield reduction. Do not apply to stressed or injured plants.
Chlorothalonil[4]					May cause sunburn on mature watermelon fruit. Do not tank mix or use surfactants for watermelon applications.
Bravo Ultrex	M	0	1.8 to 2.7 lb	19 lb	
Bravo Weather Stik	M	0	1.5 to 3 pt	21 pt	There are multiple Bravo formulations and chlorothalonil generics on the market. See label for rates.
Copper, fixed coppers[4]	M	0			See label for rates, mixing instructions, and tank-mix precautions. Some products are approved for greenhouse use.
Mancozeb[4]					Some cantaloupe varieties are sensitive to Dithane F-45.
Dithane M45 and mancozeb[3] generics	M	5	2 to 3 lb	24 lb	There are multiple Dithane formulations and mancozeb generics on the market. See label for rates.
Dithane F-45	M	5	1.6 to 2.4 qt	8 apps	
Miravis Prime	7/12	1	9.2 to 11.4 oz	22.8 oz	
Ridomil Gold Bravo SC	4/M	0	2.5 to 3.25 pt	4 apps	Avoid late-season applications.

1 Products with numerical FRAC codes must be alternated or tank-mixed with products that have a different FRAC code to discourage resistance development. See product label for maximum number of consecutive applications allowed. Refer to the table on pages 22-24 for more information on FRAC codes.
2 Pre-harvest interval.
3 Observe seasonal limits for mancozeb.
4 Generic products available (Appendix F). Amounts and seasonal limits per acre are product dependent.
5 Use higher rate when pressure is severe.

Eggplant

Nightshade family (Solanaceae): *Solanum melongena*

For information on eggplant see "Fruiting Vegetables" section on page 86

Fruiting Vegetables (Tomato, Pepper, & Eggplant)

Nightshade family (Solanaceae): *Solanum melongena, Capsicum annuum, Solanum lycopersicum*

Planting and Culture

Eggplant

Eggplants need warm soil and warm air temperatures to yield well. Sample soil and consult soil test results and apply preplant fertilizer based on soil test recommendations. After the danger of frost has passed (see Appendix K), transplant into rows 36 to 42 inches apart with plants 18 to 24 inches apart in the rows. Plant on a well-drained loam soil for best results. Prepare the starter fertilizer by mixing 3 pounds of 10-52-17 or similar analysis water-soluble fertilizer in 50 gallons of water. Immediately following transplanting, flea beetles must be carefully monitored and treated if necessary. Yields of large-fruited varieties are in the range of 12 to 15 tons per acre of marketable fruit. Eggplant benefits from irrigation at flowering and fruit set if soil moisture is low.

Eggplants are most productive on black plastic with trickle irrigation. Mulched beds are usually spaced 5 to 6 feet apart with individual plants spaced 18 to 24 inches apart within the row. The recommendations in the "Fertigation" table are based on a plant population of 4,356 plants per acre (beds on 5-foot centers and 24 inches between plants within rows). Fertigation should begin about two weeks after transplanting and continue throughout the season. Growers may need to modify these guidelines depending on soil type, previous crop, etc. Eggplants may benefit from staking or trellising similar to that used in tomatoes. Staking helps prevent late-forming fruit from pulling the branches over to the ground.

Pepper

Peppers are grown primarily for the fresh market in Kentucky. To be successful it is important to begin by selecting a good field location. Low-lying fields next to creeks and rivers are subject to high humidity and moisture conditions that result in serious disease risks; these areas are especially prone to bacterial leaf-spot epidemics. Avoid poorly drained fields or fields where imazaquin or atrazine herbicides may have been used the previous season. Herbicide carryover (especially from corn and soybean herbicides) can cause serious injury to peppers (see "Weed Management" on page 14).

Growers also should locate pepper plantings as far away from tobacco plantings as possible because of the danger of aphid movement and virus disease spread from tobacco to peppers. Although tobacco ground may represent some of the best land on a farm, it is also not advisable to grow peppers after tobacco, tomatoes, eggplants, potatoes, or vining crops for a period of three years, because these crops are susceptible to many of the same diseases.

Soils known to be high in residual nitrogen should also be avoided to prevent peppers from producing excessive foliage at the expense of fruit. Consider the previous crop when deciding how much nitrogen to apply; there will probably be some residual nitrogen following a crop that received heavy doses of nitrogen fertilizer during the previous season.

Potassium and especially phosphorus are likely to accumulate in most Kentucky soils following several years of heavy applications for vegetable crops. Make sure to get your soil tested in the fall or early winter so that you will know exactly what nutrients are required.

Plow soil 8 to 10 inches deep several weeks in advance of the transplanting date. Peppers do extremely well following fescue sod. Prepare a fine seedbed by disking or rototilling.

Fresh Market Bell Peppers-- Production with Plasticulture

Planting hybrid bell peppers on 6- to 8-inch-high raised beds covered with black plastic mulch and using drip irrigation has resulted in high yields of excellent quality peppers for fresh market sales. A bed shaper/ plastic mulch layer and a setter that will transplant through plastic are essential for this production system. Two rows of peppers spaced 15 inches apart are planted on each bed; plants are spaced 12 to 15 inches apart within each row. The beds are usually 5 to 6 feet from center to center (approximately 14,500 plants per acre).

Since a portion of the fertilizer will be applied though the drip irrigation system (fertigation), uniform watering will ensure that plants receive adequate nutrients. Don't assume that because it has rained there will be water in the root zone under plastic. Also, while the consequences of under-watering (and therefore under-fertilizing) are obvious, many growers overlook the fact that over-watering will leach nutrients out of the root zone. Growers using trickle irrigation and plastic mulch should carefully monitor soil moisture using tensiometers. Check these instruments daily. For more details on how to set up a trickle irrigation system with fertilizer injection,

contact your county Extension agent or irrigation supply representative.

In Kentucky, pepper plants should be transplanted to the field after danger of frost, usually around the second week of May (see Appendix K). A 7- to 8-week-old transplant is best.

Greenhouse container-grown plants are recommended for planting with mulch and trickle irrigation. Trays with 72-128 cells are considered economical but large enough to produce large and vigorous transplants. Using a larger transplant container (larger cell size) will usually result in better transplant survival and earlier yields.

Seed should be treated by the seed company or treated with chlorine bleach by the grower to help reduce seed transmission of bacterial leaf spot (see Appendix I). Bacterial spot remains a serious risk to pepper plantings in many parts of the state, and most growers should use resistant varieties as well as early-season sprays containing fixed copper plus manzate to reduce ephypitic populations of leaf spot bacteria. Bare root transplants are not recommended for fresh market pepper production.

When transplanting, use 4 to 8 ounces of a starter solution around the roots of each plant. Use 3 pounds of a 10-52-17 or similar analysis fertilizer in 50 gallons of water for the starter mix.

Poor fruit set and deformed fruit may result when nighttime temperatures drop below 60°F or when daytime temperatures exceed 90°F. Varieties differ considerably in their response to temperature extremes.

Most types of hot and specialty peppers can be grown using the same techniques and spacings as for bell peppers; however, some types require staking and tying**.** Serrano peppers, anaheims, poblanos, and some cubanelle varieties should be staked and tied when using plasticulture and high plant populations. Tomato stakes are placed every 6 to 10 feet on each side of the double-row beds. Tomato twine is looped and tightened around each stake at 7 to 9 inches above the soil to "fence-in" the plants. Second and third stringings can be used higher on the stakes as needed during the season. To reduce sunburn to fruit, shorter (2½ to 3 feet) stakes are sometimes also used for very tall bell pepper varieties or where bell pepper plantings are exposed to high winds.

Peppers for Processing

There are few processing peppers being produced in Kentucky. Peppers grown for processing are usually transplanted 16 inches apart in single rows 36 to 42 inches apart, which will require about 10,000 plants per acre. If pimento peppers are grown, space plants 18 to 22 inches apart in rows 40 to 42 inches apart (7,500 plants per acre). Although processing peppers have traditionally been grown on bare ground in Kentucky, several growers in recent years have doubled their profits by using higher plant populations, hybrid varieties, and black plastic mulch with drip irrigation.

Given the higher cost of the raised bed/plasticulture production system, most processors do not object to growers selling a portion of the crop as fresh greens. In fact, it has become very common for growers to sell the first harvests as green peppers for the fresh market and sell later-maturing fruits as red peppers for processors. Yields can be dramatically increased with plastic and drip irrigation, especially in a dry season.

Techniques (including double-row spacings) for using this system with processing peppers are the same as those described for fresh market peppers (see page 86).

Growers contracting with a processor, however, are advised to check with the processing company regarding varieties. Due to the devastating nature of bacterial leaf spot on peppers in Kentucky it is advised that growers use a hybrid variety with leaf spot resistance. Some processors may supply open-pollinated, non-resistant varieties. The risks of using a non-resistant variety are too great for large wholesale growers in Kentucky and should be avoided.

Tomato

Staked tomatoes for fresh market sales have been most profitable when planted and given protection for the very early market or when planted for a late fall crop and harvested just before frost. Tomatoes are usually transplanted during the latter part of April or early May for the spring crop and in mid-July for the fall crop (see Appendix K). A well-drained soil that warms up quickly in the spring is most desirable. Be careful following corn or soybeans because common herbicides used in these crops can be very damaging to tomatoes (see the "Herbicide Label Restrictions" table on page 16). Also be wary of plantings close to your neighbor's corn, soybeans, or small grains, because tomatoes are very sensitive to herbicide drift from these crops. If possible, avoid low-lying fields subject to late frosts and high humidity.

Think twice about locating your tomato planting on land used for tobacco. Although tobacco ground may represent some of the best land on a farm, it is not advisable to grow tomatoes (or peppers or potatoes) after tobacco for a period of at least three years because these crops are susceptible to many of the same diseases. Tomatoes should also not follow tomatoes on the same land for a period of at least three years. Tomatoes should not be grown in short rotation with crops in the same family (tobacco, peppers, potatoes, eggplant, etc.) nor with any of the vine crops (cucumbers, squash, pumpkins, melons, etc.) as all of these are susceptible to Phytophthora blight. Tomatoes do well when transplanted to fields where fescue sod was plowed under the previous fall. Soil should be plowed 8 to 10 inches deep and disked well in the spring to produce a firm plant bed.

Stocky, container-grown plants are most desirable for transplanting. Although it is possible to use bare root plants on bare ground plantings,

higher early yields will be obtained from container-grown plants. Larger cell trays or containers (up to 3 inches) produce higher early yields than small containers or bare root plants. Early tomatoes generally command higher prices, which usually more than offset the higher cost of good quality, container-grown plants. During transplant production, the greenhouse temperature should not be allowed to drop below 60°F, or the fruit in the first few clusters may become cat-faced.

Most growers use approximately 4,200 to 5,000 plants per acre. Plants are usually grown in rows 6 feet apart with plants 18 to 22 inches apart in the row. Most varieties should be pruned, staked, and trellised to obtain higher and earlier yields. A satisfactory trellis (Figures 1a and 1b) may be constructed using 1-inch-square, 5-foot-long stakes driven 10 to 12 inches into the soil between every other plant (approximately 2,100 to 2,500 stakes per acre). A simple, hand-operated stake-driving tool can be made from a 36-inch length of 2½-inch galvanized pipe with a cap screwed or welded on one end. Slide the pipe down over the stake, striking down repeatedly with force to drive stakes.

The first stringing should be about 10 inches above the soil and should be done when the plants are 12 to 15 inches high. A simple stringing tool can be made by drilling holes in each end of a short length of broomstick. Tomato twine is passed though the holes in the tool, which is used to pass the string along one side of the row, looping the string around each stake. It is important to keep the twine pulled tight. Proceed to the end of the row and return on the opposite side passing the string along the other side of the plants, again looping each stake. It is helpful at the first stringing to cross the string between plants (Figure 1a). To maintain a well-trained system, subsequent strings should be put up as the plants grow. Three to four stringings are desirable, each about 6 to 10 inches higher than the preceding one. "Crossing over" or weaving with twine between plants, is not necessary after the first stringing (Figure 1b).

Pruning will help maintain the desired balance between vegetative growth and fruit production. Little or no pruning results in more vine growth with a heavier load of smaller fruit. Moderate pruning results in a smaller vine and larger fruit that mature earlier. Except for small-vined, very early-maturing tomato varieties such as 'Sunshine' (which should not be pruned at all), remove all suckers up to the one immediately below the first flower cluster (Figure 2). Leave this lateral shoot to form a fork just below the first fruit cluster. A single pruning when basal suckers are no longer than 3 or 4 inches will usually be adequate (especially on large fruited cultivars).

At transplanting, a starter fertilizer mix can be applied to each plant. Prepare the starter fertilizer by mixing 3 pounds of a 10-52-17 or similar analysis fertilizer in 50 gallons of water and applied in the transplant holes.

Higher yields and profits will be obtained using a system of producing tomatoes on 6- to 8-inch raised beds covered with black plastic mulch with drip irrigation and fertigation. Most growers prefer embossed plastic mulch, which seems to be more durable and tear-resistant than smooth plastic. When using the plasticulture system, it is extremely important to monitor moisture levels under the plastic. Many Kentucky growers have substantially reduced their yields and fruit size by incorrectly assuming that if the field is muddy between the rows, there is sufficient moisture beneath the plastic. Use tensiometers to monitor soil moisture levels and check them daily to determine

Figure 1a.

Cross over between plants when weaving the first row.

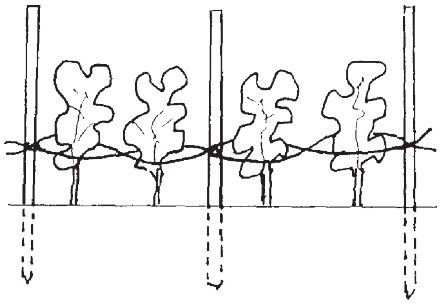


Figure 1b.

Second, third, and fourth rows of twine are pulled along sides of plants without crossing over.

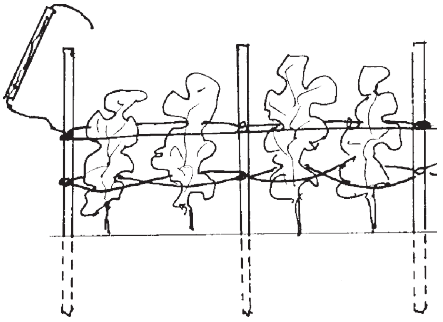
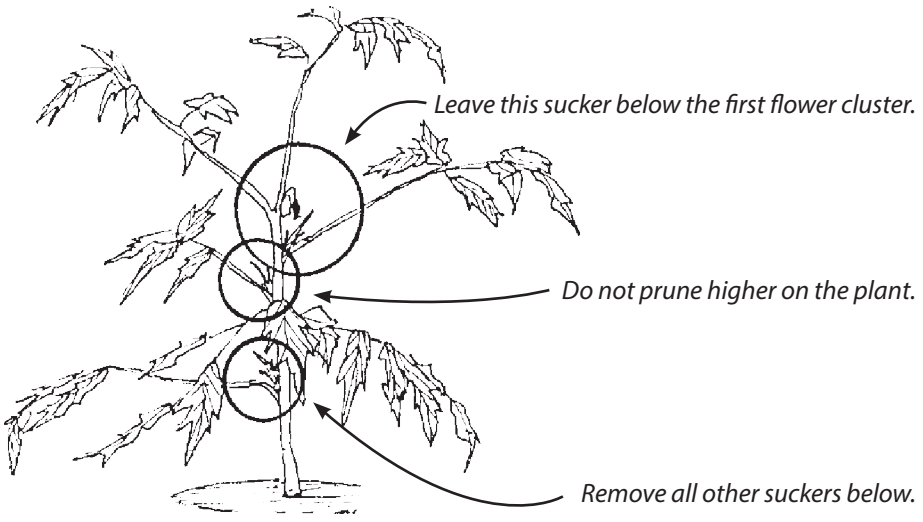


Figure 2.



irrigation intervals. Two tensiometers are recommended, one at a 6-inch depth and one at 12 inches. Contact your county Extension agent or irrigation supply sales representative for more information on setting up a drip irrigation/fertigation system.

Fertilizing

Eggplant

Lime the soil if needed to obtain a soil pH of 6.0 to 6.8. Too much early nitrogen results in large plants, delayed maturity, and stem breakage. For eggplants grown using plastic mulch and drip irrigation, apply all phosphorus and potassium and a portion of the total nitrogen requirement prior to laying plastic. The remaining N requirement can be fertigated in weekly doses (see "Fertigation" table).

Pepper

For fresh-market bell pepper production on most medium-textured soils where plastic mulch and drip irrigation are being used, we recommend that all of the phosphorus, all the potassium, and 50 percent of the nitrogen requirement be applied prior to bedding and laying plastic.

Consider the previous crop when deciding how much nitrogen to apply; there will probably be some residual nitrogen following a crop that received heavy doses of nitrogen fertilizer during the previous season. The fertigated portion of the total nitrogen requirement can be divided into equal amounts (remaining nitrogen requirement divided by the number of weeks until final harvest) and injected weekly as in the "Fertigation" table (based on 14,500 plants per acre). Growers with very sandy soils should also consider applying 50 to 60 percent of their potassium requirement in weekly increments through the drip system in addition to nitrogen.

Growers should always have annual soil test results on which to base phosphorus and potassium applications. Potassium and especially phosphorus are likely to accumulate in most Kentucky soils following several years of heavy applications for vegetable crops or tobacco. A pH range of 6.5 to 7.0 is best for peppers, and liming may be required if soil pH falls below 6.0. For bare ground plantings apply 50 pounds of nitrogen per acre preplant. Apply one-half at plowing and one-half just prior to transplanting, and disk into the soil.

For processing bell pepper production where plastic mulch is not used, sidedressing or banding additional nitrogen to either side of the plant when the first fruit begin setting is essential for good yields. Apply 30 pounds of nitrogen per acre at the first sidedressing. A second sidedressing of 30 pounds of nitrogen two weeks later should also be applied.

Tomato

Growing a high-investment, high-dollar crop such as staked tomatoes requires that the best information available be used whenever possible. Soil testing is an important tool that should always be used to determine fertilizer needs. Apply lime if needed to raise the pH to 6.5 to 6.8. Apply phosphate, potash, magnesium, and calcium as required based on soil test results. Soil test magnesium levels should be 200 pounds per acre (see Appendix B). Potassium and especially phosphorus are likely to accumulate in most Kentucky soils following several years of heavy applications for vegetable crops or tobacco.

Consider the previous crop when deciding how much N to apply; there will probably be some residual N following a crop that received heavy doses of N fertilizer during the previous season. Apply 50 pounds of N per acre preplant regardless of the type of irrigation system used. Simple, handheld electronic meters are available that growers can use to quickly determine the nitrogen status of soils and plants. These Cardy meters can be used to determine residual nitrate levels in soils prior to planting as well as measure N levels in plant sap in order to assess the efficiency of fertigation.

The fertigation recommendations have worked well for growers in Kentucky when tomatoes are grown on black plastic mulch with drip irrigation. This schedule is based on a standard plant population of 4,200 plants per acre (five-row blocks, beds on 6-foot centers and 18 inches between plants within rows) using the 'Mountain Spring' variety. Fertigation should begin about 10 days after transplanting and continue throughout the season. A grower may need to modify the recommendations slightly depending on length of harvest period, soil type, previous crop, weather conditions, etc.

Calcium nitrate and potassium nitrate are commonly used water-soluble sources of nitrogen. The simplest system that has worked well on medium-textured soils in Kentucky uses calcium nitrate or potassium nitrate injected into the drip irrigation water.

Soil tests and ripening disorders.

A soil test should always be done prior to planting for every site used for fresh market tomatoes. Ideally, a soil test would be conducted the fall before a spring planting in order to allow time for lime or sulfur applications which can take several months to take effect in the soil. The University of Kentucky soil test reports for tomatoes now also include a Hartz ratio calculation. Based on the nutrient balance in your soil, the Hartz ratio indicates if your site may be at risk for certain types of fruit-ripening disorders such as blotchy ripening, yellow shoulder, and internal white tissue. This information helps determine the type of fertilization program that should be followed to help reduce your risk of having these disorders.

More often than not, ripening problems are associated with low levels of soil potassium and occur most often on soils with low cation exchange capacities (CECs). If the Hartz ratio indicates that your soil is at risk, we recommend applying potassium prior to planting (according to the soil test report recommendations) and following with fertigation during the season

with a potassium source such as water-soluble muriate of potash (0-0-60) or potassium nitrate (14-0-45). See the "Fertigation" table for recommended rates. This is in addition to any preplant potassium.

Ripening disorders have also been associated with excess nitrogen and any conditions that restrict the tomato plant's root system (soil compaction, waterlogging, drought, etc.). During hot, dry years every other fertigation should contain potassium nitrate. More blotchy ripening occurs after extended periods of cloudy weather. Some tomato varieties are much more susceptible to blotchy ripening than others. Typically, varieties recommended in this publication, while not immune to blotchy ripening, are less susceptible.

Magnesium deficiencies.

Mild magnesium deficiencies sometimes appear at midseason on plants with very heavy fruit loads. A typical symptom is yellowing between the veins (veins remain green) on the lower leaves of the plant. Magnesium deficiency problems are more likely to occur on sandstone-derived soils and in very dry years.

Frequent fertigations with potassium or calcium nitrate could make the problem worse by competing with and displacing magnesium in soils. Mild symptoms are not generally a problem, and corrective measures are not necessary; however, symptoms may become severe and appear on the entire lower portion of the plant. In such cases, and especially on low CEC soils, preventive and/or corrective measures are required.

In general, it is recommended to have 200 pounds per acre of magnesium on soil tests for staked tomatoes prior to planting. Magnesium sources include dolomitic lime (11 to 12% Mg), epsom salts (= magnesium sulfate, 10 to 16% Mg), magnesium nitrate (6.3% Mg), and magnesium oxide (45 to 55% Mg). Epsom salts and magnesium oxide can be fertigated through the drip system: make weekly applications of 1 to 2 pounds actual magnesium per acre (10 to 20 pounds per acre epsom salts or 2 to 4 pounds per acre magnesium oxide). Application rates may vary with solubility of the materials (check with the manufacturer). A better long-term solution is to raise soil test magnesium levels with dolomitic lime prior to planting. Be careful to not over-apply magnesium as it can compete with potassium for uptake by the plant which can contribute to ripening disorders, specifically yellow shoulder.

Harvesting, Grading, and Marketing

Eggplant

The time required from flowering to marketable fruit size is about three weeks. Large fruit should weigh in the range of three quarters to 1 pound. Oriental type fruit should weigh one third to of half of a pound. The principal market container is a 1⅑ bushel fiberboard carton, 18 to 21 fruit per box.

Harvest fruit when they reach a dark, glossy, uniform, purple-black color. They should be firm (non-wrinkled). Wipe fruit clean or wash. Frequent pickings will result in higher yields.

Cut the stem from the plant. The calyx and stem should be fresh green in color. For transit and storage, hold eggplants at a temperature of 45° to 50°F and 90 to 95 percent relative humidity. Handle fruit carefully, as they bruise easily.

Pepper

Mature green peppers ready for harvest will be firm and will have attained their maximum size. Fresh market green peppers are normally harvested when firm and before they lose their dark green color. Harvest peppers for processing when red ripe.

Peppers should be handled carefully when picking and dumping to avoid bruising and punctures. Hard and rough picking containers may cause skin breakage or punctures and should be avoided. Do not use plastic bags, because peppers will heat up and quickly decay.

Pack only clean, undamaged, insect- and disease-free peppers. Peppers are graded into "U.S. Fancy" (not less than 3 inches in diameter and not less than 3½ inches long) and U.S. No. 1 (not less than 2½ inches in diameter or length).

All grades must have similar varietal characteristics, be firm, fairly well shaped, and free from damage caused by freezing injury, hail, scars, sunburn, disease, insects, or mechanical or other means. Free copies of USDA standards for grades of peppers and other fruit and vegetables are available on the Web at ams.usda.gov/AMSv1.0/freshmarketvegetablestandards.

Cool peppers to 45° to 50°F by putting them in the cooler as soon as possible after harvest; cool rooms with forced-air equipment will greatly speed the process and extend shelf life. Once fruit are precooled, hold them at 45° to 50°F with a relative humidity of 90 to 95 percent. Peppers suffer chilling injury when stored at temperatures below 40°F. Symptoms of chilling injury are browning at the calyx end and surface pitting. Peppers are usually packed in 1⅑ bushel waxed corrugated cartons (30 to 33 pounds) or in bushel crates (28 to 30 pounds) according to the preference of your particular market.

MARKETING CONTAINERS: *Peppers*

Pepper Type	Container Weight	Volume	No. Fruit/ Container
Long hot	30 lb	1 bu	variable
Jumbo bells	30 lb	1 ⅑ bu	40-45
Extra Large bells	30 lb	1 ⅑ bu	55-65
Large bells	30 lb	1 ⅑ bu	65-75
Medium bells	30 lb	1 ⅑ bu	75-90
Cubanelle	30-32 lb	1 ⅑ bu	variable
Specialty hot peppers[1]	16 lb	½ bu	variable

1 Including most of the small-fruited hot and specialty peppers in the "Varieties" table.

Tomato

Tomatoes are easily damaged and should be handled as carefully as possible in all picking, grading, packing, and hauling operations. Tomatoes should be grasped in the hand with the thumb and forefinger pressing against the stem, forcing the stem from the fruit.

When to harvest depends on what market you are growing for. "Vine-ripe" tomatoes that are to be shipped moderate distances are usually harvested at the "breaker" stage or at the "turning" stage. The breaker stage occurs when pink color first becomes noticeable, that is, when the white "star" at the blossom end of the fruit has turned pink, tannish-yellow, or red. In this case, 10 percent or less of the fruit surface shows the color change. Fruits harvested at the breaker stage can be handled and shipped with less damage than those with more color. "Turning" tomatoes are those with more than 10 percent but less than 30 percent of the fruit surface showing a color change from green to tannish-yellow, pink, or red.

Vine-ripe tomatoes must be harvested often (normally twice a week) to avoid having too many red fruit. Tomatoes for local markets should be harvested with much more color, according to customer preferences. Mature green tomatoes for distant markets are picked when the white "star" first appears on the blossom end. This indicates that seed are mature and that fruit will develop normal color when exposed to ethylene gas in a ripening room. Mature green tomatoes are normally harvested only three or four times during the season. Mature green tomatoes should be stored at 55° to 70°F and 85 to 90 percent relative humidity. Firm, ripe fruit should be stored at 45° to 50°F and 85 to 90 percent relative humidity.

All tomatoes must be sorted or graded before going to market. Tomatoes received at Kentucky's larger markets are often graded in the presence of a federal inspector. The USDA's Agricultural Marketing Service has established precise standards for grades of tomatoes. These are available on the Internet at ams.usda.gov/AMSv1.0/freshmarketvegetablestandards. Size classifications for both No. 1 and No. 2 grade tomatoes are shown in the table above (the USDA "small" category is not shown because there is little market for tomatoes of this size). Growers should be aware that some buyers may have their own size classifications that differ from these. "U.S. Combination" grade consists of a combination of Nos. 1 and 2, provided that at least 60 percent by count meet the requirements of No. 1 grade.

All grades must be free from decay, freezing injury, and sunscald and be reasonably well formed. No. 2 grade tomatoes differ from No. 1 grade in that they may be "slightly rough" and "reasonably well formed," whereas No. 1's must be "well formed" and "smooth." Some buyers will also consider fruits with 60 percent or more color a No. 2 grade.

Pack in the type and size container your market requires. Tomatoes are usually packed in 20 or 25 pounds cardboard cartons and are packed as tightly as possible without bruising. Packs must be of uniform size, color, and quality.

Growers should evaluate their marketing opportunities before the first seed is sown. Roadside stands, U-pick, delivery to local grocers, cooperatives, farmers' markets, and independent buyers are potential channels for selling produce. Contacts need to be made before planting. Beginners should consider the low-volume retail sales opportunities at farmers' markets or roadside stands. Large-scale production usually requires knowledge of wholesale marketing channels that can handle larger volumes of produce. Research at the University of Kentucky has shown that all marketing channels in the state are currently underused.

TOMATO SIZE CLASSES

The numbers in parentheses after each category indicate the number of rows and columns of fruit in a box: 6 x 7, for example indicates that in most cases a box of tomatoes in this size category will consist of an arrangement of 6 rows by 7 columns of fruits in one layer.

Size Class	Minimum Diameter[1] (in)	Maximum Diameter[2] (in)
Medium (6 x 7)	2 ¼	2 17/32
Large (6 x 6)	2 ½	2 25/32
Extra Large (5 x 5)	2 ¾ and above	
Maximum Large/Jumbo[3] (4 x 4 or 4 x 5)	3 ½ and above	

1 Will not pass through a round opening of this diameter when tomato is placed with its greatest traverse diameter across the opening.
2 Will pass through a round opening of this diameter in any position.
3 The USDA no longer lists the Maximum Large or Jumbo classification, however, many buyers require this size pack (4 x 4's or 4 x 5's). The old USDA Extra Large class had a range of 2 7/8 minimum to 3 15/32 maximum.

VARIETIES: Eggplant

Variety	DTM[1]	Comments
TRADITIONAL ITALIAN		
Nadia	62	Medium, teardrop shaped fruit, deep purple-black skin, soft spines; will set fruit in cool weather.
Epic	64	Good yield, strong upright plant; medium teardrop shaped fruit, deep purple/black, few spines.
Irene	65	Large broad fruit, high yield, purple/black, sharp spines.
Night Shadow	68	Medium sized, teardrop shaped, glossy purple/black, few soft spines.
Belen	70	Oval, medium sized purple/black, spineless.
Santana	80	Elongated oval shape, glossy purple/black, high yielding, green calyx, fewer spines.
ASIAN TYPE		
Orient Express	58	Elongated Oriental eggplant, sets fruit in cool and hot weather.
Dairyu	60	Long slim, purple/black fruit, few soft spines, Ichiban replacement.
Specialty		
Fairy Tale	55	Mini purple fruit with white strips, AAS winner.
Megal	60	Long tapered purple/black attractive fruit, few soft spines
Kermit	60	Small, round eggplant, green skinned
Nubia	64	Medium size, broad teardrop shape, dark wine streaks over cream background, sharp spines, very attractive
Little Fingers	66	Mini slender purple/black 6-inch long fruit; borne in clusters of 4 to 6 fruits.
Ghostbuster	80	White skinned, excellent flavor.

1 Days to Maturity

VARIETIES: Peppers

Variety	DTM[1]	Comments
BELL (ALL ARE F1 HYBRIDS AND HAVE RESISTANCE TO SEVERAL RACES OF BACTERIAL SPOT)		
Socrates	64	Race 1, 2, 3 resistant, PVY, early blocky fruits.
Declaration	70	Race 1, 2, 3, 5 resistant, intermediate resistance to *Phytophthora blight*, CMV, TSWV, high yields, little silvering.
Aristotle	70	Race 1, 2, 3 resistant, *Phytophthora* blight tolerant, slightly lighter fruit color, consistent producer from year to year.
Turnpike	72	Race 1-5 and 7-9 resistant, *Phytophthora* blight tolerant with TMV resistance; fruit have low silvering, dark green color and retain size very well all season.
Samuri S10	72	Race 1-10 intermediate resistance, Tobamovirus 0 resistant, very dark green uniformly shaped and sized fruit with very low silvering, good for early market.
Boca	73	Race 1-10 resistant, intermediate resistance to TSWV, very dark green thick walled fruit, good for early market.
Currier	73	Race 1-3 resistant, TMV, PVY 0, 1, 1-2, PepMoV, PepYMV, and intermediate resistance to CMV and *Phytophthora* blight. Blocky, large to extra-large fruit.
Sdy 48	73	Race 1-10 resistant, very dark green, large-jumbo fruit.
Green Flash	74	Race 1-10 intermediate resistance, dark green blocky X-large-jumbo fruit, attractive.
Alliance	74	Race 1, 2, 3, 5 resistant, PVY 0, 1, 1-2, TMV, PepMoV, Pep YMV with intermediate resistance to CMV, high yields, light to medium green fruit, little silvering..
Revolution	74	Race 1, 2, 3, 5 resistant, CMV and *Phytophthora blight* intermediate resistance, light to medium green fruit, may flatten in very hot weather.
PS 9928302	75	Race 1-5 resistant, TMV 1-3 resistant; very large to jumbo, dark green fruit.
Karisma	75	Race 1, 2, 3 intermediate resistance, resistant to TMV, PVY 0, 1, 1-2. Intermediate resistance to PepMoV, PepYMV, and CMV. Blocky, large to extra-large fruit.
Colored Bell		
Mavras	68	TMV, large blocky deep purple fruit (for trial).
Milena	70	Race 0, 1, 2, 3 resistant, PVY 0 intermediate resistance, TSWV intermediate resistance, orange fruit
Early Sunsation	70	Race 1, 2, 3 resistant, PVY tolerant, green to golden yellow, blocky.
SPECIALTY		
Cherry		
Cherry Bomb	68	High yielding, very hot; TMV resistance
Cherry Hot 102	70	Moderate heat level
Large Red Cherry	75	Very hot, 1¼ inch diameter fruits.
Pimento		
Pimento Elite (hybrid)	87	Heart-shaped, 3 x 3 inches, tapered.

(continued on next page)

VARIETIES: Peppers *(continued)*

Variety	DTM[1]	Comments
Jalapeño (all are F1 hybrids)		
Baluarte	71	Race 1, 2, 3 resistant; large fruit, low cracking
Tormenta	72	Race 1, 2, 3 resistant, TEV, large upright plant with thick fruit, average heat.
El Jefe	72	Bacterial spot resistant (races 1, 2, 3); dark green.
Banana and Wax		
Inferno	60-65	Hot banana, thick walled fruits, yellow and red.
Blazing Banana	60-70	Very hot; Race 1, 2, 3 resistant; thick walled
Hungarian Yellow Wax	65-70	Yellow to orange red, mildly hot, fruit 6 to 6.5 inches long, tapered.
Sweet Spot (X3R)	70	Race 1, 2, 3 resistant, banana, light yellow to red, 2 x 8 inches.
Italian/Cubanelle		
Aruba	65	High yielding, 2 x 7.5 inches, light green to pale yellow.
Corno di Toro	70-75	Light to medium green, 8 inches long, tapered, large plant, heirloom type from Italy.
Key West X3R	70-75	Light green, 2.5 x 7.5 inches, bacterial spot resistant (races 1, 2, 3).
Carmen	75	Green to red, fruit 7 inches long, AAS winner.
Poblano/Ancho		
San Ardo	75	Dark green to red, early and productive.
Tiburon	80	Dark green, 2.5 x 5.5 inches, high yields, sturdy plant.
Anaheim		
Anaheim TMR 23	75	Thick walled, 8 inches long, TMV tolerant.
Anaheim 118	75	Thick fleshed, light green to red
Serrano		
Serrano del Sol	70-72	High yielding and attractive fruits, 0.5 x 3.5 inches, tolerance to PMV and PVY.

1 Days to Maturity
Most of these have been tested at two or more locations by the University of Kentucky. We recommend that only bacterial spot resistant varieties be used. See "Common Diseases and Management" for more information on management of this important disease.

VARIETIES: Tomatoes—Fresh Market

Variety	DTM[1]	Comments
LARGE RED (ALL ARE DETERMINATE HYBRIDS)		
Defiant	67	High-yielding, mid-sized, globe shaped fruit. Disease resistance: Late blight, *Fusarium* race 1, 2, and *Verticillium*; Intermediate resistance: Early blight
Primo Red	68	Excellent vine ripe tomato for early plantings. Resistant to *Verticillium*, *Fusarium* race 1, 2, Tomato Mosaic Virus, and intermediate resistance to Tomato Spotted Wilt Virus. Crown set can have a pronounced, pointed blossom end. Performs well in high tunnel.
Red Deuce	71	Very large smooth fruit. Fruit size holds with average fruit weight 1 lb. Good for soilless production. Disease resistance: *Fusarium* race 1, 2, *Verticillium* race 1, Alternaria stem canker, Gray Leaf Spot.
Mountain Spring	72	Earliest of "Mountain" series; crack-resistant fruits; excellent for shipping. Spring and summer planting. Highly susceptible to Early blight. Disease resistance: *Fusarium* race 1, 2, *Verticillium* race 1
Phoenix	72	Good for later plantings, sets well in high temperatures. Disease resistance: Alternaria stem canker, *Fusarium* race 2, Verticillium Wilt 1
Amelia	75	Resistant to nematodes and intermediate resistance to tomato spotted wilt virus (TSWV). Disease resistance: *Fusarium* race 1, 2, 3, *Verticillium*, TSWV
Florida 47 R	75	Good yield and nice uniform 10-12 oz fruit. Disease resistance: Alternaria stem canker, *Fusarium* race 1, 2, *Verticillium* race 1, and gray leaf spot.
Rocky Top	76	Large smooth uniform fruit averaging 3/4 lb. Good for high tunnels production as well. Disease resistance: *Fusarium* race 1, 2, 3, and Gray Leaf Spot.
Mountain Fresh Plus	77	Crack-resistant fruit, mid-season; excellent flavor; for local sales or shipping. Disease resistance: *Fusarium* race 1, 2, *Verticillium* race 1, nematodes, Early blight tolerance
Red Defender	77	Good midseason variety, mostly large and extra-large fruits, uniform. Disease resistance: *Fusarium* race 1, 2, *Verticillium* race 1, TSWV, Alternaria stem canker
BHN 602	77	10-12 oz globe fruit with high yields good mid- and late-season tomato. Disease resistance: *Fusarium* race 1, 2, 3, *Verticillium* race 1, TSWV
BHN 589	75	8-10 oz. fruit. Plant is well-adapted to high tunnel growing conditions. High yield potential with large, deep red fruit. Excellent flavor and shelf life. Disease resistance: *Fusarium* wilt (races 1 and 2), TMV, and *Verticillium* wilt.

(continued on next page)

VARIETIES: Tomatoes—Fresh Market *(continued)*

Variety	DTM[1]	Comments
ROMA/PEAR/PASTE		
Pony Express	69	Concentrated early fruit set allows for short harvest window, 4 oz fruit, good performer in Kentucky. Disease resistance: *Fusarium* race 1, 2, 3, *Verticillium*, TMV, nematodes
Plum Crimson	80	Determinate hybrid; contains gene for early dark red interior color, high lycopene content, productive and Early blight tolerant. Disease resistance: *Fusarium* race 1, 2, 3, *Verticillium* race 1
Plum Regal	80	Pear/plum-shaped, high yielding variety, 4 oz. fruits. Disease resistance: *Fusarium* race 1, 2, *Verticillium*, TSWV, Late blight, Early blight
YELLOW/GOLD FRUIT		
Carolina Gold	72	Determinate; large, tangerine-colored, smooth, crack-resistant fruit for shipping or local sales. Early to midseason with resistance to gray wall; also excellent for fried green tomatoes. Tangerine color. Disease resistance: *Fusarium* race 1, 2, *Verticillium* race 1, susceptible to Early blight and bacterial leaf spot.
BHN 871	74	Determinate; large orange fruit, globe-shaped. Disease resistance: *Fusarium* race 1, 2, *Fusarium* crown and root rot, TMV, *Verticillium*.
GRAPE		
Golden Sweet	60	Indeterminate hybrid. Crack resistant, deep yellow fruit with mild flavor. Disease resistance: leaf mold, *Fusarium* wilt race 1.
Tami G	60	Indeterminate hybrid.½ to ¾ oz oval fruit, vigorous, yields well and picks for an extended season.
Smarty	68	Indeterminate hybrid. Compact plant, small 1⁄2 to 1 oz fruit. Disease resistance: *Fusarium* race 1, *Verticillium*
Mountain Honey	71	Semi-Indeterminate, ½-3/4 oz deep red fruit. Disease resistance: *Fusarium* race 3, Late blight, TSWV
CHERRY		
Sun Gold	57	Indeterminate hybrid. Bright orange, tendency to split. Disease resistance: *Fusarium* wilt, TMV.
Sun Sugar	62	½-3/4 oz yellow very sweet excellent flavored fruit, indeterminate plant. Disease resistance: *Fusarium* and TMV.
BHN 268	65-68	1 oz fruit, good shipper and shelf life. Disease resistance: *Fusarium* race 2, *Verticillium*
Sweet Chelsea	65	Indeterminate—1½ inch diameter very sweet fruit. Shipping and local sales. Disease resistance: *Fusarium* race 1, 2, *Verticillium*, Nematodes, TMV
Mountain Magic	72	Larger saladette type, indeterminate, excellent flavor. Disease resistance: *Fusarium* race 1, 2, Early blight, Late blight, *Verticillium*
HYDROPONIC		
Big Beef (see comments)	70	Not a true hydroponic variety, but successfully grown for spring-early summer hydroponic production, not for full season (10 month) production (yields decline after 6 months). Disease resistance: *Fusarium* race 2, *Verticillium*, Nematodes, Alternaria stem canker
Geronimo	78	Extremely vigorous plants, high yields, small stem scar, good performer. Disease resistance: *Fusarium* race 2, *Verticillium*, TMV
Bigdena	73	Large to extra-large fruit, uniform shape, good shelf life. Disease resistance: Leaf mold, *Fusarium* race 0, 1, ToMV, and TMV
Arbason	76	7-9 oz fruit with good yields and quality. Disease resistance: *Fusarium* race 1, 2, *Verticillium*, ToMV
INDETERMINATE, SPECIALTY, AND HEIRLOOM[2]		
Better Boy	72	Indeterminate, large fruit. On-farm and local sales only. Spring planting. Disease resistance: *Fusarium* race 1, *Verticillium*, Root-knot nematode
Lemon Boy	72	Yellow, indeterminate F1 hybrid for local sales; spring and summer planting. Disease resistance: *Verticillium* race 1, *Fusarium*, nematodes
Pink Girl	76	Hybrid, indeterminate. For local sales. Disease resistance: *Verticillium* race 1, *Fusarium* race 1
Delicious	77	Very large 1 1/2 to 2 1/2 lb fruit; solid red with small seed cavities; resists cracking.
San Marzano	78	Heirloom, indeterminate. Small oblong 5 to 6 oz fruit, meaty flesh, good for canning, high quality fruit. Disease resistance: *Fusarium* race 2, *Verticillium*
Mortgage Lifter	85	Heirloom, indeterminate. Large 1 lb fruit, pink, smooth and uniform in size, very meaty with few seeds; very heavy producer.
Arkansas Traveler	85	Heirloom, indeterminate. Medium 1/2 lb fruit, pink, smooth and uniform, good producer in hot weather.
Kentucky Beefsteak	90	Open-pollinated, indeterminate. Medium 1/2 lb fruit, yellow-orange with deep ridges at stem end; retains green shoulders on stem end when ripe.

(continued on next page)

VARIETIES: Tomatoes—Fresh Market *(continued)*

Variety	DTM[1]	Comments
Giant Belgium	90	Heirloom, indeterminate. Large 1 to 2 lb and larger fruit; solid dark pink flesh; very sweet; less cracking than other heirlooms; heavy producer.
German Johnson	80-90	Open-pollinated, indeterminate. Large-fruited "heirloom;" for local sales. Susceptible to cracking and roughness.
Big Rainbow	90-100	Heirloom, indeterminate. Large 1 to 2 lb fruit, meaty, golden orange-yellow with red stripes radiating from blossom end; prone to cracking.

1 Days to maturity

2"Heirloom" tomato varieties are popular for farm market and local sales. Growers should be aware that seed of some of these varieties may have become contaminated with TMV, clavibacter (canker), and Xanthomonas (bacterial spot), and should not be grown adjacent to plantings of other commercial varieties. Indeterminate varieties are best grown using wider in-row spacings of 24 to 36 inches and longer stakes (6 feet) or cages. UK trials of two popular varieties, "Brandywine" and "Cherokee Purple," have shown that fruit quality and appearance are highly variable from year to year; this variability likely stems from different seed sources. Growers are encouraged to test varieties from different sources before large-scale plantings.

FERTILIZER: Eggplant

Soil Test Results (lb/A)		Fertilizer Needed (lb/A)
Phosphorus		**Phosphate (P_2O_5)**
Low	<31	181-240
Medium	31-60	121-180
High	61-80	61-120
Very High	>80	0-60
Potassium		**Potash (K_2O)**
Low	<201	101-150
Medium	201-300	51-100
High	301-450	1-50
Very High	>450	0
Nitrogen		**N**

Apply 75 lb nitrogen (N)/A before transplanting. Broadcast and disk well with other fertilizer. Sidedress plants with 35 to 40 lb of N/A when first fruit appear. Too much N can delay fruiting and lead to large plants that fall over. See "Fertigation" table for N recommendations using plastic mulch and drip irrigation.

FERTILIZER: Peppers

Soil Test Results (lb/A)		Fertilizer Needed (lb/A)
Phosphorus		**Phosphate (P_2O_5)**
Low	<31	81-100
Medium	31-60	61-80
High	61-80	1-60
Very High	>80	0
Potassium		**Potash (K_2O)**
Low	<201	81-100
Medium	201-300	61-80
High	301-450	1-60
Very High	>450	0
Nitrogen		**N**

Peppers use approximately 100 to 150 lb of N/A. Apply 25 to 50 lb of N/A preplant. Rate to use will vary depending on previous crop and general fertility of the soil. Following sod, apply 50 lb of N/A prior to planting. After fruit begin setting, sidedress with another 30 to 50 lb of N/A. Two weeks later, make an additional application of 30 to 50 lb of N/A. For N fertigation, see comments in text and specific recommendations in the "Fertigation" table.

FERTILIZER: Tomatoes

The following fertilizer rates are to be used only as guidelines. Research at the University of Kentucky and at the University of Tennessee indicates that there is no yield increase from using more than 60 lb/A of P_2O_5 when soil test P levels are high.

Soil Test Results (lb/A)		Fertilizer Needed (lb/A)
Phosphorus		**Phosphate (P_2O_5)**
Low	<31	181-240
Medium	31-60	61-180
High	61-80	1-60
Very High	>80	0
Potassium		**Potash (K_2O)**
Low	<201	121-250
Medium	201-300	61-120
High	301-450	1-60
Very High	>450	0
Basal nitrogen where tomatoes:		**N**
1. follow grass-legume or legume sod		30
2. follow grass sod		50
3. are grown on continually cropped land		60

Supplemental applications: On bare ground plantings, apply an additional 30 lb of N/A as a sidedressing when the first fruits are golf-ball size. A second sidedress application of 30 lb N/A may also be desirable two or three weeks later, depending on the crop's growing condition. For plasticulture with drip on medium-textured soils, apply all recommended phosphorus and potassium requirements prior to laying plastic mulch. See "Fertigation" table for N application rates.

FERTIGATION: Eggplant[1]

Actual N/week:	6 lb/A
Calcium Nitrate	38 lb 11 oz/A 8 lb 14 oz/1,000 plants

Total amount/season: 120 lb/A

Preplant amount: 60 lb/A

Fertigated amount: 60 lb/A

Growing season: 10 weeks

Fertigation can begin 10 to 14 days after transplanting.

The doses listed for 1,000 plants are based on a plant population of 4,356 plants/A (i.e., rows on 5 foot centers and plants 24 inches apart).

For seasons extending beyond 10 weeks from transplanting, a maintenance dose of 1 to 1.5 lb N/week/A (6.5 to 9.7 lb calcium nitrate) is adequate.

1 All recommendations assume starter fertilizer was used.

FERTIGATION: Bell Peppers[1]

Moderate Rate

Actual N/week:	6 lb 4 oz/A
Calcium Nitrate	40 lb/A 3 lb/1,000 plants

High Rate

Actual N/week:	8 lb 5 oz/A
Calcium Nitrate	54 lb/A 4 lb/1,000 plants

Total amount/season: 125 lb/A (moderate rate)

150 lb/A (high rate)

Preplant amount: 50 lb/A

Fertigated amount: 75 lb/A (moderate rate)

100 lb/A (high rate)

Growing season: 12 weeks

Fertigation should begin about 2 weeks after transplanting.

The dose for 1,000 plants is based on a plant population of 14,500 plants/A (i.e., double rows on 6 foot centers with plants 12 inches apart in the rows).

For seasons extending beyond 12 weeks, a maintenance dose of 1 to 1.5 lb N/A/week is adequate

1 All recommendations assume starter fertilizer was used.

FERTIGATION: Staked Tomatoes[1]

Moderate Rate

Actual N/week:	7 lb 8 oz/A
Calcium Nitrate	48 lb 6 oz/A 11 lb 8 oz/1,000 plants

High Rate

Actual N/week:	10 lb/A
Calcium Nitrate	64 lb 8 oz/A 15 lb 6 oz/1,000 plants

AT-RISK SITES

Moderate Rate

Actual N/week:	7 lb 8 oz/A
Potassium Nitrate	57 lb 11 oz/A 13 lb 12 oz/1,000 plants
Potassium Nitrate: K provided	25 lb 6 oz/A 6 lb 1 oz/1,000 plants

High Rate

Actual N/week:	10 lb/A
Potassium Nitrate	76 lb 15 oz/A 18 lb 5 oz/1,000 plants
Potassium Nitrate: K provided	33 lb 14 oz/A 8 lb 1 oz/1,000 plants

Total amount/season: 125 lb/A (moderate rate)

150 lb/A (high rate)

Preplant amount: 50 lb/A

Fertigated amount: 75 lb/A (moderate rate)

100 lb/A (high rate)

Growing season: 10 weeks

Fertigation can begin 10 to 14 days after transplanting.

The doses for 1,000 plants are based on a plant population of 4,200 plants/A (i.e., rows on 6 foot centers in 5-row blocks and plants 18 inches apart).

For harvest seasons extending beyond 10 weeks from transplanting, a maintenance dose of 1 to 1.5 N (6.5 to 9.7 lbs of calcium nitrate, or 11.5 lbs of potassium nitrate for "at risk" sites) per week is adequate.

IMPORTANT: If growing tomatoes, be sure to enter "tomato" into the "Crop to be Grown" category on your soil test. UK soil testing will provide you with a Hartz ratio that will indicate if your plants may be at risk for ripening disorders. Potassium nitrate supplies both nitrogen and potassium and can be used as a substitute for calcium nitrate.

1 All recommendations assume starter fertilizer was used.

PESTICIDE SAFETY: Eggplant, Peppers, and Tomatoes

	Signal[1]	Re-entry (hrs)	Harvest (days)
INSECTICIDES			
Acramite 50 WS	C	12	3
Actara 25 W	C	12	0
Admire Pro	C	12	0/21[4]
Assail 30 SG	C	12	7
Avaunt eVo 30 DG	C	12	3
Azera	C	12	0
Belay 50 WDG	C	12	7/AP
Beleaf 50 SG	C	12	0
Bt products	C	4/12	0
Coragen 1.67 SC	-	4	1
Courier 40 SC	W	12	1
Dimethoate 4 E	W	48	7
Entrust 2 SC	C	4	1
Exirel 0.83 SE	C	21	1
Fulfill 50 DF	C	12	0
Grandevo 30 W	C	12	1
Harvanta 50 SL	C	4	1
Intrepid 2 F	C	4	1
Kanemite 15 SC	C	12	1
Knack 0.86 EC	C	12	1
Magister SC	W	12	3
Malathion 8	C	12	1/3[4]
Miteus 0.42 EC	W	12	1
Movento 2	C	24	1
Nealta 1.67 SC[2]	C	12	3
Oberon 2 SC	C	12	1
Orthene 97 S[2]	C	24	7
Platinum 2 SC	C	12	30
Portal 0.4 EC	W	12	1
PQZ 1.87 SC	C	12	1
Pyganic 5 EC	C	12	0
Pylon 0.5 EC	C	12	0
Radiant SC	C	4	1
Requiem 25 EC	C	4	0
Rimon 0.83 EC	W	12	1
Scorpion 3.5 SL	C	12	1/21[4]
Sefina 0.42 SC	C	12	0
Sevin XLR Plus	W	12	3
Sivanto Prime 1.67 SL	C	12	1/45[4]
Torac 1.29 EC	W	12	1
Transform 50 WG	D	24	1
Trident	C	4	0

(continued)

PESTICIDE SAFETY: Eggplant, Peppers, and Tomatoes *(continued)*

	Signal[1]	Re-entry (hrs)	Harvest (days)
Trigard 75 WP	C	12	0
Venom 70 SG	C	12	1/21[4]
Verimark 1.67 SC	-	4	1
Zeal 72 WP[2]	C	12	7
Restricted Use			
AgriMek 0.7 SC	W	12	7
Asana XL	W	12	1
Baythroid XL	W	12	0/7[4]
Brigade 2 EC	W	12	1/7[4]
Danitol 2.4 EC	W	24	3
Diazinon AG 500[2]	C	24	1
Diazinon 50 W[2]	C	24	1
Fastac 0.83 EC	D	12	1
Lannate 90 SP	DP	48	1/3/5[4]
Mustang Maxx	W	12	1
Permethrin 3.2 EC	C	12	0/3[4]
Proaxis 0.5 EC	C	24	5
Proclaim 5 WDG	C	48	7
Vydate L	DP	48	3
Warrior II	W	24	5
FUNGICIDES			
Actigard 50 WG	C	12	14
Aprovia Top	W	12	0
Ariston	C	12	3
Azoxystrobin[3]	C	4	0
Blocker 4F	C	12	0
Botran 75 W	C	12	10
Cabrio EG	C	12	0
Chlorothalonil[3]	D	12	0
Fixed coppers[3]	D	24/48[5]	0
Curzate 60 DF	W	12	3
Dexter Max	C	24	5
Dexter XCEL	C	24	7
Endura	W	12	0
Fluoxastrobin[3]	C	12	3
Fontelis	C	12	0
Forum	C	12	4
Fracture	C	4	0
Gavel 75 DF	C	48	3
Inspire Super	C	12	0
Luna Sensation	C	12	3
Luna Tranquility	C	12	1
Mancozeb[3]	C	24	5
ManKocide	D	24	5

(continued)

PESTICIDE SAFETY: Eggplant, Peppers, and Tomatoes *(continued)*

	Signal[1]	Re-entry (hrs)	Harvest (days)
Mandipropamid[3]	C	4	1
Mefenoxam[3]	C/W	48	7/28
Metalaxyl[3]	W	48	28
Miravis Prime	C	12	0
Orondis Gold 200	C	4	0
Orondis Opti	D	12	0
Orondis Ultra	C	4	1
Presidio	C	12	2
Previcur Flex	C	12	5
Priaxor	C	12	7
Pyraclostrobin[3]	C	12	0
Quadris Opti	W	12	0
Quadris Top	C	12	0
Rally 40 WSP	W	24	0
Ranman	C	12	0
Reason 500 SC	C	12	14
Revus Top	C	12	1
Rhyme	W	12	0
Ridomil Gold Bravo SC	W	48	14
Ridomil Gold Copper	D	48	14
Ridomil Gold MZ	C	48	5
Scala	C	12	1
Streptomycin[3]	C	12	n/a
Switch 62.5 WG	C	12	0
Tanos	C	12	3
Trifloxystrobin[3]	C	12	3
Topguard	C	12	0
Torac	W	12	1
Torino	C	12	0
Velum	C	12	7
Vivando	C	12	0
Zampro	C	12	4
Zing!	C	12	5
Ziram[3]	D	48	7

1 W: Warning, C: Caution, D: Danger; P: Poison
2 Not all insecticides can be used on all listed crops. Check labels carefully.
3 Several formulations are marketed. See the general introduction for more details on fungicides.
4 Dependent on crop, application rates and types see label.
5 Varies by formulation; consult labels carefully.

INSECT CONTROL: Fruiting Vegetables - Eggplant, Peppers,Tomatoes[1,2]

Insecticide	Product Amt/A	Seasonal Limit/A	Comments and Other Restrictions
Soil Application			
Aphids, Flea Beetles, Colorado Potato Beetle: Do not use foliar sprays of Actara, Assail, Belay, Provado, or Venom following soil applications of Admire, Belay, Platinum, or Venom.			
Admire Pro	7 to 14 fl oz	14 fl oz	See label for application methods. Use lower rate (10.5) for tomato and eggplant.
Belay 50 WDG	4.8 to 6.4 oz	6.4 oz	Apply at planting.
Coragen 1.67 SC	3.5 to 7.5 fl oz	15.4 fl oz	Soil and foliar applications possible for CPB. See label for limitations.
Platinum 2 SC	5 to 11 fl oz	11 fl oz	See label for application alternatives. Also, helps to control thrips.
Sivanto Prime 1.67 SL	21 to 28 fl oz	28 fl oz	For aphids and whiteflies.
Venom 70 SG	5 to 7.5 oz	12 oz	
Verimark 1.67 SC	6.75 to 13.5 fl oz	13.5 or 31.5 fl oz	At planting or through dripline.
Foliar Application			
Aphids: Treat if aphids are found on 50% of leaves.			
Actara 25 WDG	2 to 3 oz	11 oz	Allow 5 days between applications. Not during bloom. Field use only.
Admire Pro	1.3 to 2.2 fl oz	6.7 fl oz	Allow 5 days between applications. Not during bloom.
Assail 30 SG	2 to 4 oz	16 oz	Limit 4 applications. Allow 7 days between applications.
Belay 50 WDG	1.6 to 2.1 oz	6.4 oz	Allow 10 days between applications.
Beleaf 50 WDG	2.8 to 4.28 oz	8.4 oz	Allow 7 days between applications.
Dimethoate 4 E	8 to 16 fl oz	16 fl oz	Allow 6 days between applications. Not for use on eggplant, use lower rate for peppers.
Exirel 0.83 SE	13.5 to 20.5 fl oz	61.5 fl oz	Allow 5 days between applications.
Fulfill 50 DF	2.75 oz	5.5 oz	Allow 7 days between applications.
Lannate 90 SP	0.25 to 1 lb	4, 5 or 7 lb	Limit 8, 10 or 16 applications. Total use depends on crop treated.
Malathion 8	1.5 pt	2 or 4 applications	Allow 5 days between applications. Application limits depend on crop treated.
Movento 2 SC	4 to 5 fl oz	10 fl oz	Allow 7 days between applications. Field use only. Requires surfactant.
PQZ 1.87 SC	2.4 to 3.2 fl oz	4.8 fl oz	Limit 2 applications. Allow 7 days between applications.
Sefina 0.42 SC	3 fl oz	28 fl oz	Allow 7 days between applications.
Sivanto Prime 1.67 SL	7 to 14 fl oz	28 fl oz	Allow 7 days between applications.
Torac 1.29 EC	17 to 21 fl oz	42 fl oz	Limit 2 applications. Allow 14 days between applications.
Transform 50 WG	0.75 to 1 oz	8.5 oz	Allow 7 days between applications. Limit 4 applications.
Beet Armyworm: First detected in Kentucky in 1993, this insect can cause serious losses to pepper and tomato when present. Large larvae are difficult to control effectively with insecticides.			
Avaunt eVo	3.5 to 6 oz	24 oz	Allow 5 days between applications. Limit 4 applications.
Coragen 1.67 SC	3.5 to 7.5 fl oz	15.4 fl oz	Soil and foliar applications possible. See label for limitations.
Exirel 0.83 SE	7 to 13.5 fl oz	61.5 fl oz	Allow 5 days between applications.
Harvanta 50 SL	10.9 to 16.4 fl oz	49.2 fl oz	Allow 7 days between applications.
Intrepid 2 F	4 to 16 fl oz	64 fl oz	Allow 7 days between applications. Limit 4 applications.
Proclaim 5 WDG	2.4 to 4.8 oz	14.4 oz	Allow 7 days between applications.
Pylon 0.125	6.5 to 13 fl oz	39 fl oz	Allow 5 days between applications. For greenhouse use only.
Radiant SC	5 to 10 fl oz	34 fl oz	Allow 4 days between applications.
Rimon 0.83 EC	9 to 12 fl oz	36 fl oz	Allow 7 days between applications.
Colorado Potato Beetle: This is a pest of tomato transplants and eggplant. This pest has the ability to develop resistance to all major classes of insecticides. Do not tank-mix insecticides with the same mode of action and frequently rotate among insecticides with different modes of action to discourage resistance. Treat for Colorado potato beetle if an average of 1 adult larva or egg mass per plant is found and plants are less than 12 inches tall (staked). IRAC Codes: Insecticides followed by the same number share the same mode of action.			
Actara 25 W (4A)	2 to 3 oz	11 oz	Allow 5 days between applications. Not during bloom.
Admire Pro (4A)	1.3 to 2.2 fl oz	6.7 fl oz	Allow 5 days between applications. Not during bloom.
AgriMek 0.7 SC (6)	1.75 to 3.5 fl oz	10.25 fl oz	Allow 7 days between applications. Must use non-ionic surfactant.
Assail 30 SG (4A)	1.5 to 2.5 oz	16 oz	Limit 4 applications. Allow 7 days between applications.

(continued on next page)

INSECT CONTROL: Fruiting Vegetables - Eggplant, Peppers,Tomatoes[1,2] *(continued)*

Insecticide	Product Amt/A	Seasonal Limit/A	Comments and Other Restrictions
Belay 50 WDG (4A)	1.6 to 2.1 oz	6.4 oz	Allow 10 days between applications.
Coragen 1.67 SC (28)	3.5 to 7.5 fl oz	15.4 fl oz	Soil and foliar applications possible. See label for limitations.
Exirel 0.83 SE (28)	7 to 13.5 fl oz	61.5 fl oz	Allow 5 days between applications.
Harvanta 50 SL (28)	10.9 to 16.4 fl oz	49.2 fl oz	Allow 7 days between applications.
Radiant SC (5)	5 to 10 fl oz	34 fl oz	Allow 4 days between applications.
Rimon 0.83 EC (15)	9 to 12 fl oz	36 fl oz	Allow 7 days between applications.
Sivanto Prime 1.67 SL (4D)	10.5 to 14 fl oz	28 fl oz	Allow 7 days between applications.
Torac 1.29 EC (21A)	14 to 21 fl oz	42 fl oz	Limit 2 applications. Allow 14 days between applications.
Trident (11A)	3 to 6 qt	-	-
Venom 70 SG (4A)	1 to 4 oz	6 oz	For foliar applications.
Cutworms: Eliminate weeds from field margins and plow fields at least 2 weeks before planting to destroy cutworm food sources and egg laying sites.			
Asana XL	5.8 to 9.6 fl oz	67 or 96 fl oz	Allow 7 days between applications. For cutworm control on tomato only.
Brigade 2 E	2.1 to 5.2 or 6.4 fl oz	12.8 or 25.6 fl oz	Allow 7 or 10 days between applications. Rate and application limitations depend on crop.
Fastac 0.83 EC	2.2 to 3.8 fl oz	11.4 fl oz	Allow 7 days between applications.
Mustang Maxx	2.24 to 4 fl oz	24 fl oz	Allow 7 days between applications.
Proaxis 0.5 EC	1.92 to 3.2 fl oz	46 fl oz	Allow 5 days between applications.
Sevin XLR Plus	2 qt	8 qt	Limit 7 applications. Allow 7 days between applications.
Warrior II	0.96 to 1.6 fl oz	23 fl oz	Allow 5 days between applications.
European Corn Borer: Key insect pest of peppers. Use pheromone traps to monitor for adult activity. Begin applications when trap catches or moths exceed 10 moths per week.			
Asana XL	5.8 to 9.6 fl oz	67.2 fl oz	Allow 7 days between applications.
Baythroid XL	1.6 to 2.8 fl oz	16.8 fl oz	Allow 7 days between applications.
Brigade 2 E	2.1 to 6.4 fl oz	12.8 fl oz	Allow 7 days between applications.
Coragen 1.67 SC	3.5 to 7.5 fl oz	15.4 fl oz	Foliar, drip, and soil applications possible. See label for limitations.
Exirel 0.83 SE	7 to 13.5 fl oz	61.5 fl oz	Allow 5 days between applications. Use an adjuvant.
Fastac 0.83 EC	2.2 to 3.8 fl oz	11.4 fl oz	Allow 7 days between applications.
Harvanta 50 SL	10.9 to 16.4 fl oz	49.2 fl oz	Allow 7 days between applications.
Intrepid 2 F	4 to 16 fl oz	64 fl oz	Limit 4 applcations. Allow 7 days between applicatrions.
Mustang Maxx	2.24 to 4 fl oz	24 fl oz	Allow 7 days between applications.
Orthene 97 S	0.75 to 1 lb	2.12 lb	Bell peppers only. Allow 3 days between applications.
Permethrin 3.2 EC	8 fl oz	32 fl oz	Bell peppers only. Allow 5 days between applications.
Proaxis 0.5 EC	2.56 to 3.84 fl oz	46 fl oz	Allow 5 days between applications.
Radiant SC	5 to 10 fl oz	34 fl oz	Allow 4 days between applications.
Rimon 0.83 EC	9 to 12 fl oz	36 fl oz	Allow 7 days between applications.
Sevin XLR Plus	1 to 2 qt	8 qt	Limit 7 applications. Allow 7 days between applications.
Warrior II	1.28 to 1.92 fl oz	23 fl oz	Allow 5 days between applications.
Fruitworms: Pests of pepper and tomato. Carefully monitor plants for eggs on undersides of leaves, often near flower clusters. Treat if an average of more than 1 egg or larvae per 40 plants is found.			
Asana XL	5.8 to 9.6 fl oz	67 or 96 fl oz	Allow 7 days between applications.
Avaunt eVo	3.5 to 6 oz	24 oz	Allow 5 days between applications. Limit 4 applications.
Baythroid XL	1.6 to 2.8 fl oz	16.8 fl oz	Allow 7 days between applications.
Brigade 2 E	2.1 to 5.2 or 6.4 fl oz	12.8 or 25.6 fl oz	Allow 7 or 10 days between applications. Rate and application limitations depend on crop.
Coragen 1.67 SC	3.5 to 7.5 fl oz	15.4 fl oz	Soil and foliar applications possible. See label for limitations.
Danitol 2.4 EC	10.67 fl oz	42.6 fl oz	Allow 7 days between applications.
Fastac 0.83 EC	2.2 to 3.8 fl oz	11.4 fl oz	Allow 7 days between applications.
Harvanta 50 SL	10.9 to 16.4 fl oz	49.2 fl oz	Allow 7 days between applications.
Lannate 90 SP	0.5 to 1 lb	5 or 7 lb	Limit 10 or 16 applications. Not for fruitworms on peppers. Application limitations depend on crop.
Mustang Maxx	2.24 to 4 fl oz	24 fl oz	Allow 7 days between applications.
Permethrin 3.2 EC	2 to 8 fl oz	24 or 32 fl oz	Not for use on cherry tomatoes. Allow 5 or 7 days between applications. Application limitations depend on crop.

(continued on next page)

INSECT CONTROL: Fruiting Vegetables - Eggplant, Peppers,Tomatoes[1,2] *(continued)*

Insecticide	Product Amt/A	Seasonal Limit/A	Comments and Other Restrictions
Proaxis 0.5 EC	2.56 to 3.84 fl oz	46 fl oz	Allow 5 days between applications.
Radiant SC	5 to 10 fl oz	34 fl oz	Allow 4 days between applications.
Rimon 0.83 EC	9 to 12 fl oz	36 fl oz	Allow 7 days between applications.
Sevin XLR Plus	1 to 2 qt	8 qt	Limit 7 applications. Allow 7 days between applications.
Warrior II	1.28 to 1.92 fl oz	23 fl oz	Allow 5 days between applications.
Grasshoppers			
Asana XL	5.8 to 9.6 fl oz	96 fl oz	Allow 7 days between applications. For hornworm control on tomato only.
Brigade 2 E	2.1 to 5.2 fl oz	25.6 fl oz	Allow 10 days between sprays. For grasshopper control on tomato.
Fastac 0.83 EC	3.2 to 3.8 fl oz	11.4 fl oz	Allow 7 days between applications.
Mustang Maxx	3.2 to 4 fl oz	24 fl oz	Allow 7 days between applications.
Proaxis 0.5 EC	2.56 to 3.84 fl oz	46 fl oz	Allow 5 days between applications.
Warrior II	1.28 to 1.92 fl oz	23 fl oz	Allow 5 days between applications.
Hornworms: A pest of tomato. Treat if an average of more than 1 hornworm per 5 plants is found.			
Asana XL	2.9 to 5.8 fl oz	67 or 96 fl oz	-Allow 7 days between applications. For grasshopper control on tomato.
Avaunt eVo	2.5 to 6 oz	24 oz	Allow 5 days between applications. Limit 4 applications.
Baythroid XL	1.6 to 2.8 fl oz	16.8 fl oz	Allow 7 days between applications.
Bt var kurstaki products	See labels	-	-
Coragen 1.67 SC	2 to 5 fl oz	15.4 fl oz	Soil and foliar applications possible. See label for limitations.
Fastac 0.83 EC	2.2 to 3.8 fl oz	11.4 fl oz	Allow 7 days between applications.
Harvanta 50 SL	10.9 to 16.4 fl oz	49.2 fl oz	Allow 7 days between applications.
Intrepid 2 F	4 to 16 fl oz	64 fl oz	Allow 7 days between applications. Limit 4 applications.
Lannate 90 SP	0.5 to 1 lb	7 lb	Limit 16 applications. For hornworm control on tomato.
Mustang Maxx	2.24 to 4 fl oz	24 fl oz	Allow 7 days between applications.
Permethrin 3.2 EC	2 to 8 fl oz	24 fl oz	Allow 7 days between applications. For hornworm control on tomato varieties over 1 inch in diameter.
Proaxis 0.5 EC	1.92 to 3.2 fl oz	46 fl oz	Allow 5 days between applications.
Radiant SC	5 to 10 fl oz	34 fl oz	Allow 4 days between applications.
Rimon 0.83 EC	9 to 12 fl oz	36 fl oz	Allow 7 days between applications.
Sevin XLR Plus	1 to 2 qt	8 qt	Limit 7 applications. Allow 7 days between applications.
Warrior II	0.96 to 1.6 fl oz	23 fl oz	Allow 5 days between applications.
Flea Beetles: Maintain defoliation below 5 to 10%.			
Asana XL	5.8 to 9.6 fl oz	67 or 96 fl oz	Allow 7 days between applications. Limitations based on crop treated.
Belay 50 WDG	1.6 to 2.1 oz	6.4 oz	Allow 10 days between applications.
Brigade 2 E	2.1 to 5.2 or 6.4 fl oz	12.8 or 25.6 fl oz	Allow 10 days between applications. Limit 2 or 4 applications. Limitations based on crop treated.
Danitol 2.4 EC	10.67 fl oz		
Fastac 0.83 EC	2.2 to 3.8 fl oz	11.4 fl oz	Allow 7 days between applications.
Mustang Maxx	2.24 to 4 fl oz	24 fl oz	Allow 7 days between applications.
Proaxis 0.5 EC	2.56 to 3.84 fl oz	46 fl oz	Allow 5 days between applications.
Scorpion 35 SL	2 to 7 fl oz	10.5 fl oz	Allow 7 days between applications.
Sevin XLR Plus	0.5 to 1 qt	8 qt	Limit 7 applications. Allow 7 days between applications.
Torac 1.29 EC	17 to 21 fl oz	42 fl oz	Limit 2 applications. Allow 14 days between applications.
Venom 70 SG	1 to 4 oz	6 oz	Allow 7 days between applications.
Warrior II	1.28 to 1.6 fl oz	23 fl oz	Allow 5 days between applications.
Mites			
Acramite 50 WS	0.75 to 1 lb	1 application	For spider mites.
AgriMek 0.7 SC	1.75 to 3.5 fl oz	10.25 fl oz	Allow 7 days between applications. For broad, russet, and spider mites. Must use non-ionic surfactant.
Brigade 2 E	2.1 to 5.2 fl oz	12.8 or 25.6 fl oz	Allow 10 days between applications. For end of season control. For spider mites only. Limit 2 or 4 applications. Limitations based on crop treated.
Danitol 2.4 EC	10.67 fl oz	42.6 fl oz	Allow 7 days between applications. For end-of-season control. For spider mites only.

(continued on next page)

INSECT CONTROL: Fruiting Vegetables - Eggplant, Peppers,Tomatoes[1,2] *(continued)*

Insecticide	Product Amt/A	Seasonal Limit/A	Comments and Other Restrictions
Kanemite 15 SC	31 fl oz	62 fl oz	Allow 21 days between applications. For spider and broad mites.
Magister 1.7 SC	24 to 36 fl oz	36 fl oz	Limit 1 application. For spider and broad mites.
Miteus 0.42 EC	2 pt	4 pt	Allow 14 days between applications. Limit 2 applications.
Movento 2 SC	4 to 5 fl oz	10 fl oz	For broad and russett mites. Allow 7 days between applications. Requires surfactant.
Nealta 1.67 SC	13.7 fl oz	27.4 fl oz	Allow 14 days between applications. For spider mites only. Limit 2 applications. For tomato only.
Oberon 2 SC	7 to 8.5 fl oz	25.5 fl oz	Limit 3 applications. For broad, russett, and spider mites.
Portal 0.4 EC	2 pt	4 pt	Limit 2 applications. For broad, russett, and spider mites. Allow 14 days between applications.
Torac 1.29 EC	14 to 21 fl oz	42 fl oz	Limit 2 applications. Allow 14 days between applications. For broad mite only.
Stink Bugs, Leaf-footed Bugs: Treat if an average of more than 1 stink bug per 40 plants or 0.75% damaged fruit is found.			
Actara 25 WDG	3 to 5.5 oz	11 oz	Allow 5 days between applications. Not during bloom.
Baythroid XL	1.6 to 2.8 fl oz	16.8 fl oz	Allow 7 days between applications.
Belay 50 WDG	1.6 to 2.1 oz	6.4 oz	Allow 10 days between applications.
Brigade 2 E	2.1 to 5.2 or 6.4 fl oz	12.8 or 25.6 fl oz	Allow 7 or 10 days between applications. Limit 2 or 4 applications. Limitations based on crop treated.
Danitol 2.4 EC	10.67 to 16 fl oz	42.6 fl oz	Allow 7 days between applications.
Fastac 0.83 Ec	2.2 to 3.8 fl oz	11.4 fl oz	Allow 7 days between applications.
Mustang Maxx	3.2 to 4 fl oz	24 fl oz	Allow 7 days between applications.
Proaxis 0.5 EC	2.56 to 3.84 fl oz	46 fl oz	Allow 5 days between applications.
Rimon 0.83 EC	12 fl oz	36 fl oz	Allow 7 days between applications. For immature control only.
Scorpion 35 SL	2 to 7 fl oz	10.5 fl oz	Allow 7 days between applications.
Warrior II	1.28 to 1.92 fl oz	23 fl oz	Allow 5 days between applications.
Thrips			
Assail 30 SG	4 oz	16 oz	Allow 7 days between applications.
Baythoid XL	2.1 to 2.8 fl oz	16.8 fl oz	Allow 7 days between applications.
Brigade 2 E	2.1 to 5.2 or 6.4 fl oz	12.8 or 25.6 fl oz	Allow 7 or 10 days between applications. . Limit 2 or 4 applications. Limitations based on crop treated.
Radiant SC	6 to 10 fl oz	34 fl oz	Allow 4 days between applications.
Requiem EC	2 to 4 qt	-	-
Rimon 0.83 EC	12 fl oz	36 fl oz	Allow 7 days between applications. For immature control only.
Scorpion 35 SL	2 to 7 fl oz	10.5 fl oz	Allow 7 days between applications.
Torac 1.29 EC	21 fl oz	42 fl oz	Limit 2 applications. Allow 14 days between applications.
Venom 70 SG	1 to 4 oz	6 oz	Allow 7 days between applications.
Whiteflies			
Actara 25 WDG	3.0 to 5.5 oz	11 oz	Allow 5 days between applications. Not during bloom.
Admire Pro	1.3 to 2.2 fl oz	6.7 fl oz	Allow 5 days between applications. Not during bloom.
Assail 30 SG	2.5 to 4 oz	16 oz	Limit 4 applications. Allow 7 days between applications.
Exirel 0.83 SE	13.5 to 20.5 fl oz	61.5 fl oz	Allow 5 days between applications. Use a spray adjuvant.
Fulfill 50 DF	2.75 oz	5.5 oz	Allow 7 days between applications.
Knack 0.86 EC	8 to 10 fl oz	16 fl oz	Allow 14 days between applications. Limit 2 applications.
Movento 2 SC	4 to 5 fl oz	10 fl oz	Allow 7 days between applications. Requires surfactant.
Oberon 2 SC	7 to 8.5 fl oz	25.5 fl oz	Limit 3 applications.
PQZ 1.87 SC	2.4 to 3.2 fl oz	4.8 fl oz	Limit 2 applications. Allow 7 days between applications.
Portal 0.4 EC	2 pt	4 pt	Limit 2 applications. Allow 14 days between applications.
Requiem EC	2 to 3 qt	-	-
Rimon 0.83 EC	12 fl oz	36 fl oz	Allow 7 days between applications. For immature control only.
Scorpion 35 SL	2 to 7 fl oz	10.5 fl oz	Allow 7 days between applications.
Sefina 0.42 SC	14 fl oz	28 fl oz	Allow 7 days between appications.
Sivanto Prime 1.67 SL	10.5 to 14 fl oz	28 fl oz	Allow 7 days between applications.
Venom 70 SG	1 to 4 oz	6 oz	Allow 7 days between applications.

INSECT CONTROL: Greenhouse/High Tunnel Grown Eggplant, Pepper and Tomatoes[1,2]

Insecticide	Product Amt/A	Seasonal Limit/A	Comments and Other Restrictions
Mites: Two spotted spider mite, broad mite, and tomato russett mite			
Acramite 50 WS	0.75 to 1 lb	1 lb	For spider mites only. Limit 1 application.
AgriMek 0.7 SC	1.75 to 3.5 fl oz	10.25 fl oz	Allow 7 days between applications. For russett and spider mites. Must use non-ionic surfactant. Only for tomatoes in greenhouses.
Brigade 2 E	2.1 to 5.2 fl oz	12.8 to 25.6 fl oz	Allow 7 or 10 days between applications. For end of season control. For spider mites only. Limit 2 or 4 applications. Limitations based on crop treated.
Danitol 2.4 EC	10.67 fl oz	42.6 fl oz	Allow 7 days between applications. For end-of-season control. For spider mites only.
Kanemite 15 SC	31 fl oz	62 fl oz	Allow 21 days between applications. For spider mites only.
Magister SC	24 to 36 fl oz	36 fl oz	Limit 1 application. For spider and broad mites.
Oberon 2 SC	7 to 8.5 fl oz	25.5 fl oz	Limit 3 applications. For broad, russett, and spider mites.
Portal 0.4 EC	2 pt	4 pt	Limit 2 applications. For broad, russett, and spider mites. Allow 14 days between applications.
Pylon 2 SC	6.5 to 13 fl oz	39 fl oz	Allow 5 days between applications. For spider and broad mites. Only for tomato varieties with fruit > 1 inch. Can be used on peppers and eggplant.
Thrips			
Assail 30 SG	4 oz	16 oz	Allow 7 days between applications.
Baythoid XL	2.1 to 2.8 fl oz	16.8 fl oz	Allow 7 days between applications.
Brigade 2 E	2.1 to 5.2 or 6.4 fl oz	12.8 or 25.6 fl oz	Allow 7 or 10 days between applications. Limit 2 or 4 applications. Limitations based on crop treated.
Exirel 0.83 SE	13.5 to 20.5 fl oz	61.5 fl oz	Allow 5 days between applications. Use a spray adjuvant. For foliar feeding thrips.
Pylon 2 SC	9.8 to 13 fl oz	39 fl oz	Allow 5 days between applications. Only for tomato varieties with fruit > 1 inch. Can be used on peppers and eggplant.
Requiem EC	2 to 4 qt	-	-
Rimon 0.83 EC	12 fl oz	36 fl oz	Allow 7 days between applications. For immature control only.
Scorpion 35 SL	2 to 7 fl oz	10.5 fl oz	Allow 7 days between applications.
Torac 1.29 EC	21 fl oz	42 fl oz	Limit 2 applications. Allow 14 days between applications.
Venom 70 SG	1 to 4 oz	6 oz	Allow 7 days between applications.
Whiteflies			
Admire Pro	1.3 to 2.2 fl oz	6.7 fl oz	Allow 5 days between applications. Not during bloom.
Courier 40 SC	9 to 13.6 fl oz	27.2 fl oz	Allow 5 days between applications. Limit 2 applications.
Exirel 0.83 SE	13.5 to 20.5 fl oz	61.5 fl oz	Allow 5 days between applications. Use a spray adjuvant.
Fulfill 50 DF	2.75 oz	5.5 oz	Allow 7 days between applications.
Knack 0.86 EC	8 to 10 fl oz	16 fl oz	Allow 14 days between applications. Limti 2 applications.
Oberon 2 SC	7 to 8.5 fl oz	25.5 fl oz	Limit 3 applications.
PQZ 1.87 SC	2.4 to 3.2 fl oz	4.8 fl oz	Limit 2 applications. Allow 7 days between applications.
Requiem EC	2 to 3 qt	-	-
Rimon 0.83 EC	12 fl oz	36 fl oz	Allow 7 days between applications. For immature control only.
Scorpion 35 SL	2 to 7 fl oz	10.5 fl oz	Allow 7 days between applications.
Venom 70 SG	1 to 4 oz	6 oz	Allow 7 days between applications.

1 See An IPM Scouting Guide for Common Problems of Solanaceous Crops in Kentucky (ID-172) for photos of pests.
2 Generic products available (Appendix G).

WEED CONTROL: Fruiting Vegetables - Egglplant, Pepper, and Tomato

Product Amt/A	Lb A.I./A	Comments
0.5 to 1.6 fl oz Aim 1.9 EW	0.008 to 0.025 carfentrazone	For contact post-emergence control of annual broadleaf weeds and suppression of annual grasses. Can be applied as a preplant, pre-transplant burndown, or before crop emerges to actively growing weeds up to 4 inches tall. Can also be applied post-emergence as a directed hooded application between crop rows. Use min. 10 gal of water/A and crop oil 1% v/v. Max. rate 6.1 fl oz/A. PHI = 0 days.
0.67 to 2.67 pt Command 3ME	0.25 to 1 clomazone	Pepper only - For pre-emergence control of annual grasses and broadleaves. Apply and incorporate 1 to 2 inches before transplanting. Use in combination with other herbicides like Treflan or Devrinol to broaden the weed control spectrum. Can be used on bell, hot, pimento, and sweet peppers but not on banana peppers. Be sure to set transplants with their roots below chemical barrier when transplanting.
6-14 lb Dacthal W-75	4.5 to 10.5 DCPA	Eggplant and tomato - For pre-emergence control of annual grasses and small-seed broadleaves. Over-the-top application 4 to 6 weeds after transplanting is safe to plants. Plants should be well established. Do not apply if growing conditions are poor (i.e.. cool, wet weather).
2 to 4 lb Devrinol DF-XT 2 to 4 qt Devrinol 2-XT	1 to 2 napropamide	For control of annual grasses and broadleaves. Apply to weed free soil before transplanting and water-in or incorporate to a depth of 1 to 2 inches. If grown on beds covered with plastic mulch, apply to the bed immediately in front of the laying of the plastic mulch. If soil is dry, water or sprinkler irrigate with sufficient water to wet to a depth of 2-4 inches before covering with plastic mulch. Apply the plastic mulch over the treated soil the same day. Can be applied on bare ground middles between beds of plastic 24 hours before rain or if watered-in or incorporated. To avoid injury, do not replant with crops not specified on the label until 12 months if using the 4-lb rate.
1.0 to 2.0 pt Dual Magnum	0.95 to 1.9 s-metolachlor	Tomato - For pre-emergent control of selected weed species. In transplanted tomatoes if applied preplant incorporated, transplant to a depth greater than incorporation and use the lower rate range to avoid injury. Do not plant when cool, wet or poor growing conditions exist. Reduce risk by applying seven or more days prior to transplant. PHI = 90 days.
0.5 to 1.0 pt Dual Magnum	0.48 to 0.97 s-metolachlor	Pepper - See the "Dual Magnum 24(c) Label" section on page 15
1 to 2 pt Goal 2XL	0.25 to 0.5 oxyfluorfen	For pre-emergence and post-emergence control of certain annual grasses and most broadleaves. For fallow bed preparation only. Best if used with glyphosate for control of winter annual broadleaf weeds. Min. 30 days between application and transplanting.
2.0 to 4.0 pt Gramoxone Inteon	0.69 to 1.38 paraquat salt	For non-selective contact kill of annual grasses and broadleaf weeds and top-kill of perennial weeds. Apply preplant, pre-emergence, or before transplanting in min. 10 gal water/A. Apply banded or broadcast. Use higher rate for heavy weed infestations. Use non-ionic surfactant 0.25% v/v. **Paraquat product labels require applicators to take an EPA-approved training every 3 years to mix, load, and apply paraquat.**
4 to 6.4 oz League	0.19 to 0.3 imazosulfuron	Tomato only - For control of certain annual broadleaf weeds and nutsedge. Rainfall or irrigation needed for activation. No more than 6.4 oz per year. No more than one application per year.
2 to 4 oz Matrix	0.031 to 0.062 rimsulfuron	Tomato only - For pre-emergent control of broadleaves and grasses. Apply pre-emergence or post-emergence to actively growing weeds. PHI=45 days.
0.5 to 1.5 pt Poast 1.5	0.09 to 0.26 sethoxydim	For control of actively growing grasses only. See label for specific crop restrictions. Use high rate on Johnson grass. PHI = 20 days. Max. rate of 1.5 pt/application and 4.5 pt/season.
5 to 6 qt Prefar 4 E	5 to 6 bensulide	For control of grasses and broadleaf weeds in peppers and eggplant. Apply preplant and incorporate to 1 to 2 inch depth. Apply pre-emergence only if it can be watered in within 36 hours. Max. rate of 6 qt/season.
1.5 to 2 pt Prowl H2O 3.8 E	0.7 to 1 pendimethalin	For pre-emergence control of broadleaves and grasses. Apply preplant and incorporate prior to transplanting pepper or as a post-directed application to established plants. PHI = 70 days.
16 to 22 fl oz Roundup WeatherMax 5.5L	0.69 to 0.94 glyphosate-salt	For non-selective post-emergence control of annual and perennial grasses and broadleaf weeds. Use only AMS 1 to 2% v/v. Adding a non-ionic surfactant can reduce weed control effectiveness. Min. 3 days before seeding and min. 30 days before planting any non-labeled crop.
0.5 to 1 oz Sandea 75 DF	0.023 to 0.047 halosulfuron	Eggplant and pepper - For control of annual broadleaf weeds and yellow nutsedge. Can be applied in row middles of direct-seeded or transplanted eggplants and peppers. Avoid contact with the crop or with plastic if plastic mulch is used. Max. 2 applications/crop and 2 oz/A per season.

(continued on next page)

WEED CONTROL: Fruiting Vegetables - Egglplant, Pepper, and Tomato *(continued)*

Product Amt/A	Lb A.I./A	Comments
0.5 to 1 oz Sandea 75 DF	0.023 to 0.047 halosulfuron	Tomato - For control of broadleaf weeds and yellow nutsedge. For transplanted tomato: may be applied preplant under the plastic. Apply after final bed shaping but before installation of plastic. Transplant 7 days after plastic installation. As a post-transplant application, Sandea can also be applied over the top or as a directed spray or with shields, 14 days after plastic installation. Max. 2 applications/crop and 2 oz/A per season. See label for row middle applications and direct-seeded tomato.
9 to 16 fl oz Select Max	0.07 to 0.12 clethodim	Eggplant and pepper - For selective post-emergence of actively growing annual grasses and suppression of perennial grasses. Add crop oil 1% v/v. Max. 16 fl oz/application. Min. 14 days between applications. PHI = 20 days.
9 to 32 fl oz Select Max	0.07 to 0.24 clethodim	Tomato - For selective post-emergence of actively growing annual grasses and suppression of perennial grasses. Add crop oil 1% v/v. Max. 16 fl oz/ application. Min. 14 days between applications. PHI = 20 days.
2.25 to 6 fl oz Spartan 4F	0.07 to 0.19Sulfentrazone	Transplanted tomato only. For selective pre-emergence control of control of susceptible broadleaves, grass and sedge weeds May be applied as a broadcast or banded treatment prior to transplant.
1.25 to 2 pt Treflan HFP 4 E	0.62 to 1 trifluralin	For pre-emergence control of annual grasses and broadleaf weeds. For transplanted pepper use only. Apply as preplant soil incorporated before transplanting.
0.3 to 1.3 lb TriCor DF	0.2 to 1 metribuzin	Tomato only. For control of annual grasses and broadleaves. Preplant: apply in min. 10 gal water/A immediately before transplanting and incorporate 2 to 4 inches. Best if used with Treflan to improve weed control. Transplant tomato with roots below herbicide zone. Post-emergence broadcast (0.3 to 0.6 lb/A) or post-emergence directed (0.6 to 1.3 lb/A): apply when plants have recovered from transplant shock and new growth is evident (about 2 weeks). Do not apply within 24 hours of other pesticides or within 3 days after cool, wet, or cloudy weather. Allow 14 days between applications. May be applied to plastic mulch row middles. PHI = 7 days.

DISEASE CONTROL: Tomatoes, Peppers, and Eggplant

Product	FRAC Code[1]	PHI[2] (days)	Amt/A	Seasonal Limits/A	Comments
Anthracnose, Cercospora Leaf Spot, Early Blight, Leaf Mold, Gray Leaf Spot, Botrytis Gray Mold, Septoria Leaf Spot, Powdery Mildew					
Aftershock and fluoxastrobin[3] generics	11	3	2 to 5.7 fl oz	4 apps	Early blight and target spot.
Ariston	M/27	3	2 to 3 pt	17.5 pt	See label for specific rates per crop.
Aprovia Top	7/3	0	10.5 to 13.5 oz	53.6 oz	
Botran 75 W	14	10	1 lb	4 apps	Botrytis stem canker. Greenhouse only.
Cabrio and pyraclostrobin[3] generics	11	0	8 to 16 oz	96 oz	Not for gray leaf spot/mold. Use 8 to 16 oz/A for powdery mildew and Botrytis gray mold; apply 8 to 12 oz/A for other foliar diseases
Chlorothalonil[3]					Use higher rates fruit rots on tomato. There are multiple Bravo formulations and chlorothalonil generics on the market. See label for rates.
Bravo Ultrex	M	0/3	1.3/2.6 lb	10/18 lb	
Bravo Weather Stik	M	0/14	1.5 to 2.75 pt	16/20 pt	
Copper, fixed coppers	M	0			Not for Botrytis, powdery mildew. See label for rates, mixing instructions, and tank-mix precautions. Some products are approved for greenhouse use.
Dexter Max	M/11	5	1.6 to 3.2 lb	12 lb	Tank mixing with a fixed copper product will also manage bacterial diseases.
Dexter XCEL	M/11/3	7	36 oz	1.7 gal	Do not use adjuvants or tank mix with an EC product.
Emblem	12	0	5.5 to 7 fl oz	28 oz	Gray mold, powdery mildew. Greenhouse only, not for field use.
Endura and boscalid generics	7	0	2.5 to 12.5 oz	6 apps	Early blight, Botrytis gray mold, and Sclerotinia white mold (timber rot). Use higher rates for gray and white mold.
Flint Extra	11	3	2 to 4 oz	5 apps	

(continued on next page)

DISEASE CONTROL: Tomatoes, Peppers, and Eggplant *(continued)*

Product	FRAC Code[1]	PHI[2] (days)	Amt/A	Seasonal Limits/A	Comments
Fontelis	7	0	14 to 24 fl oz	72 fl oz	Anthracnose, Botrytis gray mold, early blight, and Septoria leaf spot.
Gem	11	3	3 to 3.8 fl oz	5 apps	Anthracnose, Septoria, and powdery mildew.
Indar 2F	3	7	6 to 12 fl oz	48 fl oz	Peppers only. Cercospora leaf spot and powdery mildew.
Inspire Super	3/9	0	16 to 20 fl oz	47 fl oz	
Luna Sensation	7/11	3	5 to 7.6 fl oz	5 app	See label for specific rates. Suppression of anthracnose, timber rot (white mold), and southern blight.
Luna Tranquility	7/9	1	11.2 fl oz	54.7 fl oz	
Mancozeb[3]					Not for Botrytis or powdery mildew. See label for rates. Addition of Latron surfactant will improve performance. There are multiple Dithane formulations and mancozeb generics on the market. See label for rates.
Dithane F-45	M	5/7	1.2 to 2.4 qt	14/16 qt	
Dithane M45	M	5/7	1.5 to 3 lb	18/21 lb	
ManKocide	M	5	2.5 to 5 lb	see footnote	Not for Botrytis or powdery mildew.
Mettle	3	0	6.0 to 8.0 fl oz	5 apps	
Miravis Prime	7/12	0	9.2 to 11.4 oz	22.8 oz	
Orondis Opti	49/M	7	1.75 to 2.5	10 pt	Do not combine with other Orondis products. Can be used in greenhouse on tomatoes only.
Priaxor	7/11	7	4 to 8 fl oz	24 fl oz	Anthracnose, Botrytis gray mold, early blight, and Septoria.
Quadris and azoxystrobin generics	11	0	5 to 15.5 fl oz	35/60 fl oz	Not for gray mold. Lower rates for tomatoes. Refer to label for tank mix and rate.
Quadris Opti	11/M	0	1.6 pt	5 apps	Not for gray mold, gray leaf spot, or leaf mold.
Quadris Top	11/3	0	8 fl oz	47 fl oz	
Quintec	13	3	4 to 6 fl oz	24 oz	Peppers only. Powdery mildew.
Rally 40 WSP and myclobutanil generics	3	0	2.5 to 4 oz	1.25 lb	Powdery mildew.
Reason	11	14	5.5 to 8.2 fl oz	24.3 fl oz	Early blight and Septoria.
Revus Top	40/3	1	5.5 to 7 fl oz	28 fl oz	Apply every 7 to 10 days. Use a spreader/penetrant surfactant.
Rhyme	3	0	3.5 to 7 fl oz	28 fl oz	Powdery mildew, Anthracnose, target spot, and early blight.
Scala	9	1	7 fl oz	35 fl oz	Early blight and Botrytis gray mold. Greenhouse use is approved.
Sulfur[3]	M				Powdery mildew. Phytotoxicity may occur if applications are made when temperatures exceed 90°F. See label for rates.
Switch 62.5 WG	9/12	0	11 to 14 oz	56 oz	Early blight, Botrytis, and powdery mildew.
Tanos	11/27	3	6 to 8 oz	5 apps	Not for Botrytis. Tanos must be tank-mixed with a fungicide from FRAC Group M appropriate for the target disease.
Toledo and tebuconazole[3] generics	3	7	8 fl oz	48 fl oz	Early blight and Septoria leaf spot. See label for rates.
Topguard EQ	3/11	0	4.0 to 8.0 fl oz	4 apps	Anthracnose, Cercospora, and powdery mildew.
Torac	39	1	21 oz	42 oz	Suppressive only on powdery mildew. Also an insecticide.
Torino	U6	0	3.4 oz	3 apps	Powdery mildew only.
Velum Prime	7	0	6.5 to 6.84 fl oz	13.7 fl oz	Powdery mildew, also soil-applied for nematode management (see label).

(continued on next page)

DISEASE CONTROL: Tomatoes, Peppers, and Eggplant *(continued)*

Product	FRAC Code[1]	PHI[2] (days)	Amt/A	Seasonal Limits/A	Comments
Vivando	U8	0	15.4 fl oz	3 apps	Powdery mildew only.
Zing!	M/22	5	36 fl oz	8 apps	Early blight and Septoria.
Ziram 76DF Ziram XCEL	M	7	3 to 4 lb	24 lb	Anthracnose, early blight, and Septoria.
Bacterial Spot/Speck of Tomato and Pepper					
Actigard	21	14	0.33 to 0.75 oz	6 apps	Apply 1 week after transplanting or emergence; begin with lowest rate and increase as plants grow. May be applied through drip irrigation.
Copper, fixed coppers					Tank-mix with mancozeb for maximum efficacy (observe seasonal limits for EBDC fungicides). See label for rates, mixing instructions, and tank-mix precautions. Some products are approved for greenhouse use.
Mancozeb[3]					For bacterial spot/speck of tomato, use full rate of fixed copper in tank mix with half to full rate of Dithane. There are multiple Dithane formulations and mancozeb generics on the market. See label for rates.
Dithane F-45	M	5/7	1.2 to 2.4 qt	14/16 qt	
Dithane M45	M	5/7	1.5 to 3 lb	18/21 lb	
Streptomycin	25	n/a	16 oz/100 gal	n/a	Pre-transplant treatment. Apply when seedlings are in 2-leaf stage and continue every 4 to 5 days until transplanting. Alternate with fixed copper. Not for field use.
Tanos	11/27	3	8 oz	5 apps	Suppression only. Tanos must be tank-mixed with copper for best results against bacterial disease.
Late Blight					
Aftershock and fluoxastrobin[3] generics	11	3	5.7 fl oz	4 apps	Tank mix or alternate with a protectant fungicide at low rate.
Chlorothalonil[3]					Use higher rates fruit rots on tomato. There are multiple Bravo formulations and chlorothalonil generics on the market. See label for rates.
Bravo Ultrex	M	0/3	1.3/2.6 lb		
Bravo Weather Stik	M	0/14	1.5 to 2.75 pt		
Copper,fixed coppers					See label for rates, mixing instructions, and tank-mix precautions. Some products are approved for greenhouse use.
Curzate 60 DF	27	3	3.2 to 5 oz	30 oz	Must be tank-mixed with a fungicide from FRAC Group M.
Forum SC	40	4	6 fl oz	30 fl oz	Must be tank-mixed with another *Phytophthora* fungicide.
Gavel 75 DF2	22/M	3	1.5 to 2 lb	8 apps	
Mancozeb[3]					There are multiple Dithane formulations and mancozeb generics on the market. See label for rates.
Dithane F-45	M	5/7	1.2 to 2.4 qt	14/16 qt	
Dithane M45	M	5/7	1.5 to 3 lb	18/21 lb	
ManKocide	M	5	1 to 3 lb	26.7 lb	For tomato only.
Micora	40		5.5 to 8.0 fl oz	2 apps	Transplant production only.
Orondis Gold 200	49/4	7	4.8 to 9.6 fl oz	19.2 fl oz	Phytophthora blight. Do not combine with applications of other Orondis products.
Orondis Opti	49/M	3	1.75 to 2.5 pt	10 pt	Do not combine with applications of other Orondis products.
Orondis Ultra	49/40	1	5.5 to 8 oz	4 app	Do not combine with applications of other Orondis products. Can be used in greenhouse on tomatoes only.
Presidio	43	2	3 to 4 fl oz	4 apps	Apply every 7 to 14 days. Must be tank-mixed with a fungicide NOT in FRAC Group 43.

(continued on next page)

DISEASE CONTROL: Tomatoes, Peppers, and Eggplant *(continued)*

Product	FRAC Code[1]	PHI[2] (days)	Amt/A	Seasonal Limits/A	Comments
Previcur Flex	28	5	0.7 to 1.5 pt	7.5 pt	Must be tank-mixed with chlorothalonil or mancozeb.
Ranman SC	21	0	2.1 to 2.75 fl oz	6 apps	
Revus	40	1	5.5 to 8 fl oz	32 fl oz	Must be tank-mixed with a fungicide NOT in FRAC Group 40.
Revus Top	40/3	1	5.5 to 7 fl oz	28 fl oz	Use a spreader/penetrant surfactant.
Ridomil Gold Bravo SC	4/M	7	2.5 pt	3 apps	Also labeled for fungal diseases.
Ridomil Gold Copper	4/M				See label for specific rates per crop.
Ridomil Gold MZ2	4/M	5	2.5 lb	3 app	For tomato only.
Tanos	11/27	3	8 oz	5 apps	Tanos must be tank-mixed with a fungicide from FRAC Group M appropriate for the target disease.
Zampro	40/45	4	14 fl oz	3 apps	
Phytophthora Blight, Buckeye Rot in Pepper					
Badge X2, Badge SC	M	0	0.75 to 1.25 lb	42 lb	OMRI-listed. Also labeled for fungal diseases.
Elumin	22	2	8 oz	2 apps	
Forum SC	40	0	6 fl oz	5 apps	Must be tank-mixed with another *Phytophthora* fungicide.
Metastar 2E and metalaxyl generics	4	7			See label for specific rates and applications per crop.
Omega 500 and fluazinam generics	29	30	16 to 24 fl oz	6 apps	Soil drench or foliar application. Note extended PHI.
Orondis Gold 200	49	0	4.8 to 9.6 fl oz	19.2 fl oz	Use in tank mix with Ridomil Gold SL.
Orondis Ultra	49/40	1	5.5 to 8.0	4 app	Do not combine with applications of other Orondis products. Can be used in greenhouse on tomatoes only.
Presidio	43	2	3 to 4 fl oz	12 fl oz	Must be tank-mixed with a fungicide NOT in FRAC Group 43.
Ranman	21	0	2.75 fl oz	16.5 fl oz	Apply to base of plants at transplant or in transplant water, make additional applications within 7-10 days. Tank-mix with an organosilcone or non-ionic surfactant.
Reason 500 SC	11	14	8.2 fl oz	24.6 fl oz	Foliar and fruit phases of disease only.
Revus	40	1	8 fl oz	32 fl oz	Use a spreader/penetrant surfactant. Must be tank-mixed with a fungicide NOT in FRAC Group 40.
Ridomil Gold SL and mefenoxam generics	4	7	1 to 2 pt	3 pt	Suppression of Phytophthora blight. Broadcast, banded, or injection. See label for specific rates per crop.
Ridomil Gold Copper	4/M				See label for specific rates per crop.
Tanos	11/27	3	8 to 10 oz	72 oz	Foliar and fruit phase only. Tanos must be tank-mixed with a fungicide from FRAC Group M appropriate for the target disease.
Zampro	40/45	4	14 fl oz	3 apps	Apply at planting as a drench or by drip irrigation; make supplemental applications every 5 to 7 days.
Pythium Seedling Disease					
Metastar 2E and metalaxyl generics	4	7			See label for specific rates and applications per crop.
Previcur Flex	28	5	1.5 pt	7.5 pt	Field application. Can be directed at lower stems and soil, applied in transplant water, or delivered through drip irrigation. Greenhouse use. Can be applied as a drench or by chemigation—see to label for rates.

(continued on next page)

DISEASE CONTROL: Tomatoes, Peppers, and Eggplant *(continued)*

Product	FRAC Code[1]	PHI[2] (days)	Amt/A	Seasonal Limits/A	Comments
Ridomil Gold SL and mefenoxam generics	4	7	1 to 2 pt	3 pt	Broadcast, banded, or injection. See label for specific rates per crop.
Ridomil Gold Copper	4/M				See label for specific rates per crop.
Ridomil Gold GR	4	7	20 lb	1 app	For preplant application only. Adjust equipment so that granules applied uniformly over soil surface. Incorporate mechanically or with irrigation water.
Southern Blight					
Aftershock and fluoxastrobin[3] generics	11	3	2 to 5.7 fl oz	4 apps	Tank mix or alternate with a protectant fungicide at low rate.
Cabrio and pyraclostrobin[3] generics	11	0	12 to 16 oz	96 oz	Suppression of Rhizoctonia, timber rot (white mold), and southern blight.
Luna Sensation	7/11	3	7.6 fl oz	5 app	Suppression of anthracnose, timber rot (white mold), and southern blight.
Rhizoctonia Stem and Root Rot					
Cabrio EG and pyraclostrobin[3] generics	11	0	12 to 16 oz	96 oz	Suppression of Rhizoctonia, Sclerotinia, and southern blight
Mural	11/7	0	0.6 to 0.8 oz/5,000 sq ft	2 apps	Rhizoctonia stem rot. Suppression of southern blight. For transplants produced for resale. See label for specific rates.
Orondis Opti	49/M	0	1.75 to 2.5 pt	4 app	Rhizoctonia fruit rot on tomato. See label for specific application detail.
Quadris and azoxystrobin generics	11	0	0.4 to 0.8 fl oz/ 1,000 row ft	3 app	Rhizoctonia seedling rot on pepper and eggplant. See label for specific application details.

1 Products with numerical FRAC codes must be alternated or tank-mixed with products that have a different FRAC code to discourage resistance development. See product label for maximum number of consecutive applications allowed. Refer to the table on pages 22-24 for more information on FRAC codes.
2 Pre-harvest interval.
3 Generic products available (Appendix F). Amounts and seasonal limits per acre are product dependent.

Greens

Collards, Kale, Lettuces, Mustards, Spinach, Swiss Chard, Turnip, and Others

Leafy greens or salad greens are consumed daily by most Americans, and nearly all types can be grown profitably in Kentucky. In fact, Kentucky was once known throughout the country for its "bibb" or "limestone" lettuce, named after Major John (Jack) Bibb, who, after fighting in the War of 1812, grew it in his garden in Frankfort. The large group of vegetable crops included under the broad term "greens" includes crops from several families: lettuces (romaine, leaf, bibb/Boston, iceberg, etc.); mustards (mustard greens, arugula, turnip greens); crucifers (collards, kale, broccoli raab, flowering or Chinese kale); spinach (flat leaf and savoy); composites (endive, escarole, radicchio, chicory, dandelion); and others including Swiss chard and beet greens. Various mixtures of green leafy vegetables ("mesclun") and immature "baby greens" are also very popular. Production guidelines for cole crops such as cabbage, broccoli, and some of the Asian vegetables are found in the chapter on "Cole Crops."

Most greens are cool-season crops that do best in the spring and fall, but heat-tolerant varieties for summer plantings are also available for some types. Many types of greens have also been successfully grown in Kentucky from September until June in unheated greenhouses or high tunnels (see Appendix K).

Production Systems

Production systems for this group are as varied as the crops themselves. Although greens have traditionally been grown as row crops at wide spacing in Kentucky, many growers are now planting at higher densities using raised beds with multiple rows per bed. Many of the crops in this group are most productive using raised beds with plastic mulch and drip irrigation. Greens are also grown on raised beds without plastic; however, weed control with hand/mechanical cultivation or with herbicides is critical when plastic mulch is not used. Black plastic mulch is used for spring plantings, and white mulch can be used for late summer plantings. Bed-shaping machines commonly used in Kentucky will form a 6-inch-high raised bed 30 to 32 inches wide at the top with 5 to 6 feet between centers of the beds. Depending on the crop and the between-row spacing, two to three rows can be used per bed. Growers in the Northeast make wider (4½ to 5½ feet), lower (4 to 5 inches high) beds on bare ground using a "meeker harrow" or roller and plant four to six rows of greens per bed, depending on the crop. This system relies heavily on the use of herbicides and overhead irrigation; similar systems are used in California but with drip irrigation.

Greens are either direct seeded and thinned or transplanted into either bare ground or plastic-mulched beds with drip irrigation. Pelleted seed is normally used for direct seeding, using a simple "Planet Jr."-type seeder or vacuum seeder. Transplanting will usually result in an earlier crop less exposed to insect damage, drought, or other early-season stresses. Some Kentucky growers have also produced leafy greens in tobacco "float beds" in the same way that tobacco transplants are grown. Keep in mind that few chemicals are available to manage diseases of greens grown in this manner. Going a step further, growers can produce high-quality bibb lettuce and other greens in traditional greenhouses using a hydroponic production system.

If transplants are used, crops are seeded in 128- to 288-cell plug trays in the greenhouse four to six weeks prior to going to the field. Harden the transplants by moving them outside the greenhouse for a few days prior to transplanting. Most greens are transplanted by hand or with a waterwheel setter onto raised beds with plastic mulch. One Kentucky grower has fabricated a three-row/bed waterwheel for this setter (8 inches within-row and 10 inches between rows) which has worked well for mustard and turnip greens. It should also be possible to use this wheel for leaf or bibb lettuce. See the table below for plant spacing used in the field for different types of greens.

Fertilizing and Cover Crops

A soil test should be taken in the fall or early spring prior to planting. Soil pH should be in the 6.0 to 6.8 range. Lime applications should be made in the fall if necessary.

Soil tests are critical to making appropriate recommendations for fertilizing vegetable crops and maintaining proper soil balance. Cover crops add organic matter and reduce weed pressure. Legume cover or green manure crops can also provide significant amounts of nitrogen. Winter cover crops include winter rye, wheat, ryegrass, or a mixture of winter rye and hairy vetch. Although this practice can delay planting, hairy vetch plowed under at 50 percent flowering in the spring (mid to late May) provides up to 80 pounds per acre of available nitrogen (140 to 160 pounds per acre total) to the following crop. Sudan grass or sorghum-Sudan grass hybrids ("Sudex") are used as summer cover crops on otherwise fallow land.

Apply all phosphorus and potassium according to soil test report recommendations prior to planting. Leafy vegetables require quick, continuous growth for best quality. Greens are high users of nitrogen, and most crops require a total of 100 to 150 pounds of nitrogen per acre. Apply 50 percent of the nitrogen together with phosphorus and potassium prior to planting. The remaining nitrogen is applied in two sidedressings on bare ground or is divided up and fertigated (injected) in equal weekly doses for plastic-mulched, drip-irrigated crops.

Tipburn and Bolting

Tipburn is a common and serious problem in lettuce and cole crops. Symptoms are brown leaf margins on the youngest leaves (sometimes concealed within the heads). It most often occurs during periods of drought followed by abundant moisture from rain or irrigation. In these cases the supply of calcium (which moves with the flow of water in plants) cannot keep up with the needs of rapidly growing new plant tissue. The calcium-deficient tissue collapses and turns brown, resulting in an unmarketable product.

Liming according to soil test results will help reduce the risk of tipburn as will any practice which ensures a regular moisture supply to plant roots. As is the case with blossom end rot, tipburn is more the result of lack of water or adverse weather conditions than a soil calcium deficiency. Excess application of ammonium nitrate can damage roots and cause tipburn as will deep cultivation, flooding, or drought. Plastic or organic mulches with drip irrigation also help reduce the risk of tipburn. Lastly, some varieties are less susceptible to the problem (see "Varieties" table).

Bolting is the formation of a flower stalk while the plant is still small or immature. Any stresses that slow vegetative growth can cause young plants to begin flowering. Generally for cool-season crops such as lettuce, favorable cool spring temperatures followed by periods of hot weather will lead to bolting. Lettuce should be harvested as soon as possible in spring crops to avoid excess heat and subsequent bolting. Seedlings subjected to low temperatures or water stress in the greenhouse prior to transplanting also are susceptible to bolting, as are transplants which are too old. Some growers have reported difficulty producing field-grown fall lettuce in Kentucky due to bolting. The practices discussed to reduce tipburn also will help reduce the risk of premature bolting. Variety selection is also important.

Harvesting and Handling

All fresh market leafy greens are hand harvested in Kentucky. Multiple harvests are possible from most types of greens. Baby greens are grown at closer spacings and are ready for market in a little more than half the time required to produce mature greens. Turnip, mustard, collards, and kale are harvested when stalks are fairly young and tender. Rubber bands can be used to bunch loose greens but larger wholesale buyers may require labels or bands with price-lookup (PLU) codes. Hydroponic producers routinely harvest lettuce with intact roots and market the product in clear clamshell containers. Harvesting hydroponic lettuce with roots intact can improve shelf-life. Turnip, mustard, collards, and kale are bunched with three to five stalks per bunch. Lower leaves that are discolored or dying are removed when bunching. Lettuces and spinach are often packed in cello bags. Greens can be field packed and top iced in waxed, corrugated cardboard boxes or wooden crates. Greens have high respiration rates and should be washed, packed, and sold as quickly as possible. Vacuum cooling to 34°F is the preferred method of pre-cooling, although forced air cooling is also possible. Greens are not usually stored for very long, although lettuce and other crops can be stored for two weeks at 32°F.

OPTIMUM IN-ROW AND BETWEEN-ROW SPACINGS: Greens

Most crops can be transplanted to 2 rows/bed using a waterwheel setter, using two wheels for 9- or 12-inch spacings.

Crop	In-row (in.)[1]	Between-row (in.)	No. rows/bed[2]
Collards	12-18	15-36	1-2
Kale	9-12	12-24	2
Mustard	9-15	12-15	2
Turnip			
for roots	3-4	12-18	2
for leaves	0.5-3	12-18	2
Brocolli raab	6-12	15-18	2
Lettuce			
leaf/bibb	9-12	12-18	2
romaine	9-12	12-18	2
Endive/escarole	12-18	15-18	2
Spinach	3-6	9-18	3-4
Swiss chard	6	18-24	2

1 Final spacing after thinning or transplanting.
2 Raised beds formed by Rainflo or similar bed shaper.

Variety	DTM[1]	Comments
COLLARDS[2]		
Top Bunch 2.0	70	Uniform hybrid that is 5 to 10 days earlier than Vates.
Flash	73	Vigorous uniform hybrid (Vates type); slow bolting.
Vates	75	Blue-green leaves; compact and uniform.
Champion	76	Slow bolting, good hardiness.
Georgia Southern	80	Blue-green leaves; produces under adverse temperatures.
KALE[2]		
Black Magic	45	Lacinato type; deep green color leaves with nearly white veins
Dazzling Blue	45	Lacinato type; dark pink mid-rib and veins with green leaves
Winterbor	50-55	Hybrid, finely curled dark green leaves; frost tolerant.
Darkibor	50-55	Hybrid, finely curled, blue-green leaves, slow bolting.
Red Russian	50	Purple stems, green, flat "oak-leaf" pattern leaves; used in salad mixes.
Redbor	55	Hybrid, finely curled, dark red and taller version of Winterbor.
Blue Curled Vates	57	Dark blue-green finely curled leaves; 15 to 20 inches tall.
White Russian	55-60	Flat dissected leaves with white stems, very tender, has done well in organic trials
MUSTARD[2]		
Savannah	35	Very early maturing, drought tolerant.
Tendergreen	40	Large, thick but tender leaves; cold resistant, mild flavor.
Southern Giant	45	Large plants, bright green leaves with crumpled frilled edges; for spring and fall.
Green Wave	45	Large plants, deeply frilled and finely cut leaves; heat tolerant and slow bolting.
Florida Broadleaf	50	Large plants, spreading oval, serrated dark green leaves.
TURNIPS/TURNIP GREENS[2]		
Alamo	33	Broad leaved greens, short petiole, slow bolting; for greens
All Top	35	Thick tender leaves, quick regrowth, slow bolting; for greens
Southern Green	40	Hybrid, very dark green, upright leaves, slow bolting.
BROCCOLI RAAB (RAPINI)[2]		
Spring Raab	42	Versatile variety for spring and summer harvests.
Zamboni	60	Large flower buds and uniform bud set, spring.
LETTUCE[3]		
Leaf/Looseleaf		
Grand Rapids	43	Early, old standard open-pollinated variety; light green leaves.
Red Sails	45-55	AAS winner; ruffled and fringed red leaves with green background; slow bolting and tipburn tolerant.
Tango	45	Pointed, deeply cut leaves (like endive), used in salad mixes.
Black-seeded Simpson	46	Early, old standard open-pollinated variety; light green leaves.
Salad Bowl	46	Oak-leaf type; light green, deeply lobed leaves; heat tolerant.
New Red Fire	48	Dark red, wavy, ruffled leaf margins; slow to bolt.
Simpson Elite	53	More ruffled and slower to bolt than Black-seeded Simpson.
Bibb/Butterhead/Boston		
Buttercrunch	44	Dark green, slow bolting, commonly grown
Harmony	50	Uniform butterhead type. Produces large heads with deep green color and smooth, glossy leaves. Intermediate resistance to bolting, tipburn, and Downy Mildew (races I, IIA, IIB, IV, V).
Pomegranate	50	Open, butterhead-like growth. Dark red leaves with light green on the inside. Resistance to Downy Mildew 1-8, 16-27, 29, 32.
Rex	50	For indoor hydroponic production, slow bolting, not for outdoor production
Nancy	52	Medium green leaves, large "heart;" mildew and virus resistant.
Sangria	55	Red butterhead type. Large round heads with smooth bright green leaves with red along the margins. Tender and flavorful. Resistant to bolting and tipburn.
Winter Density	55	Cross between butterhead and romaine. Leaves are deep green.
Milagro	55	Butterhead type. Leaves are bright green with tight head formation in the middle with looser leaves around the outside. Resistant to Downy Mildew (races 1-9, 16, 35), Fusarium Wilt (race 1), Tomato Bushy Stunt Virus, and Lettuce Mosaic Virus.
Romaine/Cos		
Coastal Star	65-70	Large heavy heads, sell as full head or heart, very heat tolerant

(continued on next page)

VARIETIES: Greens *(continued)*

Variety	DTM[1]	Comments
Parris Island	28 (58)	Commonly grown for baby romaine (28 days) or for mature heads (58), dark green, good flavor.
Green Forest	66	Dark green leaves, short core length
Green Towers	74	Dark green, lightly savoyed leaves.
ENDIVE/ESCAROLE[3]		
Natacha	48	Replaces 'Nataly'; very large heads; slow bolting, tipburn and bottom rot tolerant.
Lorca	90	Large, deep, blanched heads, tipburn resistant.
SPINACH[4]		
Flat Leaf		
Space	40	For trial, hybrid; smooth, dark green leaves; downy mildew resistant, slow to bolt.
Savoy		
Tyee	42	Hybrid; dark green, semi-savoy type; downy mildew resistant; heat tolerant and slower bolting than 'Spinner.'
Bloomsdale Long Standing	43	Open-pollinated; very hardy; savoyed dark green leaves; slow bolting.
Samish	45	For trial, hybrid, good cold hardiness, may be good for tunnels in winter.
Melody	45	Hybrid; deep green, semi-savoy type; downy mildew and mosaic tolerant, slow to bolt.
SWISS CHARD[4]		
Bright Lights	55	All America Selections winner; stalks of various colors.
Fordhook Giant	55	Very tall; dark green savoyed leaves with white stems/veins; heat tolerant.
Ruby Red (Rhubarb)	55	Deep green savoyed leaves with bright red rhubarb-like stems.
Silverado	60	Compact plants; dark green, deeply savoyed leaves with broad white stems.

1 From seeding. Days to maturity vary widely in seed catalog descriptions making comparisons difficult.
2 (Brassicaceae)—mustard family
3 (Asteraceae)—sunflower family
4 (Chenopodiaceae)—goosefoot family

FERTILIZER: Greens

Soil Test Results (lb/A)		Fertilizer Needed (lb/A)
Phosphorus		**Phosphate (P_2O_5)**
Low	<31	121-180
Medium	31-60	1-120
High	>60	0
Potassium		**Potash (K_2O)**
Low	<201	101-150
Medium	201-300	51-100
High	301-450	1-50
Very High	>450	0
Nitrogen		**N**

Apply 100 to 150 lb of actual nitrogen (N)/A. Apply 25 to 50% broadcast with other fertilizer before seeding or transplanting and disk in well. The remainder can be divided up into one or more sidedressings.

PESTICIDE SAFETY: Greens

	Signal[2]	Re-entry (hrs)	Harvest Interval (days)					
			Collards	Kale	Lettuce	Mustard	Spinach	Turnips
INSECTICIDES								
Actara 25 WP	C	12	7	7	7	7	7	-
Admire Pro	C	12	7/21[1]	7/21[1]	7/21[1]	7/21[1]	7/21[1]	7/21[1]
Assail 30 SG	C	12	3	3	3	3	7	3
Avaunt eVo 30 DG	C	12	3	3	3	3	3	3
Belay 2.13 SC	C	12	7/21[1]	7/21[1]	7/21[1]	7/21[1]	7/21[1]	-
Beleaf 50 SG	C	12	0	0	0	0	0	0
Bt products	C	12	0	0	0	0	0	0
Coragen 1.67 SC	-	4	3	3	1	3	1	-
Courier	W	12	1	1	1	1	1	1
Dimethoate 4 E	W	48	-	14	14	14	-	14
Exirel 0.83 SE	C	12	1	1	1	1	1	1
Fulfill 50 DF	C	12	7	7	7	7	7	7
Harvanta 50 SL	C	4	1	1	1	1	1	1
Intrepid 2 F	C	4	1	1	1	1	1	1
Knack 0.86 EC	C	12	7	7	14	7	14	7
Malathion 8	C	24	7	7	14	7	7	-
Movento 2 SC	C	24	1	1	3	1	3	-
Oberon 2 SC	C	12	-	-	7	7	7	-
Platinum 2 SC	C	12	30	30	30	30	30	-
PQZ 1.87 SC	C	12	1	1	1	1	1	1
Pyrethrin	C	12	0	0	0	0	0	0
Radiant SC	C	4	1	1	1	1	1	3
Requiem 25 EC	C	12	0	0	0	0	0	0
Scorpion 3.5 SL	C	12	-	-	7/21[1]	-	7/21[1]	-
Sevin XLR Plus	W	12	14	14	14	14	14	14
Sivanto 1.67 SL	C	12	1	1	1	1	1	1
Torac 1.29 EC	W	12	1	1	1	1	1	1
Trigard 75 WP	C	12	7	7	7	7	7	7
Venom 70 SG	C	12	1	1	7/21[1]	1	7/21[1]	1
Verimark 1.67 SC	-	4	AP	AP	AP	AP	AP	AP
Versys 0.83 SC	C	12	0	0	0	0	0	0
Restricted Use								
Agrimek 0.7 SC	W	12	-	-	7	-	7	-
Asana XL	W	12	7	-	-	7	-	-
Baythroid XL	W	12	-	-	0	0	0	0
Brigade 2 EC	W	12	7	7	7	7	40	7
Daizinon AG500	C	24	4	4	14	4	3	-
Diazinon 50 W	C	24	4	4	14	4	3	-
Dimilin 2L	C	12	7	7	-	7	-	7
Hero 1.24 EC	C	12	7	7	7	7	-	-
Lannate 90 SP	DP	48	10	10	10	10	7	10
Mustang Maxx	W	12	1	1	5	1	1	-
Permethrin 3.2 EC	C	12	1	-	1	-	1	1
Proaxis 0.5 EC	C	24	-	-	1	-	-	-
Proclaim 5 WDG	C	48	14	14	7	14	7	14
Warrior II	W	24	-	-	1	-	-	-

- Indicates crop does not appear on label.
1 PHI depends on the method of application.
2 W: Warning, C: Caution, D: Danger, P: Poison

PESTICIDE SAFETY: Greens

	Signal[3]	Re-entry (hrs)	Harvest (days)
FUNGICIDES			
Mustard, Turnips, Collards, Kale			
Actigard 50 WG	C	12	7
Azoxystrobin[2]	C	4	0
Cabrio EG	C	12	3
Cannonball	C	12	0
Endura	W	12	14
Fixed coppers[2]	D	12/24[1]	0
Flint Extra	C	12	0
Fluazinam	W	12	20
Fontelis	C	12	0
Forum SC	C	12	0
Inspire Super	C	12	7
Iprodione[2]	C	12/24	7/14
Luna Experience	C	12	7
Luna Sensation	C	12	0
Mefenoxam[2]	C	48	0
PCNB[2]	C	12	0
Presidio	C	12	2
Priaxor	C	12	3
Procure 480 SC	C	12	1
Propiconazole[2]	W	24	7
Quadris Top	C	12	1
Quilt	C	12	7
Ranman	C	12	0
Reason 500 SC	C	12	2
Revus	C	4	1
Rhyme	W	12	7
Sulfur[2]	C	12	0
Switch 62.6 WG	C	12	7
Tebuconazole[2]	C	12	7
Topguard EQ	C	12	7
Trionic	C	12	1
Velum Prime	C	12	0
Zampro	C	12	0
Lettuce			
Actigard 50 WG	C	12	7
Azoxystrobin[2]	C	4	0
Botran 75 W	C	12	14
Botran 5F	C	12	14
Cabrio EG	C	12	0
Cannonball WP	C	12	0
Curzate 60 DF	W	12	3
Endura	W	12	14
Fixed coppers[2]	D	24/48	1
Flint Extra	C	12	0/20
Fontelis	C	12	3
Forum SC	C	12	0
Iprodione[2]	C	24	14
Kenja	C	12	14
Luna Sensation	C	12	0

(continued)

PESTICIDE SAFETY: Greens *(continued)*

	Signal[3]	Re-entry (hrs)	Harvest (days)
Mancozeb[2]	C	24	10
Mefenoxam[2]	C	48	0
Metalaxyl[2]	W	48	0
Merivon	W	12	1
Miravis Prime	C	12	0
Orondis Gold 200	C	4	0
Orondis Ultra	C	4	1
Presidio	C	12	2
Previcur Flex	C	12	6
Quintec	C	12	1
Ranman	C	12	0
Reason 500 SC	C	12	2
Revus	C	4	1
Rhyme	W	12	7
Sulfur[2]	C	24	0
Switch 62.6 WG	C	12	0
Tanos	C	12	3
Topguard EQ	C	12	7
Torac	W	12	1
Zampro	C	12	0
Spinach			
Actigard 50 WG	C	12	7
Azoxystrobin[2]	C	4	0
Cabrio EG	C	12	0
Curzate 60 DF	W	12	3
Fixed coppers[2]	D	24/48[1]	0
Fontelis	C	12	3
Mefenoxam[2]	C	48	21
Merivon	W	12	1
Metalaxyl[2]	W	48	21
Miravis Prime	C	12	0
Orondis Gold 200	C	4	0
Orondis Ultra	C	4	1
Presidio	C	12	0
Ranman	C	12	0
Revus	C	4	1
Rhyme	W	12	7
Ridomil Gold Copper	D	48	21
Sulfur[2]	C	24	0
Tanos	C	12	1
Topguard EQ	C	12	7
Torac	W	12	1
Zampro	C	12	0

[1] Varies by formulation. Check labels carefully.
[2] Several formulations are marketed. See the general introduction for more details on fungicides.
[3] W: Warning, C: Caution, D: Danger, P: Poison

INSECT CONTROL: Greens[1]

Insecticide	Product Amt/A	Seasonal Limit/A	Comments and Other Restrictions
PREPLANT INCORPORATED			
Cutworms, Wireworms: Eliminate weeds from field margins and plow fields at least 2 weeks before planting to destroy cutworm food sources and egg laying sites. Wireworms can be a potential problem where greens follow grass or grass-legume sod.			
Diazinon AG 500	4 to 8 pt	-	Incorporate immediately. Lower rate for lettuce (4 pt limit).
SOIL APPLICATION			
Aphids, Whiteflies: Do not use a foliar spray of Actara, Assail, Belay Provado or Venom following a soil application of Admire, Belay, Platinum, or Venom.			
Admire Pro	4.4 to 10.5 fl oz	10.5 fl oz	Systemic control. See label for various application methods.
Belay 2.13 SC	9 to 12 fl oz	12 fl oz	At planting only.
Platinum 2 SC	5 to 11 fl oz	11 fl oz	-
Venom 70 SG	5 to 7.5 oz	12 oz	Not for collards, kale, or mustard greens.
FOLIAR TREATMENTS			
Aphids: Excessive nitrogen application favors increased aphid reproduction. Use no more nitrogen than is necessary. Eliminate remnants of fall crops to reduce numbers of overwintering eggs.			
Actara 25 W	1.5 to 3 oz	11 oz	Allow 7 days between applications. Not during bloom.
Admire Pro	1.3 fl oz	6.5 fl oz	Allow 5 days between applications. Not during bloom.
Assail 30 SG	2 to 4 oz	20 oz	Limit 4 applications. Allow 7 days between applications.
Belay 2.13 SC	3 to 4 fl oz	12 fl oz	Allow 10 days between applications. Not during bloom.
Beleaf 50 SG	2 to 2.8 oz	8.4 oz	Allow 7 days between applications.
Dimethoate 4 E	8 fl oz	16 fl oz	Allow 3 to 15 days between treatments.
Exirel 0.83 SE	13.5 to 20.5 fl oz	61.5 fl oz	Allow 5 days between applications. Use an adjuvant.
Fulfill 50 DF	2.75 oz	5.5 oz	Allow 7 days between applications.
Lannate 90 SP	0.5 to 1 lb	4 lb	For spinach only.
		10 lb	For lettuce only.
Malathion 8	1 pt	2 applications	Allow 7 days between applications.
	1.88 pt	2 applications	Lettuce and spinach only. Allow 6 days between applications.
PQZ 1.87 SC	2.4 to 3.2 fl oz	4.8 fl oz	Allow 7 days between applications. Limit 2 applications.
Sivanto Prime 1.67 SL	7 to 14 fl oz	28 fl oz	Allow 7 days between applicatons.
Torac 1.29 EC	17 to 21 fl oz	42 fl oz	Limit 2 applications and allow 14 days between applications.
Venom 70 SG	1 to 3 oz	6 oz	Allow 7 days between applications.
Versys 0.83 SC	1.5 fl oz	14 fl oz	Allow 7 days between applications.
Flea Beetles			
Admire Pro	1.3 fl oz	6.5 fl oz	Allow 5 days between applications. Not during bloom.
Belay 2.13 SC	3 to 4 fl oz	12 fl oz	Allow 10 days between applications. Not during bloom.
Brigade 2 EC	2.1 to 6.4 fl oz	25.6 fl oz	Allow 7 days between applications.
		32 fl oz	For lettuce only. Allow 7 days between applications.
Harvanta 50 SL	16.4 fl oz	49.2 fl oz	Allow 5 days between applications. Three applicatons allowed.
Mustang Maxx	2.24 to 4 fl oz	24 fl oz	Allow 7 days between applications.
Proaxis 0.5 EC	2.56 to 3.84 fl oz	38.4 fl oz	-
Scorpion 35 SL	2 to 5.25 fl oz	10.5 fl oz	Allow 7 days between applications.
Sevin XLR Plus	0.5 to 1 qt	4 applications	Allow 7 days between applications. Apply within 30 days of planting.
Torac 1.29 EC	17 to 21 fl oz	42 fl oz	Limit 2 applications and allow 14 days between applications.
Venom 70 SG	1 to 3 oz	6 oz	Allow 7 days between applications.
Warrior II	1.28 to 1.92 fl oz	19.2 fl oz	-
Grasshoppers, Leafhoppers, Leafminers			
Admire Pro	1.3 fl oz	6.5 fl oz	Allow 5 days between applications. Not during bloom. Leafhoppers only.
Brigade 2 EC	2.1 to 6.4 fl oz	25.6 fl oz	Allow 7 days between applications.
		32 fl oz	For lettuce only. Allow 7 days between applications.
Dimethoate 4 E	8 fl oz	16 fl oz	Allow 3 to 15 days between treatments.
Harvanta 50 SL	10.9 to 16.4 fl oz	65.6 fl oz	Allow 5 days between applications. For leafminers only.
Mustang Maxx	2.24 to 4 fl oz	24 fl oz	Allow 7 days between applications.
Permethrin 3.2 EC	2 to 8 fl oz	24 fl oz	-
Proaxis 0.5 EC	2.56 to 3.84 fl oz	38.4 fl oz	-

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INSECT CONTROL: Greens[1] *(contiued)*

Insecticide	Product Amt/A	Seasonal Limit/A	Comments and Other Restrictions
Sevin XLR Plus	0.5 to 1 qt	4 applications	Leafhoppers only. Allow 7 days between applications. Apply within 30 days of planting.
Sivanto 1.67 SL	7 to 14 fl oz	28 fl oz	Allow 7 days between applications. Leafhoppers only.
Torac 1.29 EC	17 to 21 fl oz	42 fl oz	Limit 2 applications and allow 14 days between applications. For leafhoppers.
Trigard 75 WP	2.66 oz	6 applications	Allow 7 days between applications. Leafminers only.
Warrior II	1.28 to 1.92 fl oz	19.2 fl oz	-
Whiteflies			
Actara 25 W	3 to 5.5 oz	11 oz	Allow 7 days between applications.
Admire Pro	1.3 fl oz	6.5 fl oz	Allow 5 days between applications. Not during bloom.
Assail 30 SG	2.5 to 5.3 oz	20 oz	Limit 4 applications. Allow 7 days between applications. Field use only.
Belay 2.13 SC	3 to 4 fl oz	12 fl oz	Allow 10 days between applications.
Beleaf 50 SG	2.8 oz	8.4 oz	Allow 7 days between applications. Greenhouse whitefly only.
Courier 40 SC	9 to 13.6 fl oz	27.2 fl oz	Allow 7 days between applications. Limit 2 applications.
Exirel 0.83 SE	13.5 to 20.5 fl oz	61.5 fl oz	Allow 5 days between applications. Use an adjuvant.
Knack 0.86 EC	8 to 10 fl oz	20 fl oz	Allow 14 days between applications.
Oberon 2 SC	7 to 8.5 fl oz	25.5 fl oz	Allow 7 days between applications.
PQZ 1.87 SC	2.4 to 3.2 fl oz	4.8 fl oz	Allow 7 days between applications. Limit 2 applications.
Requiem EC	2 to 4 qt	-	-
Scorpion 35 SL	2 to 5.25 fl oz	10.5 fl oz	Allow 7 days between applications.
Sivanto 1.67 SL	10.5 to 14 fl oz	28 fl oz	Allow 7 days between applications.
Venom 70 SG	1 to 3 oz	6 oz	Allow 7 days between applications.
Versys 0.83 SC	5 to 7 fl oz	14 fl oz	Allow 7 days between applications.

1 Generic products available (Appendix G).

WEED CONTROL: Greens[1]

Product Amt/A	lb A.I./A	Comments
0.5 to 1.6 fl oz Aim 1.9 EW	0.008 to 0.025 carfentrazone	For contact post-emergence control of annual broadleaf weeds and suppression of annual grasses. Can be applied as a preplant, pre-transplant burndown, or before crop emerges to actively growing weeds up to 4 inches tall. Can also be applied post-emergence as a directed hooded application between crop rows. Use min. 10 gal water/A and crop oil 1% v/v. Max. rate 6.1 fl oz/A. PHI = 0 days.
6 to 14 lb Dacthal 75W	4.5 to 10.5 DCPA	For pre-emergence control of annual grasses and small-seeded broadleaves. Apply at seeding. Can be preplant incorporated.
1 to 2 pt Goal 2XL	0.25 to 0.5 oxyfluorfen	NOT LABELED ON COLLARDS, KALE, MUSTARD OR TURNIP GREENS. For pre-emergence and post-emergence control of certain annual grasses and most broadleaves. For fallow bed preparation only. Best if used with glyphosate for control of winter annual broadleaf weeds. Min. 90 days at 1 pt/A and 120 days at 2 pt/A between application and seeding.
2 to 4 pt Gramoxone Inteon	0.67 to 1.35 paraquat salt	ONLY LABELED FOR COLLARDS, CHINESE CABBAGE AND LETTUCE. For non-selective contact kill of annual grasses and broadleaf weeds and top-kill of perennial weeds. Apply preplant, pre-emergence, or before transplanting in min. 10 gal water/A. Apply banded or broadcast. Use higher rate for heavy weed infestations. Use non-ionic surfactant 0.25% v/v. **Paraquat product labels require applicators to take an EPA-approved training every 3 years to mix, load, and apply paraquat.**
2 to 4 lb Kerb 50 WP	1 to 2 pronamide	LABELED ON LETTUCE ONLY. For control of grasses and certain broadleaf weeds. Apply before or after seeding but before crop and weeds emerge. Moisture is necessary to activate. Label rates vary depending on variety, rainfall, and soil texture. Can be incorporated or watered in.
0.5 to 1.5 pt Poast	0.09 to 0.27 sethoxydim	For control of actively growing grasses only. Use high rate on Johnson grass. PHI = 30 days. Max. rate of 1.5 pt/application and 3 pt/season.
5 to 6 qt Prefar 4 E	5 to 6 bensulide	NOT LABELED ON SPINACH or TURNIP. For control of grasses and broadleaf weeds. Apply preplant and incorporate to 1 to 2 inch depth. Apply pre-emergence only if it can be watered in within 36 hours. Max. rate of 6 qt/season.
16 to 22 fl oz Roundup WeatherMax 5.5L	0.69 to 0.94 glyphosate-salt	For non-selective post-emergence control of annual and perennial grasses and broadleaf weeds. Use only AMS 1 to 2% v/v. Adding a non-ionic surfactant can reduce weed control effectiveness. Min. 3 days before seeding and min. 30 days before planting any non-labeled crop.

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WEED CONTROL: Greens[1] *(continued)*

Product Amt/A	lb A.I./A	Comments
9 to 16 fl oz Select Max	0.06 to 0.12 clethodim	For selective post-emergence of actively growing annual grasses and suppression of perennial grasses. Add crop oil 1% v/v. Max. 16 fl oz/ application. Min. 14 days between applications. PHI = 14 days for leafy greens but PHI = 30 days for leaf petioles (i.e. Swiss Chard)
1.5 pt Treflan HFP 4 E	0.75 trifluralin	NOT LABELED ON SPINACH AND LETTUCE. For control of annual grasses and broadleaf weeds. Use on turnip greens used for processing only. Apply as a preplant soil incorporated treatment.

1 Due to the wide range of crops grown under the title "Greens," growers must carefully read labels before applying herbicides.

DISEASE CONTROL: Greens

Product	FRAC Code[1]	PHI[2] (days)	Amt/A	Seasonal Limits/A	Comments
MUSTARD, TURNIP, COLLARDS, KALE					
Black Spot (*Alternaria*), Cercospora, Cercosporella Leaf Spots					
Cabrio and pyraclostrobin[3] generics	11	3	12 to 16 oz	64 oz	
Endura	7	14	6 to 9 oz	2 apps	Not for turnip greens.
Copper, fixed coppers[3]	M				See label for rates, mixing instructions, and tank-mix precautions. Some products are approved for greenhouse use.
Flint Extra	11	0	3.0 to 3.8 oz	7.6 oz	Black spot and powdery mildew. Apply preventatively and rotate with a non group 11 fungicide.
Fontelis	7	0	14 to 30 fl oz	72 fl oz	
Inspire Super	3/9	7	16 to 20 fl oz	80 fl oz	
Luna Experience	7/3	7	6.0 to 8.6 fl oz	34 fl oz	
Luna Sensation	7/11	0	4.0 to 7.6 fl oz	23 fl oz	
Priaxor	7/11	3	6 to 8.2 fl oz	3 apps	
Procure 480SC	3	1	6 to 8 fl oz[4]	18 fl oz	Black spot.
Quadris and azoxystrobin[3] generics	11	0	6 to 15.5 fl oz	42 fl oz	Use higher rates for Cercospora. May be applied through drip irrigation.
Quadris Top	11/3	1	12 to 14 fl oz	56 fl oz	
Rhyme	3	7	5 to 7 fl oz	4 apps	
Reason 500 SC	11	2	8.2 fl oz	24.6 fl oz	
Switch 62.5WG	9/12	7	11 to 14 oz	56 oz	
Toledo and tebuconazole[3] generics	3	7	3 to 4 fl oz	16 fl oz	Cercospora.
Tilt and propiconazole[3] generics	3	7	3 to 4 fl oz	12 fl oz	May be applied by drip irrigation.
Topguard EQ	3/11	7	5.0 to 8.0 fl oz	4 apps	
Trionic	3	1	6 to 8 fl oz	16 fl oz	Black spot and powdery mildew.
Black Rot					
Actigard	21	14	0.5 to 1 oz	4 apps	Not for turnip greens. Suppression only of black rot (*Xanthomonas)*. See label for application instructions. May be applied through drip irrigation. May cause phytotoxicity and yield reduction. Do not apply to stressed or injured plants.
Copper, fixed coppers[3]	M				See label for rates, mixing instructions, and tank-mix precautions. Some products are approved for greenhouse use.
Basal Stem Rot, Root Rot, Wirestem (*Rhizoctonia*), Clubroot (*Plasmodiophora*)					
Omega 500 and fluazinam[3] generics	29	20			Clubroot. Apply in transplant water or incorporate into soil. See label for rates and instructions.
Luna Experience	7/3	7	6.0 to 8.6 fl oz	34 fl oz	Suppression only for Rhizoctonia bottom rot.

(continued on next page)

DISEASE CONTROL: Greens *(continued)*

Product	FRAC Code[1]	PHI[2] (days)	Amt/A	Seasonal Limits/A	Comments
Quadris and azoxystrobin[3] generics	11	0	0.4 to 0.8 fl oz per 1000 row ft	42 fl oz	Preplant or post plant application, banded or in furrow. See label for instructions. May be applied through drip irrigation.
Damping-off (*Pythium*)					
Presidio	43	2	3 to 4 fl oz	12 fl oz	Must be tank-mixed with a fungicide NOT in FRAC Group 43. Can be applied by drip-irrigation.
Ranman	21	0	2.75 fl oz	1 app	Prior to planting, apply as a banded spray followed by incorporation. Can be applied as a drench at planting or in transplant water; see label for instructions.
Ridomil Gold and mefenoxam[3] generics	4	7	1 to 2 pt	2 pt	Preplant or post plant application, broadcast or band. See label for instructions. Some products can be injected through drip irrigation.
Downy Mildew					
Actigard	21	14	0.5 to 1 oz	4 apps	Not for turnip greens. See label for application instructions. May be applied through drip irrigation. May cause phytotoxicity and yield reduction. Do not apply to stressed or injured plants.
Cabrio and pyraclostrobin[3] generics	11	3	12 to 16 oz	64 oz	
Copper, fixed coppers[3]	M				See label for rates, mixing instructions, and tank-mix precautions. Some products are approved for greenhouse use.
Forum SC	40	0	6 fl oz	30 fl oz	Must be tank-mixed with another downy mildew product NOT in FRAC Group 40.
Luna Sensation	7/11	0	4.0 to 7.6 fl oz	23 fl oz	Suppressive only.
Orondis Gold 200	49	0	4.8 to 9.6 fl oz	19.2 fl oz	Do not combine with foliar applications of Orondis Opti.
Presidio	43	2	3 to 4 fl oz	12 fl oz	Must be tank-mixed with a fungicide NOT in FRAC Group 43.
Ranman	21	0	2.75 fl oz	39.5 fl oz	Tank-mix with an organosilcone or non-ionic surfactant.
Reason 500 SC	11	2	5.5 to 8.2 fl oz	24.6 fl oz	
Revus, Micora, and mandipropamid generics	40	1	8 fl oz	32 fl oz	Revus, use a spreader/penetrant surfactant. Must be tank-mixed with a fungicide NOT in FRAC Group 40. Micora for transplant production only.
Topguard	3/11	7	6.0 to 8.0 fl oz	4 apps	Use high rate for downy mildew.
Zampro	40/45	0	14 fl oz	3 apps	
Powdery Mildew					
Cabrio and pyraclostrobin[3] generics	11	3	12 to 16 oz	64 oz	
Endura	7	14	6 to 9 oz	2 apps	Not for turnip greens.
Fontelis	7	0	14 to 30 fl oz	72 fl oz	
Inspire Super	3/9	7	16 to 20 fl oz	80 fl oz	
Luna Experience	7/3	7	6.0 to 8.6 fl oz	34 fl oz	
Luna Sensation	7/11	0	5.0 to 7.6 fl oz	23 fl oz	
Priaxor	7/11	3	6 to 8.2 fl oz	3 apps	
Procure 480SC	3	1	6 to 8 fl oz[4]	18 fl oz	
Quadris and azoxystrobin[3] generics	11	0	6 to 15.5 fl oz	42 fl oz	May be applied through drip irrigation.
Quadris Top	11/3	1	12 to 14 fl oz	56 fl oz	
Rhyme	3	7	5 to 7 fl oz	4 apps	
Sulfur[3]	M				Phytotoxicity may occur when sulfur is applied when temperatures exceed 90°F.
Switch 62.5WG	9/12	7	10 to 12 oz	56 oz	Rate is 11 to 14 oz for turnip greens.

(continued on next page)

DISEASE CONTROL: Greens *(continued)*

Product	FRAC Code[1]	PHI[2] (days)	Amt/A	Seasonal Limits/A	Comments
Toledo and tebuconazole[3] generics	3	7	3 to 4 fl oz	16 fl oz	
Tilt and propiconazole[3] generics	3	7	3 to 4 fl oz	12 fl oz	May be applied by drip irrigation.
Topguard EQ	3/11	7	6.0 to 8.0 fl oz	4 apps	Use high rate for downy mildew.
Trionic	3	1	6 to 8 fl oz	16 fl oz	Black spot and powdery mildew.
Velum Prime	7	0	6.5 to 6.84 fl oz	13.7 fl oz	Can be applied to foliage or through drip application.
Sclerotinia Stem Rot					
Cabrio and pyraclostrobin[3] generics	11	3	12 to 16 oz	4 apps	
Endura	7	14	6 to 9 oz	2 apps	Not for turnip greens.
Fontelis	7	0	16 to 30 fl oz	72 fl oz	
Luna Experience	7/3	7	6.0 to 8.6 fl oz	34 fl oz	
Luna Sensation	7/11	0	7.6 fl oz	23 fl oz	
LETTUCE					
Bottom Rot (*Rhizoctonia*)					
Cueva	M	0	0.5 to 2 gal		OMRI-listed. Mix in 100 gallons of water, use 50 to 100 gal/A of solution.
Endura	7	14	8 to 11 oz	2 apps	
Kenja	7	14	12.3 oz	24.6 oz	
Luna Sensation	7/11	0	7.6 fl oz	23 fl oz	Suppressive only.
Rovral and iprodione[3] generics	2	14	1.5 to 2 pt	3 app	Make first application from planting to just after thinning. See label for application instructions.
Quadris and azoxystrobin[3] generics	11	0	0.4 to 0.8 fl oz per 1000 row ft	42 fl oz	Preplant or post plant application, banded or in furrow. See label for instructions. May be applied through drip irrigation.
Damping-off (*Pythium*)					
MetaStar and metalaxyl[3] generics	4	21	4 to 8 pts	1 app	Preplant or post plant application, broadcast or band. See label for instructions.
Previcur Flex	28	6	2 pt	8 pt	Apply to lower stem and surrounding soil. See label for application instructions. May be applied by drip or sprinkler irrigation. Approved for greenhouse use.
Ranman	21	0	2.75 fl oz	1 app	Prior to planting, apply as a banded spray followed by incorporation. Can be applied as a drench at planting or in transplant water; see label for instructions.
Ridomil Gold and mefenoxam[3] generics	4	7	1 to 2 pt	2 pt	Preplant or post plant application, broadcast or band. See label for instructions. Some products can be injected through drip irrigation.
Downy Mildew					
Actigard	21	7	0.75 to 1 oz	4 apps	Apply after thinning and make up to three additional applications every 7 days. Apply in a min of 20 gal/A of water. May be applied through drip irrigation. May cause phytotoxicity—see label. Do not apply to stressed or injured plants.
Cabrio and pyraclostrobin[3] generics	11	0	16 oz	64 oz	
Curzate 60 DF	27	3	3.2 to 5 oz	30 oz	Head lettuce only. Must be tank-mixed with a protectant fungicide such as mancozeb.
Copper, fixed coppers[3]	M				See label for rates, mixing instructions, and tank-mix precautions. Some products are approved for greenhouse use.
Forum SC	40	0	6 fl oz	5 apps	Must be tank-mixed with another downy mildew product.
Dithane M45 and mancozeb[3] generics	M	10	2 lb	12 lb	There are multiple Dithane formulations and mancozeb generics on the market. See label for rates.

(continued on next page)

DISEASE CONTROL: Greens *(continued)*

Product	FRAC Code[1]	PHI[2] (days)	Amt/A	Seasonal Limits/A	Comments
ManKocide	M	10	1 to 2 lb	26 lb	
Orondis Gold 200	49	0	4.8 to 9.6 fl oz	19.2 fl oz	Apply at crop establishment or through drip irrigation. Do not combine with foliar applications of Orondis.
Orondis Ultra	40/49	1	5.5 to 8.0 oz	32 oz	Apply at crop establishment or through drip irrigation. Do not combine with foliar applications of Orondis.
Presidio	43	2	3 to 4 fl oz	12 fl oz	Must be tank-mixed with a fungicide NOT in FRAC Group 43.
Previcur Flex	28	6	1.33 to 2 pt	8 pt	Apply to lower stem and surrounding soil. See label for application instructions. May be applied by drip or sprinkler irrigation. Approved for greenhouse use.
Quadris and azoxystrobin[3] generics	11	0	12 to 15.5 fl oz	90 fl oz	May be applied through drip irrigation.
Ranman	43	0	2.75 fl oz	16.5 fl oz	
Reason 500 SC	11	2	5.5 to 8.2 fl oz	24.6 fl oz	
Revus	40	1	8 fl oz	32 fl oz	Use a spreader/penetrant surfactant. Must be tank-mixed with a fungicide NOT in FRAC Group 40.
Tanos	11/27	3	8 oz	3 apps	Tanos must be tank-mixed with a fungicide from FRAC Group M appropriate for the target disease.
Topguard EQ	3/11	7	6.0 to 8.0 fl oz	4 apps	Use high rate for downy mildew.
Torac	39	1	21 oz	4 apps	Downy and powdery mildews, suppressive only.
Zampro	40/45	0	14 fl oz	3 apps	
Drop, Gray Mold					
Botran 75 W	14	14	2 to 5.33 lb	5.33 lb	Rates are timing dependent (pre-emergence, thinning, and post-thinning). See label for application instructions. Approved for greenhouse use.
Botran 5F	14	14	1.2 to 6.4 pt	6.4 pt	
Cannonball WP and fludioxonil[3] generics	12	0	7 oz	28 oz	May be applied through drip irrigation.
Endura	7	14	8 to 11 oz	2 apps	Apply immediately after emergence/ transplanting or before disease onset.
Flint Extra	11	0/20	3.0 to 3.8 oz	7.6 oz	Anthracnose, black spot, and powdery mildew.
Fontelis	7	3	16 to 24 fl oz	72 fl oz	
Rovral and iprodione[3] generics	2	14	1.5 to 2 pt	3 app	Drop. Make first application from planting to just after thinning. Repeat applications can be made every 10 days. See label for application instructions.
Kenja	7	14	12.3 fl oz	24.6 fl oz	Drop only. First application at crop establishment, follow with second app 14 days later.
Luna Sensation	7/11	0	7.6 fl oz	23 fl oz	
Merivon	7/11	1	4 to 11 fl oz	3 apps	
Miravis Prime	7/12	0	9.2 to 13.4 oz	2 apps	
Rhyme	3	7	5 to 7 fl oz	4 apps	
Switch 62.5WG	9/12	0	11 to 14 oz	56 oz	
SPINACH					
Damping-off (*Pythium*)					
MetaStar and metalaxyl[3] generics	4	21	4 to 8 pts	1 app	Preplant or post plant application, broadcast or band. See label for instructions.
Ranman	21	0	2.75 fl oz	1 app	Prior to planting, apply as a banded spray followed by incorporation. Can be applied as a drench at planting or in transplant water; see label for instructions.
Ridomil Gold and mefenoxam[3] generics	4	21	1 to 2 pts	2 pt	Preplant or post plant application, broadcast or band. See label for instructions.

(continued on next page)

DISEASE CONTROL: Greens *(continued)*

Product	FRAC Code[1]	PHI[2] (days)	Amt/A	Seasonal Limits/A	Comments
Downy Mildew, White Rust					
Actigard	21	7	0.5 to 0.75 oz	3 apps	See label for application instructions. May be applied through drip irrigation. May cause phytotoxicity and yield reduction. Do not apply to stressed or injured plants.
Cabrio and pyraclostrobin[3] generics	11	0	16 oz	64 oz	Use highest rate for downy mildew.
Copper, fixed coppers[3]	M				See label for rates, mixing instructions, and tank-mix precautions. Some products are approved for greenhouse use.
Curzate	27	1/3	5.0 oz	30 oz	Use higher rate when environmental conditions are cool and damp.
MetaStar and metalaxyl[3] generics	4	21	4 to 8 pts	11 pt	Must be used at planting for white rust. Do not use as a foliar application. See label for application instructions.
Orondis Gold 200	49	0	4.8 to 9.6 fl oz	19.2 fl oz	Apply at crop establishment or through drip irrigation. Do not combine with foliar applications of Orondis.
Orondis Ultra	40/49	1	5.5 to 8.0 oz	32 oz	Apply at crop establishment or through drip irrigation. Do not combine with foliar applications of Orondis.
Presidio	43	0	3 to 4 fl oz	12 fl oz	Must be tank-mixed with a fungicide NOT in FRAC Group 43.
Quadris and azoxystrobin[3] generics	11	0	12 to 15.5 fl oz	90 fl oz	May be applied through drip irrigation.
Ranman	21	0	2.1 to 2.75 fl oz	13.75 fl oz	Tank-mix with an organosilicone or non-ionic surfactant.
Revus	40	1	8 fl oz	32 fl oz	Use a spreader/penetrant surfactant. Must be tank-mixed with a fungicide NOT in FRAC Group 40.
Ridomil Gold and mefenoxam[3] generics	4	21	0.25 pt	2 pt.	Not for foliar application. Post-plant sidedress application. See label for instructions.
Ridomil Gold Copper	4/M	21	2.5 lb	2 apps	Apply 21 days after initial (at-planting) treatment with Ridomil Gold EC or GR and continue every 14 days. Avoid late-season applications.
Tanos	11/27	1	8 to 10 oz	84 oz	Tank-mix with fixed copper.
Topguard EQ	3/11	7	6.0 to 8.0 fl oz	4 apps	Use high rate for downy mildew.
Torac	39	1	21 oz	4 apps	Downy and powdery mildews, suppressive only.
Zampro	40/45	0	14 fl oz	3 apps	Downy mildew.
Leaf Spots (Anthracnose, *Cercospora*)					
Cabrio and pyraclostrobin[3] generics	11	0	12 to 16 oz	4 apps	
Copper, fixed coppers[3]	M				See label for rates, mixing instructions, and tank-mix precautions. Some products are approved for greenhouse use.
Fontelis	7	3	16 to 24 fl oz	72 fl oz	
Merivon	7/11	1	4 to 11 fl oz	3 apps	Do not tank mix with other products for spinach.
Miravis Prime	7/12	0	9.2 to 13.4 oz	2 apps	
Quadris and azoxystrobin[3] generics	11	0			
Rhyme	3	7	5 to 7 fl oz	4 apps	
Topguard EQ	3/11	7	6.0 to 8.0 fl oz	4 apps	

1 Products with numerical FRAC codes must be alternated or tank-mixed with products that have a different FRAC code to discourage resistance development. See product label for maximum number of consecutive applications allowed. Refer to the table on pages 22-24 for more information on FRAC codes.
2 Pre-harvest interval.
3 Generic products available (Appendix F). Amounts and seasonal limits per acre are product dependent.
4 Use higher rate when pressure is severe.

Okra

Mallow family (Malvaceae): *Abelmoschus esculentus*

Planting and Culture

Well-drained, fertile, silt loam soils are most desirable; however, okra will grow on a wide range of soil types. Prepare a firm, friable seedbed as for other vegetable crops.

Seed okra only after the soil has warmed up (65°F) in the spring to allow good seed germination (see Appendix K). Plant four to six seeds per foot in rows 28 to 36 inches apart; thin plants to 10 to 18 inches apart in rows. Ten to 12 pounds of seed is required to plant an acre. Seed should be planted 1½ to 2 inches deep. Planet Jr.-type planters work well for direct seeding. In addition, very high yields have been obtained with transplanted okra using black plastic mulch and drip irrigation.

Fertilizing

Apply P_2O_5, K_2O, and lime according to soil test results. A total of about 80 to 90 pounds N per acre is used, with about half that amount applied prior to planting. Fertilizer should be applied broadcast and disked in prior to seeding. A sidedressing of nitrogen applied after the first harvest will help to prolong the harvesting period (see "Fertilizer" table). Soil pH should be 6.0 to 6.5.

Harvesting and Handling

Harvesting under favorable conditions should start about six days after flowering. Harvesting of the pods should be done on a regular basis (about every two days) so that the pods do not become over-mature. Regular picking increases yield. Old pods should be removed and discarded, because mature ones retard future pod set. The pods should be harvested when 2 to 3½ inches long. Move harvested pods to a shady, cool area as soon as possible to maintain good quality. Fresh market okra is usually graded into the following sizes:

- Fancy: pods up to 3½ inches long
- Choice: pods 3½ to 4½ inches long
- Jumbo: pods over 4½ inches long but still tender

Pods should be harvested from the plant with a sharp knife to make a smooth, neat cut.

Okra can be kept for fresh consumption for two weeks at a temperature of 50°F and a relative humidity of 90 to 95 percent. Okra chilled below temperatures of 50°F will turn dark and decay.

Potential yields of 12,000 pounds per acre are possible; however, 8,000 to 10,000 pounds per acre is considered more realistic. A bushel of okra weighs approximately 30 pounds.

VARIETIES: Okra

Variety	DTM[1] From Seeding	Comments
Jambalaya	50	Compact plant, uniform pods.
Burgundy	60	Dark Red Pods, flowers are edible and may be stuffed.
Clemson Spineless	55	Heavy yields—almost spineless pods.

1 Days to Maturity

FERTILIZER: Okra

Soil Test Results (lb/A)		Fertilizer Needed (lb/A)
Phosphorus		**Phosphate (P_2O_5)**
Low	<31	181-240
Medium	31-60	91-180
High	61-80	1-90
Very High	>80	0
Potassium		**Potash (K_2O)**
Low	<201	151-200
Medium	201-300	101-150
High	301-450	1-100
Very High	>450	0
Nitrogen		**N**

Apply 40 to 50 lb nitrogen (N)/A before planting seed. After harvest begins sidedress plants with an additional 35 to 40 lb N/A.

PESTICIDE SAFETY: Okra

	Signal[1]	Re-entry (hrs)	Harvest (days)
INSECTICIDES			
Acramite 50 WS	C	12	3
Admire Pro	C	12	21
Assail 30 SG	C	12	7
Avaunt eVo 30 DG	C	12	3
Beleaf 50 SG	C	12	0
Bt products	C	12	0
Coragen 1.67 SC	-	4	1
Exirel 0.83 SE	C	4	1
Harvanta 50 SL	C	4	1
Intrepid 2 F	C	4	1
Kanemite 15 SC	C	12	1
Knack 0.86 EC	C	12	1
Magister SC	W	12	3
Malathion 8	C	12	1
Miteus 0.42 EC	W	12	1
Movento 2 SC	C	24	1
Portal 0.4 EC	W	12	1
PQZ 1.87 SC	C	12	1
Radiant SC	C	4	1
Requiem 25 EC	C	4	0
Rimon 0.83 EC	W	12	1
Sefina 0.42 SC	C	12	0
Sevin XLR Plus	C	12	3
Sivanto Prime 1.67 SL	C	4	1
Torac 1.29 EC	W	12	1
Transform 50 WG	D	24	1
Verimark 1.67 Sc	-	4	1
Zeal 72 WP	C	12	7
Restricted Use			
Brigade 2 EC	W	12	7
Danitol 2.4 EC	W	24	3
Fastac 0.83 EC	D	12	1
Mustang Maxx	W	12	1
Proclaim 5 SG	C	12	7

(continued)

PESTICIDE SAFETY: Okra *(continued)*

	Signal[1]	Re-entry (hrs)	Harvest (days)
FUNGICIDES			
Aprovia Top	W	12	0
Ariston	C	12	3
Azoxystrobin[2]	C	12	0
Chlorothalonil[2]	C	12	3
Elumin	C	12	2
Emblem	C	12	0
Fixed coppers[2]	W	24/48	0
Fontelis	C	12	0
Inspire Super	C	12	0
Lektivar	W	12	30
Luna Experience	C	12	3
Luna Sensation	C	12	3
Mettle	C	12	0
Micora	C	4	
Miravis Prime	C	12	0
Orondis Gold	C	4	0
Orondis Ultra	C	4	1
Pageant Intrinsic	C	12	0
Quadris Top	C	12	0
Rally 40 WSP	W	24	0
Ranman	C	12	0
Reason	C	12	14
Rhyme	W	12	0
Sulfur[2]	C	24	0
Switch	C	12	0
Tebuconazole[2]	C	12	3
Topguard	C	12	0
Torac	W	12	1
Torino	C	4	0
Velum Prime	C	12	0
Vivando	C	12	0

1 W: Warning, C: Caution, D: Danger; P: Poison
2 Several formulations are marketed. See the general introduction for more details on fungicides.

INSECT CONTROL: Okra[1]

Insecticide	Product Amt/A	Seasonal Limit/A	Comments and Other Restrictions
Aphids			
Admire Pro	7 to 14 fl oz	14 fl oz	Soil application, see label for methods.
	1.3 to 2.2 fl oz	6.7 fl oz	Foliar application. Allow 5 days between applications. Not during bloom.
Assail 30 SG	2 to 4 oz	16 oz	Limit 4 applications. Allow 7 days between applications.
Beleaf 50 SG	2.8 to 4.28 oz	8.4 oz	Allow 7 days between applications. Limit 2 to 3 applications.
Malathion 8	1.2 pt	5 applications	Allow 7 days between applications.
Movento 2 SC	4 to 5 fl oz	10 fl oz	Allow 7 days between applications. Requires surfactant.
PQZ 1.87 SC	2.4 to 3.2 fl oz	4.8 fl oz	Limit 4 applications. Allow 7 days between applications.
Sefina 0.42 SC	3 fl oz	28 fl oz	Allow 7 days between applications.
Sivanto Prime 1.67 SL	7 to 14 fl oz	28 fl oz	Allow 7 days between applications.
Torac 1.29 EC	17 to 21 fl oz	42 fl oz	Allow 7 days between applications. Limit 2 applications.
Transform 50 WG	0.75 to 1 oz	8.5 oz	Limit 4 applications. Allow 7 days between applications.

(continued on next page)

INSECT CONTROL: Okra[1] *(continued)*

Insecticide	Product Amt/A	Seasonal Limit/A	Comments and Other Restrictions
Corn Earworms			
Avaunt eVo 30 WG	3.5 to 6 oz	14 oz	Allow 5 days between applications.
Brigade 2 E	2.1 to 6.4 fl oz	12.8 fl oz	Allow 7 days between applications.
Bt products	See labels		
Coragen 1.67 SC	3.5 to 7.5 fl oz	15.4 fl oz	Allow 5 days between applications.
Danitol 2.4 EC	10.67 fl oz	42.67 fl oz	Allow 7 days between applications.
Exirel 0.83 SE	7 to 13.5 fl oz	61.5 fl oz	Allow 5 days between applications.
Fastac 0.83 EC	2.2 to 3.8 fl oz	11.4 fl oz	Allow 7 days between applications.
Harvanta 50 SL	10.9 to 16.4 fl oz	49.2 fl oz	Allow 7 days between applications.
Intrepid 2 F	10 to 16 fl oz	64 fl oz	-
Mustang Maxx	2.24 to 4 fl oz	24 fl oz	Allow 7 days between applications.
Proclaim 5 SG	2.4 to 4.8 oz	14.4 oz	Allow 7 days between applications.
Radiant SC	5 to 10 fl oz	34 fl oz	Allow 4 days between applications.
Sevin XLR Plus	1 to 1.5 qt	6 qt	Allow 6 days between applications.
Japanese Beetles			
Brigade 2 E	2.1 to 6.4 fl oz	12.8 fl oz	Allow 7 days between applications.
Malathion 8	1.5 pt	5 applications	Allow 7 days between applications.
Stink bugs			
Brigade 2 EC	2.1 to 6.4 fl oz	12.8 fl oz	Allow 7 days between applications.
Danitol 2.4 EC	10.67 fl oz	42.67 fl oz	Allow 7 days between applications.
Fastac 0.83 EC	2.2 to 3.8 fl oz	11.4 fl oz	Allow 7 days between applications.
Mustang Maxx	3.2 to 4 fl oz	24 fl oz	Allow 7 days between applications.
Rimon 0.83 EC	12 fl oz	36 fl oz	For immatures only. Allow 7 days between applications.

1 Generic products available (Appendix G).

WEED CONTROL: Okra

Product Amt/A	lb A.I./A	Comments
0.5 to 1.6 fl oz Aim 1.9 EW	0.008 to 0.025 carfentrazone	For contact post-emergence control of annual broadleaf weeds and suppression of annual grasses. Can be applied as a preplant, pre-transplant burndown, or before crop emerges to actively growing weeds up to 4 inches tall. Can also be applied post-emergence as a directed hooded application between crop rows. Use min. 10 gal water/A and crop oil 1% v/v. Max. rate 6.1 fl oz/A. PHI = 0 days.
1.5 to 3.0 pt Caparol 4L	0.375 to 0.75 prometryn	Apply as pre-emergence or post-directed application. See label for crop rotation restrictions.
1 to 2 pt Dual Magnum	0.95 to 1.9 s-metolachlor	See the "Dual Magnum 24(c) Label" section on page 15.
2 to 4 pt Gramoxone Inteon	0.67 to 1.35 paraquat salt	For non-selective contact kill of annual grasses and broadleaf weeds and top-kill of perennial weeds. Apply preplant, pre-emergence, or before transplanting in min. 20 gal of water/A. Apply banded or broadcast. Use higher rate for heavy weed infestations. Use non-ionic surfactant 0.25% v/v. PHI = 21 days. **Paraquat product labels require applicators to take an EPA-approved training every 3 years to mix, load, and apply paraquat.**
1.5 pt Poast 1.5 E	0.28 sethoxydim	For control of actively growing grasses only. Use high rate on Johnson grass. PHI = 14 days. Max. rate of 1.5 pt/application and 5.5 pt/season.
16 to 22 fl oz Roundup WeatherMax 5.5L	0.69 to 0.94 glyphosate-salt	For non-selective post-emergence control of annual and perennial grasses and broadleaf weeds. Use only AMS 1 to 2% v/v. Adding a non-ionic surfactant can reduce weed control effectiveness. Min. 30 days before planting any non-labeled crop.
0.5 to 1.0 oz Sandea 75 DG	0.024 to 0.048	Apply to row middles as a postemergence shielded or hooded spray to avoid contact with planted crop. In plasticulture, do not allow spray to contact plastic. Do not apply more than 2 oz per acre per 12 month period. PHI = 30 days.
1.25 to 2 pt Treflan HFP 4 E	0.62 to 1 trifluralin	For pre-emergence control of annual grasses and broadleaf weeds. Apply as preplant soil incorporated. Can also be applied before or immediately after planting.

DISEASE CONTROL: Okra

Product	FRAC Code[1]	PHI[2] (days)	Amt/A	Seasonal Limits/A	Comments
Foliar Diseases (Anthracnose, Leaf Spots, Powdery Mildew)					
Ariston	M/27	3	2.0 - 2.4 pt	17.5 pt	Anthracnose only.
Aprovia Top	3/7	0	10.5 to 13.5 oz	53.6 oz	Fungal leaf spots; also suppressive for southern blight.
Quadris and azoxystrobin[3] generics	11	0	6 to 15.5 fl oz[3]	4 apps	
Chlorothalonil[3]					There are multiple Bravo formulations and chlorothalonil generics on the market. See label for rates.
Bravo Ultrex	M	14	1.4 lb	10.9 lb	
Bravo Weather Stik	M	3	1.5 lb	12 pt	
Emblem	12	0	5.5 to 7 fl oz[5]	28 fl oz	Gray mold, powdery mildew.
Copper, fixed coppers[3]	M	0			See label for rates, mixing instructions, and tank-mix precautions. Some products are approved for greenhouse use.
Fontelis	7	0	16 to 24 fl oz	72 fl oz	
Inspire Super	3/9	0	16 to 20 fl oz	47 fl oz	
Luna Experience	7/3	3	12.8 fl oz	34 fl oz	Cercospora leaf spot.
Luna Sensation	7/11	3	5.0 to 7.6 oz	27.1 oz	Fungal leaf spots.
Mettle	3	0	6.0 to 8.0 fl oz	5 apps	
Miravis Prime	7/12	0	9.2 to 11.4 oz	22.8 oz	Fungal leaf spots.
Pageant Intrinsic	7/11	0	9.7 to 23 oz	54 oz	Fungal leaf spots.
Quadris Top	11/3	0	8.0 to 14.0 oz	55.3 oz	Fungal leaf spots.
Rally and myclobutanil[3] generics	3	0	2.5 to 5 oz	4 apps	Powdery mildew.
Rhyme	3	0	7 fl oz	28 fl oz	Anthracnose, Cercospora leaf spot, powdery mildew.
Sulfur[3]	M	0	3 to 10 lb	n/a	Phytotoxicity may occur when sulfur is applied when temperatures exceed 90°F.
Switch 62.5 WG	9/12	0	11 to 14 oz	56 oz	Gray mold and powdery mildew.
Toledo and tebuconazole[3] generics	3	3	4 to 6 fl oz	24 fl oz	Cercospora leaf spot.
Topguard	3	0	14 fl oz	56 fl oz	Anthracnose, Cercospora leaf spot, powdery mildew.
Torac	39	1	21 oz	2 apps	Powdery mildew suppression only.
Torino	U6	0	3.4 oz	3 apps	Powdery mildew.
Velum Prime	7	0	6.5 to 6.84 oz	13.7 oz	Powdery mildew; also nematode suppression. Drip applications are effective for both.
Vivando	U8	0	15.4 fl oz	3 apps	Powdery mildew suppression only.
Phytophthora blight, crown and root rot					
Elumin	22	2	8 oz	16 oz	Phytophthora blight and root rot. Can be injected, applied to soil, or as a foliar spray.
Omega 500 and fluazinam[3] generics	29	30	16 to 24 oz	144 oz	Soil drench at transplanting followed by foliar applications. See label for application instructions.
Orondis Gold 200	49	7	4.8 to 9.6 fl oz	19.2 fl oz	Phytophthora blight. Do not combine with applications of Orondis Ultra.
Orondis Ultra	49/40	1	5.5 to 8.0 oz	32.0 fl oz	Phytophthora blight. Do not combine with applications of Orondis Gold.
Ranman SC	21	0	2.1 to 2.75 fl oz	6 apps	Phytophthora blight.
Reason 500 SC	11	14	5.5 to 8.2 fl oz	24.6 fl oz	Foliar application only.
Seedling Rot (*Rhizoctonia*)					
Quadris and azoxystrobin[3] generics	11	0	0.40 to 0.80 fl oz/1,000 ft	1 app	May be applied in-furrow or as banded spray. See label for additional details.

1 Products with numerical FRAC codes must be alternated or tank-mixed with products that have a different FRAC code to discourage resistance development. See product label for maximum number of consecutive applications allowed. Refer to the table on pages 22-24 for more information on FRAC codes.

2 Pre-harvest interval.

3 Generic products available (Appendix F). Amounts and seasonal limits per acre are product dependent.

Onions

Onion family (Alliaceae): *Allium cepa* Cepa group

Planting and Culture

Due to weed pressure, it is recommended that onion producers use transplants or sets for planting. The easiest way to grow green bunching onions is by using sets. Sets should be planted by mid-March for best results (see Appendix K).

Typically, transplants can be planted into the field about 8 to 10 weeks after seeding. At this time the base of the plants should be ¼ to ½ inch in diameter. Transplants can be planted into raised beds on rows 8 to 12 inches apart with in-row spacing between 6 and 8 inches. Some growers have had success using black or white plastic; however, growing onions on plastic can also increase the incidence of bacterial diseases in bulbs, particularly in hot or wet weather. If using plastic mulches, white-colored mulch is preferred for onion production due to the lower soil temperatures that occur. Use drip irrigation, as onions have poor root systems and will not achieve maximum size without adequate moisture. A well-drained soil is essential for good onion production. A soil pH between 6.0 and 6.8 is most desirable for onions.

Many growers produce onions for direct market sales. Often consumers at these markets are looking for sweet "Vidalia"-type onions. In order to produce mild tasting onions for fresh consumption, growers must have the correct combination of both variety and environment. Sweet, mild varieties bred specifically for fresh consumption should be chosen. In addition, onions grown with low levels of sulfur in soils or irrigation water will tend to be milder than those grown in a high sulfur environment. Growers should also be careful to choose the correct varieties for Kentucky. Intermediate or "day-neutral" type varieties perform well at this latitude.

Harvesting, Curing, and Storing

Onions should be harvested when at least 70 percent of the bulbs in the field have gone "tops-down" (foliage has fallen). Irrigation can be stopped about one week prior to harvest. At harvest, bulbs should be undercut and pulled by hand, with foliage and roots removed, and put in shallow trays inside for drying. Onions can be cured outside on a dry surface for one week prior to storing as long as they are protected from rain. Throw out diseased or injured bulbs. A temperature of 35°F and a relative humidity of 70 to 75 percent is the most desirable for storing onions for long periods. Do not store bulbs at a high relative humidity, as is appropriate for many other vegetables. Good ventilation is essential.

Green-bunching onions should be pulled and put into bunches (containing five to seven plants) when they are ⅓ to 1 inch in diameter. To achieve the long white shoulders desired on green onions, the soil is hilled around plants two to three weeks before harvest.

VARIETIES: Onions—Green and Bulb

Variety	DTM[1]	Comments
GREEN (BUNCHING/SCALLIONS)		
Ishikura Improved	60-66	Long very slim white stems
Evergreen White	65-70	Hardy, will overwinter, white stems
BULB		
Gunnison	100 (300)[1]	Medium bulbs, some success overwintering, for storage, hot and pungent.
Super Star	100	Large (3/4 lb) bulbs; white, pungent, stores well; AAS winner.
Candy	110	Large bulbs, sweet mild flavor, does very well in KY, not for storage.
Expression	110	Large bulbs, sweet mild, similar to Candy
Redwing	110-115	Red, medium bulbs, uniform, long day type will mature later.
Walla Walla	125 (300)[1]	Very large, sweet and mild, some success overwintering, stores poorly.
Yellow Sweet Spanish	130	Yellow, very large, globe-shaped, long-day onion will mature mid-late summer.

1 Days to maturity if overwintering.

FERTILIZER: Onions

Soil Test Results (lb/A)		Fertilizer Needed (lb/A)
Phosphorus		**Phosphate (P_2O_5)**
Low	<31	181-240
Medium	31-60	61-180
High	61-80	1-60
Very High	>81	0
Potassium		**Potash (K_2O)**
Low	<201	176-250
Medium	201-300	101-175
High	301-450	1-100
Very High	>450	0
Nitrogen		**N**

Apply 90 to 100 lb of nitrogen (N)/A to soils of relatively low fertility; broadcast and disk before planting. Decrease nitrogen application according to soil fertility. On heavily fertilized soils, apply 50 to 60 lb N/A. Once bulbing starts sidedress with 25 lb N/A every two weeks for a total of four applications.

PESTICIDE SAFETY: Onions

	Signal[1]	Re-entry (hrs)	Harvest (days)
INSECTICIDES			
Admire Pro	C	12	21
Assail 30 SG	C	12	4
Coragen 1.67 SC	C	4	1
Exirel 0.83SE	C	12	1
Intrepid 2 F	C	4	1
Knack 0.83 EC	C	12	3
Malathion 8	C	12	3
Movento 2 SC	C	24	3
Radiant SC	C	4	1
Requiem 25 EC	C	4	0
Scorpion 3.5 SL	C	12	AP/1
Torac 1.29 EC	W	12	7
Transform 50 WG	D	24	7
Venom 70 SG	C	12	1
Vantacor 5 SC	-	4	1
Verimark 1.67 SC	-	4	1
Restricted Use			
Agri-Mek 0.7 SC	W	12	30
Diazinon AG 500	C	24	14
Diazinon 50 W	C	24	14
Lannate 90 SP	DP	48	7
Mustang Maxx	W	12	7
Permethrin 3.2 EC	C	12	1
Proaxis 0.5 EC	C	24	14
Warrior II	W	24	14
FUNGICIDES			
Actigard 50WG	C	12	7
Ariston	C	12	7
Aprovia Top	W	12	7
Azoxystrobin[3]	C	12	0
Azoxystrobin + Propiconazole[3]	W	12	0
Azoxystrobin + Tebuconazole[3]	W	12	7
Botran	C	12	14
Cabrio EG	C	12	7
Cannonball	C	12	7
Chlorothalonil[3]	D	12	7/14[4]
Dexter Max	C	24	[7]
Dexter XCEL	C	24	[7]
Endura	W	12	7
Fixed coppers[3]	D	24/48	0
Fontelis	C	12	3

(continued)

PESTICIDE SAFETY: Onions *(continued)*

	Signal[1]	Re-entry (hrs)	Harvest (days)
Forum SC	C	12	0
Gavel	C	48	7
Inspire Super	C	12	7
Iprodione[3]	W	24	7
Luna Experience	C	12	7
Luna Tranquility	C	12	7
Mancozeb[3]	C	24	7
Mandipropamid[3]	C	4	7
ManKocide	D	24	7
Mefenoxam[3]	W	48	0
Metalaxyl[3]	C	48	0
Merivon	W	12	7
Miravis Prime	C	12	7
Muscle	C	12	7/14[4]
Omega 500F	W	48	7
Orondis Opti	D	12	7
Orondis Ultra	D	12	7
Presidio	C	12	2
Pristine	C	12	7
Propiconazole[3]	W	12	14
Quadris Opti	W	12	7
Quadris Top	C	12	7
Quilt	C	12	14
Ranman	C	12	0
Reason 500 SC	C	12	7
Ridomil Gold Bravo SC	W	48	7/21[4]
Ridomil Gold Copper[3]	D	48	7/10[4]
Ridomil Gold MZ	W	48	7
Scala	C	12	7
Sulfur[3]	C	24	0
Switch	C	12	7
Tanos	C	12	3
Tebuconazole[3]	C	12	7
Thiophanate-methyl[3]	C	72	-
Trivapro	W	12	14
Vangard	C	12	7
Zampro	C	12	0
Zing!	C	12	7

1 W: Warning, C: Caution, D: Danger; P: Poison
2 AP: At planting
3 Several formulations are marketed. See the general introduction for more details on fungicides.
4 Dependent on type of onion (green, bulb or dry), see label.

INSECT CONTROL: Onions[1]

Insecticide	Product Amt/A	Seasonal Limit/A	Comments and Other Restrictions
PREPLANT/PLANTING			
Onion Maggots: Problems with onion maggots are often associated with soils that are high in organic matter or amended with manure. Continuous planting of onions on the same ground will increase onion maggot problems. When possible, rotate with other crops. Eliminate culls and volunteer onions after harvest to reduce the overwintering population.			
Diazinon 50 W	4 to 8 lb	8 lb	Incorporate immediately into top 3-4 inches of soil.
Malathion 8	1.5 pt	2 applications	For post-plant, allow 7 days between applications.
FOLIAR TREATMENTS			
Thrips: In general, red onions are more susceptible to thrips injury. Monitor for thrips regularly, especially during hot, dry weather. When needed, treat during early bulb stage and use 10 to 25 thrips per plant as a guideline for treatment.			
Admire Pro	14 fl oz	14 fl oz	Soil application only.
Agri-Mek 0.7 SC	1.75 to 3.5 fl oz	10.25 fl oz	Allow 7 days between applications. Must use a non-ionic surfactant.
Assail 30 SG	5 to 8 oz	32 oz	Limit 4 applications. Allow 7 days between applications.
Knack 0.83 EC	8 fl oz	16 fl oz	Target immatures. Limit 2 applications.
Lannate 90 SP	1 lb	4 lb	Limit 8 applications, allow 5 days between applications.
Movento 2 SC	5 fl oz	10 fl oz	For thrips larvae. Allow 7 days between applications. Requires surfactant.
Mustang Maxx	2.88 to 4 fl oz	20 fl oz	Allow 7 days between applications.
Permethrin 3.2 EC	6 to 12 fl oz	40 oz	Bulb onions only.
Proaxis 0.5 EC	2.56 to 3.84 fl oz	30.7 fl oz	Allow 5 days between applications. Bulb onions only.
Radiant SC	6 to 10 fl oz	30 fl oz	Allow 4 days between applications.
Requiem EC	1.5 to 3 qt		-
Scorpion 35SL	2 to 7 fl oz	10.5 fl oz	Allow 7 days between applications.
Torac 1.29 EC	24 fl oz	72 fl oz	Limit 3 applications. Allow 7 days between applications.
Venom 70 SG	3 to 4 oz	6 oz	Foliar application. Allow 7 days between applications.
	5 to 6 oz	6 oz	Soil application.
Verimark 1.76 SE	10 to 13.5 fl oz	61.5 fl oz	Soil application at planting.
	6.75 to 10 fl oz	61.5 fl oz	Drip application.
Warrior II	1.28 to 1.92 fl oz	15.36 fl oz	Bulb onion and garlic only.

1 Generic products available (Appendix G).

WEED CONTROL: Onion

Product Amt/A	lb A.I./A	Comments
0.5 to 1.6 fl oz Aim 1.9 EW	0.008 to 0.025 carfentrazone	For contact post-emergence control of annual broadleaf weeds and suppression of annual grasses. Can be applied as a preplant, pre-transplant burndown, or before crop emerges to actively growing weeds up to 4 inches tall. Can also be applied post-emergence as a directed hooded application between crop rows. Use min. 10 gal of water/A and crop oil 1% v/v. Max. rate 6.1 fl oz/A. PHI = 0 days.
1 to 1.5 pt Buctril	0.25 to 0.38 bromoxynil	For selective post-emergence control of broadleaf weeds in DRY BULB ONIONS. Use in 50 to 70 gal of water/A. Apply when both soil and onion leaves are dry and when temperature is 70 to 85°F. Apply to onions with 2 to 5 leaves and when weeds are < 2 inches tall. Do not add surfactant. Do not irrigate within 2 days of a pre-emergence application or within 3 days of crop emergence.
2 oz Chateau 51 WDG	0.064 flumioxazin	Apply to transplanted onions (dry bulb) between the 2-leaf and 6-leaf stage and on direct seed onions (dry bulb) between the 3-leaf and 6-leaf stage. Apply to weed-free onions (dry bulb) for pre-emergence control of the weeds listed. For use on all soil types with up to 5% organic matter. Do not apply more than 2 oz of Chateau WDG per acre during a single application. Do not apply more than 3 oz of Chateau WDG per acre during a single growing season. PHI = 45 days. Min. 14 days between applications.
6 to 14 lb Dacthal W-75	4.5 to 10.5 DCPA	For pre-emergence control of annual grasses and small-seeded broadleaves. Can be broadcasted over transplants. Can be applied up to 14 weeks after planting at 14 pt/A rate. Do not preplant incorporate.
0.67 to 1.3 pt Dual Magnum	0.64 to 1.25 s-metolachlor	See the "Dual Magnum 24(c) Label" section on page 15.
1 pt Fusilade-DX 2E	0.25 fluazifop-p	For selective post-emergence control of annual grasses and suppression of perennial grasses. Include 1% v/v crop oil or 0.25% v/v non-ionic surfactant/A. PHI = 45 days. Max. rate is 48 fl oz/A.

(continued on next page)

WEED CONTROL: Onion (continued)

Product Amt/A	lb A.I./A	Comments
0.5 pt Goal 2XL	0.12 oxyfluorfen	For pre-emergence control of certain annual grasses and most broadleaves on dry bulb onion only immediately after transplanting. Transplanted onions are most tolerant of a postemergence application immediately after transplanting. Do not exceed the maximum use rate of 2 pints per acre of Goal 2XL per season as a result of multiple applications.
2 to 4 pt Gramoxone Inteon	0.67 to 1.35 paraquat salt	For non-selective contact kill of annual grasses and broadleaf weeds and top-kill of perennial weeds. Apply preplant, pre-emergence, or before transplanting in min. 20 gal of water/A. Apply banded or broadcast. Use higher rate for heavy weed infestations. Use non-ionic surfactant 0.25% v/v. PHI = 60 days**. Paraquat product labels require applicators to take an EPA-approved training every 3 years to mix, load, and apply paraquat.**
10 to 21 fl oz Outlook 6 EC	0.47 to 0.98 dimethenamid-P	For pre-emergent control of select annual grasses and broadleaf weeds. Apply to onions after the 2 leaf stage and after soil has settled around transplanted onions, or injury may be severe. Can be applied in a single or split application. PHI = 30 days.
0.5 to 1.5 pt Poast 1.5 EC	0.09 to 0.27 sethoxydim	For control of actively growing grasses only. Use high rate on Johnson grass. PHI = 30 days. Max. rate of 1.5 pt/application and 4.5 pt/season.
5 to 6 qt Prefar 4 E	5 to 6 bensulide	For control of annual grasses and small-seeded broadleaves in DRY BULB ONIONS. Apply preplant incorporated to a depth of 1 inch or pre-emergence after planting. Irrigate immediately after pre-emergence application.
2 pt Prowl H2O	0.95 pendimethalin	For control of annual grasses and broadleaf weeds. The label allows use of 2 pints pre-emergence and 2 pints after the two leaf stage. A maximum of 4 pints (1.9 lb ai) may be applied per crop. It should not be used on soils with less than 3% OM. PHI = 30-days.
16 to 22 fl oz Roundup WeatherMax 5.5L	0.69 to 0.94 glyphosate-salt	For non-selective post-emergence control of annual and perennial grasses and broadleaf weeds. Use only AMS 1 to 2% v/v. Adding a non-ionic surfactant can reduce weed control effectiveness. Min. 30 days before planting any non-labeled crop.

DISEASE CONTROL: Onions—Dry and Spanish

Product	FRAC Code[1]	PHI[2] (days)	Amt/A	Seasonal Limits/A	Comments
Bacterial Leaf Blight					
Actigard	21	7	0.75 to 1.0 oz	4 oz	Begin applications 2 to 4 weeks prior to bulb initiation and continue on 7 to 10 day interval. Include copper in spray program for best results.
Copper, fixed coppers[4]					See label for rates, mixing instructions, and tank-mix precautions. Some products are approved for greenhouse use.
ManKocide[3]	M	7	1.5 to 2.25 lb	see footnote	
Botrytis Leaf Blight, Purple Blotch, Stemphylium Blight					
Ariston	M/27	7	1.6 - 2.4 pt	14 pt	Downy mildew and purple blotch.
Aprovia Top	7/3	7	10.5 oz	4 apps	Fungal leaf spots. Use a spreading/ penetrating surfactant.
Botran 75 W	14	14	1.66 to 3.33 lb	5.33 lb	Botrytis leaf blight.
Bravo and chlorothalonil[4] generics	M	7/14			There are multiple Bravo formulations and chlorothalonil generics on the market. See label for rates.
Cabrio and pyraclostrobin[4] generics	11	7	8 to 12 oz[5]	6 apps	Use higher rates for downy mildew and Botrytis leaf blight.
Copper, fixed coppers[4]					Purple blotch and downy mildew. See label for rates, mixing instructions, and tank-mix precautions. Some products are approved for greenhouse use.
Dexter Max	M/11	7	3.2 lb	30 lb	Do not apply to exposed bulbs.
Dexter XCEL	M/11/3	7	48 to 72 oz	144 oz	Do not allow contact with bulbs.
Dithane M45, mancozeb[4] generics	M	7	3 lb	30 lb	Do not apply to exposed bulbs. There are multiple Dithane formulations and mancozeb generics on the market. See label for rates.
Endura	7	7	6.8 oz	6 apps	Purple blotch and botrytis leaf blight only.
Fontelis	7	3	16 to 24 fl oz	72 fl oz	
Gavel	22/M	7	1.5 to 2.0 lb	16 lb	Fungal leaf spots, also downy mildew. Do not apply to exposed bulbs.

(continued on next page)

DISEASE CONTROL: Onions—Dry and Spanish *(continued)*

Product	FRAC Code[1]	PHI[2] (days)	Amt/A	Seasonal Limits/A	Comments
Inspire Super	3/9	7	16 to 20 fl oz	80 fl oz	Botrytis leaf blight, purple blotch.
Luna Experience	7/3	3	8.0 to 12.8 fl oz	34 fl oz	
Luna Tranquility	7/9	7	16 to 27 oz	54.7 oz	
ManKocide[3]	M	7	2.5 lb	see footnote	
Merivon	7/11	7	5.5 to 11 fl oz	3 apps	Use higher rates for downy mildew.
Miravis Prime	7/12	7	10.3 to 11.4 oz	34.2 oz	Use higher rate for downy mildew.
Muscle ADV	3/M	7/14	1.1 to 1.6 pt	6.4 pt	
Omega 500 and fluazinam[4] generics	29	7	16 fl oz	6 apps	Botrytis leaf blight, Botrytis neck rot, downy mildew, purple blotch. Do not use a spray adjuvant.
Orondis Opti	49	7	1.75 to 2.5 pt	10 pt	Do not combine with soil applications of Orondis Gold.
Pristine	7/11	7	14.5 to 18.5 oz	4 apps	Use lower rates for Botrytis leaf blight.
Quadris and azoxystrobin[4] generics	11	0	6 to 15.5 fl oz	90 fl oz	Use higher rates for downy mildew and Botrytis leaf blight. There are multiple Quadris formulations and azoxystrobin generics on the market. See label for rates.
Quilt Xcel and Propiconazole + azoxystrobin[4] generics	11/3	0	14 to 26 fl oz	56 fl oz	Use higher rates for downy mildew and Botrytis leaf blight.
Reason	11	7	5.5 fl oz	22 fl oz	Downy mildew and purple blotch.
Ridomil Gold Bravo SC	4/M	7/21	2.5 pt	4 apps	Avoid late-season applications.
Rovral and iprodione[4] generics	2	7	1 to 1.5 pt	5 app	Use lower rate if tank mixed. See label for rates and application instructions. Also labeled for white rot on garlic.
Scala	9	7	9 to 18 fl oz	54 fl oz	Purple blotch and botrytis leaf blight only.
Switch 62.5WG	9/12	7	11 to 14 oz	56 oz	Not for downy mildew.
Tanos	11/27	3	8 oz	84 oz	Downy mildew, purple blotch. Must be tank-mixed with a multi-site inhibitor (FRAC Group M).
Toledo and tebuconazole[4] generics	3	7	4 to 6 fl oz	12 fl oz	Purple blotch only. Use lowest listed rate of surfactant to improve coverage. Also labeled for white rot.
Tilt and Propiconazole[4] generics	3	14	2 to 8 fl oz	16 fl oz	Purple blotch and botrytis leaf blight. See label for specific rates.
Trivapro	3/11/7	14	16.0 to 27.7 oz	55.4 oz	
Vangard	9	7	10 oz	28 oz	
Viathon	3/33	7	2 to 3 pt	6 pt	
Zing!	M/22	7	30 fl oz	8 apps	Do not apply directly to bulbs.
Downy Mildew					
Actigard	21	7	0.75 to 1 oz	4 oz	Apply in a min of 20 gal/A of water. May cause phytotoxicity and yield reduction. Do not apply to stressed or injured plants.
Ariston	M/27	7	1.6 - 2.4 pt	14 pt	
Bravo and chlorothalonil[4] generics	M	7/14			See label for rates.
Cabrio and pyraclostrobin[4] generics	11	7	12 oz	6 apps	
Dithane M45 and mancozeb[4] generics	M	7	3 lb	30lb	There are multiple Dithane formulations and mancozeb generics on the market. See label for rates.
Forum SC	40	0	6 fl oz	5 apps	Must be tank-mixed with another downy mildew fungicide, excluding mefenoxam.
Gavel	22/M	7	1.5 to 2.0 lb	16 lb	Do not apply to exposed bulbs.
ManKocide[3]	M	7	2.5 lb		
Merivon	7/11	7	5.5 to 11 fl oz	3 apps	.
Omega 500 and fluazinam[4] generics	29	7	16 fl oz	6 apps	Do not use a spray adjuvant.
Orondis Opti	49/M	7	1.75 to 2.5 pt	10 pt	Do not combine with applications of Orondis Ultra.
Orondis Ultra	49/40	7	5.5 to 8.0 oz	32 oz	Do not combine with applications of Orondis Opti.

(continued on next page)

DISEASE CONTROL: Onions—Dry and Spanish *(continued)*

Product	FRAC Code[1]	PHI[2] (days)	Amt/A	Seasonal Limits/A	Comments
Presidio	43	2	3 to 4 fl oz	4 apps	Must be tank-mixed with a fungicide NOT in FRAC Group 43.
Quadris and azoxystrobin[4] generics	11	0	9 to 15.5 fl oz	90 fl oz	Use higher rates for downy mildew and Botrytis leaf blight.
Ranman	21	0	2.75 to 3.0 oz	16.5 oz	Use an organosilicone surfactant for best results.
Reason	11	7	5.5 fl oz	22 fl oz	
Revus	40	7	8 fl oz	32 fl oz	Use a spreader/penetrant surfactant. Must be tank-mixed with a fungicide NOT in FRAC Group 40.
Ridomil Gold Copper	4/M	7/10	2 lb	4 apps	Avoid late-season applications.
Ridomil Gold MZ[3]	4/M	7	2.5 lb		Avoid late-season applications.
Zampro	40/45	0	14 fl oz	3 apps	
Zing!	M/22	7	30 fl oz	8 apps	Do not apply directly to bulbs.
Pythium Damping-off, Cottony Leak					
MetaStar and metalaxyl[4] generics	4	0	2 to 4 pts		Preplant or transplant applications. See label for rate and application instructions. Do not use MetaStar in greenhouse or transplant beds.
Ridomil Gold and mefenoxam[4] generics	4	0	0.5 to 1 pt		

NOTE: Some of the chemicals listed above may not be labeled for green onions—check product labels carefully before use.

1 Products with numerical FRAC codes must be alternated or tank-mixed with products that have a different FRAC code to discourage resistance development. See product label for maximum number of consecutive applications allowed. Refer to the table on pages 22-24 for more information on FRAC codes.

2 Pre-harvest interval.

3 Observe seasonal limits for mancozeb.

4 Generic products available (Appendix F). Amounts and seasonal limits per acre are product dependent.

5 Use higher rate when pressure is severe.

Peas

Pea family (Fabaceae): *Pisum sativum*

Planting and Culture

Early spring plantings are a must to ensure good yields in Kentucky. The earliest plantings should be made between February 20 and March 1 or by the time the soil temperature has reached 45°F (see Appendix K). Use seed treatments to avoid decay problems.

Select soils that are well drained and adjust the pH to 6.5. Lighter, sandy loam soils are preferred because they warm up sooner.

Seed may be planted in either double or single rows. Double rows should be spaced 6 to 8 inches between rows and 18 to 24 inches between pairs of rows or adjusted to the cultivating equipment that is available. Plants in double rows will support each other. For tall-growing, indeterminate varieties, plant supports will need to be constructed. Space single rows 24 to 36 inches apart. Seed within the row should be planted 1 to 1½ inches deep and spaced 1 inch apart. Peas requires between 60 and 100 pounds of seed per acre, depending on spacing.

Harvesting

English peas should be picked as soon as pods are well filled but before they harden and fade in color. Two or three pickings can usually be made. Peas should be cooled and processed as soon as possible because the sugar content decreases rapidly after harvest. It is best to shell the peas just before cooking.

Edible pod or snow peas are harvested while the peas are immature. Pods reach a length of 3 to 5 inches within five to seven days after flowering. Consequently, pods should be harvested every other day to prevent the development of large seeds and tough pods. Edible pod peas in plastic bags will store 10 days under refrigeration without loss of quality.

Edible pod snap peas can be harvested from the time the peas begin to form until the pods are well filled.

Peas should be stored at 32° to 34°F and 90 to 95 percent relative humidity.

VARIETIES: Peas—English, Edible Pod, Snap

Variety	DTM[1]	Comments
ENGLISH (ALL ARE DETERMINATE)		
Spring	57	Large pods for an early cultivar; excellent quality; open pollinated.
Maestro	61	Heavy producer of 4 inch long pods; excellent quality; tolerance to *Fusarium*, pea enation virus, bean yellow mosaic virus, and powdery mildew.
Legacy	67	Productive, 3.5 inch pods; 2.5 pods per node; resistant to *Fusarium* and powdery mildew.
Green Arrow	68	Productive, *Fusarium* and powdery mildew resistant.
EDIBLE POD[2]		
Oregon Giant	69	Highly productive; sweet pods 4 inches long; resistant to *Fusarium*, pea enation mosaic virus and powdery mildew.
Oregon Sugar Pod II	70	Highly productive; pods 3 inches long; *Fusarium* resistance.
Mammoth Melting Sugar	74	Vine 34 to 40 inches tall, pods 4 inches long.
SNAP		
Sugar Ann	56	Resistant to *Fusarium* race 1, very sweet.
Sugar Sprint	62	Stringless, 3 inch pods; powdery mildew resistant, pea enation virus tolerance.
Cascadia	67	Very productive; 3 inch long pods; pods remain tender and sweet longer than other cultivars; very good disease tolerance.
SL3123	70	Concentrated set, tolerant to stress, stringless.
Sugar Snap	72	Resistant to common pea wilt; an All American Selection all time winner; must be trellised; very heavy yielder.

1 Days to maturity
2 P. sativum var. macrocarpon

FERTILIZER: Peas

Soil Test Results (lb/A)		Fertilizer Needed (lb/A)
Phosphorus		**Phosphate (P_2O_5)**
Low	<31	121-180
Medium	31-60	61-120
High	61-80	1-60
Very High	>81	0
Potassium		**Potash (K_2O)**
Low	<201	101-200
Medium	201-300	51-100
High	301-450	1-50
Very High	>450	0
Nitrogen		**N**
Poor soils		50-60
Fertile soils		30-40

PESTICIDE SAFETY: Peas

	Signal[1]	Re-entry (hrs)	Harvest (days)
INSECTICIDES			
Acramite 4 SC	C	12	3
Admire Pro	C	12	7/21[3]
Assail 30 SG	C	12	7[3]
Beleaf 50 SG	C	12	7
Blackhawk 36 WG	C	4	3/28[3]
Bt products	C	4/12	0
Coragen 1.67 SC	-	4	1
Dimethoate 4 E	W	48	0
Exirel 0.83 SE	C	12	1/7[3]
Knack 0.86 EC	C	12	7
Intrepid 2 F	C	4	7
Magister SC	W	12	7
Malathion 8	C	12	3
Movento 2 SC	C	24	1/7[3]
Radiant SC	C	4	3/28
Sevin XLR Plus	W	12	3
Sivanto Prime 1.67 SL	C	4	7
Verimark 1.67 SC	-	4	AP
Restricted Use			
Agri-Mek 0.7 SC	W	12	7
Asana XL	W	12	3/21[3]
Baythroid XL	W	12	7

(continued)

PESTICIDE SAFETY: Peas *(continued)*

	Signal[1]	Re-entry (hrs)	Harvest (days)
Brigade 2 EC	W	12	3
Danitol 2.4 EC	W	24	7[3]
Diazinon 50 W	C	24	7
Fastac 0.83 EC	D	12	1/21[3]
Lannate 90 SP	DP	48	1[3]
Mustang Maxx	W	12	1/21[3]
Proaxis 0.5 EC	C	24	7/21[3]
Warrior II	W	24	7/21[3]
FUNGICIDES			
Azoxystrobin[2]	C	4/48[4]	0
Fixed coppers[2]	D	24/48[4]	0
Endura	W	12	7/21[3]
Fontelis	C	12	0
Headline[3]	W	12	7/213
Kenja	C	12	7/14/30[3]
Luna Experience	C	12	14
Metalaxyl[2]	W	48	0
Mefenoxam[2]	C	48	0
Priaxor	C	12	7
Sulfur[2]	C	24	0

1 W: Warning, C: Caution, D: Danger; P: Poison
2 Several formulations are marketed. See the general introduction for more details on fungicides.
3 PHI depends on the type of pea, see label.
4 Depends on type of application and product.

INSECT CONTROL: Peas[1]

Insecticide	Product Amt/A	Seasonal Limit/A	Comments and Other Restrictions
PREPLANT INCORPORATED			
Cutworms, Wireworms: Eliminate weeds from field margins and plow fields at least 2 weeks before planting to destroy cutworm food sources and egg laying sites. Wireworms can be a potential problem where peas follow grass or grass-legume sod.			
Diazinon 50 W	4 to 8 lb	1 application	Incorporate immediately before planting.
PLANTER BOX			
Seedcorn Maggots: Usually only a serious pest early in the season. Shallow planting in well-prepared seedbeds and adequate soil temperature to promote rapid germination will aid in reducing problems. Heavy cover crops or manure should be plowed early to render fields less attractive for egg laying.			
FOLIAR TREATMENTS			
Alfalfa Loopers, Green Cloverworms			
Asana XL	2.9 to 9.6 fl oz	19.2 fl oz	Do not feed vines.
Blackhawk 36 WG	2.2 to 3.3 oz	20 oz	Allow 5 days between applications.
Bt products	See labels.	-	-
Brigade 2 EC	2.1 to 6.4 fl oz	12.8 fl oz	Allow 3 to 7 days between applications.
Fastac 0.83 EC	2.7 to 3.8 fl oz	11.4 fl oz	Allow 5 days between applications.
Intrepid 2 F	4 to 16 fl oz	64 fl oz	Allow 7 days between applications. Limit 4 applications.
Lannate 90 SP	0.25 to 1 lb	3 lb	Wait 5 days to feed forage. Succulent peas only.
Mustang Maxx	2.72 to 4 fl oz	24 fl oz	Allow 5 days between applications.
Proaxis 0.5 EC	1.92 to 3.84 fl oz	15.36 fl oz	-
Warrior II	0.96 to 1.92 fl oz	7.68 fl oz	-
Aphids			
Admire Pro	7 to 10.5 fl oz	10.5 fl oz	Soil application.
	1.2 fl oz	3.6 fl oz	Foliar application. Allow 7 days between applications.

(continued on next page)

INSECT CONTROL: Peas[1] *(continued)*

Insecticide	Product Amt/A	Seasonal Limit/A	Comments and Other Restrictions
Assail 30 SG	2.5 to 5.3 oz	16 oz	Limit 3 applications. Allow 7 days between applications. Not for dried peas.
Beleaf 50 SG	2.8 oz	8.4 oz	Limit 3 applications. Allow 7 days between applications.
Brigade 2 EC	2.1 to 6.4 fl oz	12.8 fl oz	Allow 3 to 7 days between applications.
Malathion 8	1 pt	2 applications	Allow 7 days between applications. Do not feed vines.
Movento 2 SC	4 to 5 fl oz	10 fl oz	Allow 7 days between applications. Requires surfactant.
Sivanto Prime 1.67 SL	7 to 14 fl oz	28 fl oz	Allow 10 days between applications.
Armyworms, Cutworms			
Asana XL	5.8 to 9.6 fl oz	19.2 fl oz	Do not feed vines.
Baythroid XL	0.8 to 3.2 fl oz	6.4 fl oz	Dry peas only. Limit 3.2 fl oz per 14-day period.
Blackhawk 36 WG	2.2 to 3.3 oz	20 oz	Allow 5 days between applications.
Brigade 2 EC	2.1 to 6.4 fl oz	12.8 fl oz	Allow 3 to 7 days between applications.
Coragen 1.67 EC	3.5 to 7.5 fl oz	15.4 fl oz	Allow 3 days between applications.
Fastac 0.83 EC	1.3 to 3.8 fl oz	11.4 fl oz	Allow 5 days between applications.
Intrepid 2 F	4 to 16 fl oz	64 fl oz	Allow 7 days between applications. Limit 4 applications.
Mustang Maxx	2.72 to 4 fl oz	24 fl oz	Allow 5 days between applications.
Proaxis 0.5 EC	1.92 to 3.84 fl oz	15.36 fl oz	-
Sevin XLR Plus	1 to 1.5 qt	6 qt	Limit 4 applications. Allow 7 days between applications.
Warrior II	1.28 to 1.92 fl oz	7.68 fl oz	-

1 Generic products available (Appendix G).

WEED CONTROL: Peas

Product Amt/A	Lb A.I./A	Comments
0.5 to 1.6 fl oz Aim 1.9 EW	0.008 to 0.025 carfentrazone	For contact post-emergence control of annual broadleaf weeds and suppression of annual grasses. Can be applied as a preplant, pre-transplant burndown or before crop emerges to actively growing weeds up to 4 inches tall. Can also be applied post-emergence as a directed hooded application between crop rows. Use min. 10 gal of water/A and crop oil 1% v/v. Max. rate 6.1 fl oz/A. PHI = 0 days.
1 to 2 pt Basagran 4S	0.5 to 1 bentazon	For post-emergence control of annual broadleaves and suppression of yellow nutsedge. Two applications are needed for nutsedge and Canada thistle control. Do not add crop oil. Apply after peas have at least 3 pairs of leaves (or 4 nodes) or severe crop damage may occur. PHI for dry peas is 30 days and for succulent peas is 10 days. Do not apply when peas are in bloom.
1.3 pt Command 3ME	0.5 clomazone	For pre-emergence control of annual grasses and broadleaf weeds. Apply once in a min. 10 gal of water/A. Apply and incorporate 2 to 3 inches before planting. Use in combination with other herbicides to broaden weed control spectrum.
1.3 to 1.7 pt Dual II Magnum 7.6 E	1.3 to 1.6 s-metolachlor	For control of most annual grasses and certain broadleaves. Apply preplant surface or incorporated or pre-emergence. Small grains may be planted 4½ months following this treatment. See label for other rotational crops.
2 to 4 pt Gramoxone Inteon	0.69 to 1.38 paraquat salt	For non-selective contact kill of annual grasses and broadleaf weeds and top-kill of perennial weeds. Apply preplant, pre-emergence, or before transplanting in min. 10 gal water/A. Apply banded or broadcast. Use higher rate for heavy weed infestations. Use non-ionic surfactant 0.25% v/v. **Paraquat product labels require applicators to take an EPA-approved training every 3 years to mix, load, and apply paraquat.**
0.5 to 2.5 pt Poast 1.5	0.09 to 0.48 sethoxydim	For control of actively growing grasses only. Use high rate on Johnson grass. Dry and succulent peas. Max. rate 4 pt/A per year. Include 1% v/v crop oil. PHI = 15 days for succulent peas and 30 days for dry peas.
3 oz Pursuit 2L	0.05 imazethapyr	For control of annual grasses and broadleaf weeds. Can be applied preplant incorporated within 1 week before planting. Can be applied pre-emergence within 3 days after planting. Can be applied post-emergence to plants at least 3 inches tall but before 5 nodes and before flowering. Add non-ionic surfactant 0.25% v/v.
16 to 22 fl oz Roundup WeatherMax 5.5L	0.69 to 0.94 glyphosate-salt	For non-selective post-emergence control of annual and perennial grasses and broadleaf weeds. Use only AMS 1 to 2% v/v. Adding a non-ionic surfactant can reduce weed control effectiveness. Min. 30 days before planting any non-labeled crop.
6 to 12 oz Targa	0.04 to 0.08 quizalofop p-ethyl	See label for pea type. Apply post-emergence to weeds up to 3" when peas are at least 3" high, but prior to 5 nodes and before flowering. Add non-ionic surfactant at 2 pt per 100 gal of spray mix. See label for crop rotation restrictions. PHI = 30 days.
1 to 2 pt Treflan HFP 4 E	0.5 to 1 trifluralin	For control of annual grasses and broadleaf weeds. Apply and incorporate in spring before planting or in fall in advance of spring planting.

DISEASE CONTROL: Peas

Product	FRAC Code[1]	PHI[2] (days)	Amt/A	Seasonal Limits/A	Comments
Anthracnose, Ascochyta Leaf Spot/Pod Blight, Leaf Spots, Powdery Mildew					
Copper, fixed coppers	M	0			See label for rates, mixing instructions, and tank-mix precautions.
Endura	7	7/21	6 to 11 oz	2 apps	
Fontelis	7	0	14 to 30 fl oz	72 fl oz	
Headline and pyraclostrobin[4] generics	11	7/21	6 to 9 fl oz	18 fl oz	PHI differs for dried peas and edible-podded peas.
Kenja	7	7/14/30	17 oz	34 oz	White mold/gray mold. Make first application at 10-30% bloom.
Luna Experience	7/3	14	8.0 to 12.8 fl oz	25.6 fl oz	
Priaxor	7/11	7	4 to 8 fl oz	16 fl oz	
Quadris and azoxystrobin[4] generics	11	0			There are multiple Quadris formulations and azoxystrobin generics on the market. See label for rates.
Sulfur[4]	M				Powdery mildew. Apply when disease is first observed; continue every 14 days as needed. Phytotoxicity may occur if applications are made when temperatures exceed 90°F. Some products are OMRI-listed; refer to labels.
Pythium Damping-off, Root Rot					
Metalaxyl[4] Mefenoxam[4]	4	0		1 app	Apply pre- or post-planting as a broadcast or banded spray (7-inch band) in sufficient water to provide uniform coverage. Incorporate into the upper 2 inches of soil mechanically or by rainfall/irrigation.
Uniform	4/11	-	0.34 fl oz/ 1,000 row ft	1 app	In-furrow spray at sowing. Avoid direct contact with seed for best results.
Rhizoctonia Damping-off, Seedling Disease, Stem/Root Rot					
Quadris and azoxystrobin[4] generics	11	0			In-furrow spray at sowing.
Uniform	4/11	-	0.34 fl oz/ 1,000 row ft	1 app	In-furrow spray at sowing. Avoid direct contact with seed for best results.

1 Products with numerical FRAC codes must be alternated or tank-mixed with products that have a different FRAC code to discourage resistance development. See product label for maximum number of consecutive applications allowed. Refer to the table on pages 22-24 for more information on FRAC codes.

2 Pre-harvest interval.

3 Per 1,000 row-feet.

4 Generic products available (Appendix F). Amounts and seasonal limits per acre are product dependent.

5 Use higher rate when pressure is severe.

Peppers

Nightshade family (Solanaceae): *Capsicum annuum*

For information on peppers see "Fruiting Vegetables" section on page 86

Potatoes

Nightshade family (Solanaceae): *Solanum tuberosum*

Potatoes are grown in Kentucky as an early crop primarily for fresh market sales. Opportunity exists for the production of small red "new potatoes," russets, heirlooms, and other specialty or "gourmet" types for local markets, sales to restaurants, or sales to local/area wholesalers. Sales of very small "baby" or "mini" potatoes are also possible and command premium prices in some markets.

Planting and Culture

Loam soils are most desirable for good potato yields, though potatoes can be grown on a wide range of soil types. Select a well-drained soil. Sod ground should be treated with a soil insecticide prior to planting to control grubs and wireworms.

Optimum planting times are from March 15 to April 10 for early potatoes and from June 15 to July 15 for a late crop (see Appendix K).

Planting should be made in rows 30 to 36 inches apart with a seed piece dropped each 10 to 12 inches in the furrow. Seed planted in mid-March should be planted 2 to 3 inches deep. The late crop should be planted 4 to 5 inches deep. Seed pieces should be 1½ to 2 ounces in size. Only certified disease-free seed stock should be purchased. Freshly cut seed should be planted as soon as possible after cutting. Seed may be pre-cut several days in advance of planting if proper storage conditions are provided so the seed pieces can "heal over." A storage temperature of 60°F for 10 days to two weeks before planting will help initiate sprout activity and encourage more rapid emergence.

Fifteen to 18 (100-pound) bags of seed potatoes are usually needed to plant an acre. Potatoes should not follow potatoes or other solanaceous crops (tomatoes, tobacco, peppers) on the same ground year after year. Follow a three- or four-year rotation program.

When planting, there will be a small ridge of soil developed over each row. Dragging across the ridges just before the sprouts break through helps to eliminate weeds and allows the potato sprouts to more easily break through compacted soil.

Production with Plasticulture

Potatoes can also be grown on raised beds with black plastic and drip irrigation. Growers have obtained higher and earlier yields of better quality potatoes with plasticulture; potatoes grown on plastic mulch are also easier to dig by hand at harvest. If mechanical harvesting or growing large acreages, plastic mulch should be avoided.

All fertilizer can be applied prior to planting or half the nitrogen requirement can be applied before planting with the remainder divided into equal doses fertigated weekly. Planting holes can be made in plastic mulch using a waterwheel setter and seed pieces dropped in the holes and covered with soil by hand. Kentucky growers have used two rows per bed with 18 inches between rows, 9 to 12 inches between plants within the rows, and 5 feet between bed centers. Pennsylvania growers have used double rows 13 inches apart with 8 inches between plants in the rows. Closer spacings promote higher percentages of smaller tubers and should be used to produce potatoes to be sold as "new," "gourmet," "baby," or "mini" (see also "Harvesting and Handling" below). Vine killing can be more problematic for some specialty potato varieties. In addition to chemical dessicants, a plastic mulch lifter can be used to undercut the plants to assist in vine killing prior to digging.

Fertilizing

Fertilize and lime based on soil test results; a soil pH of 6.0 to 6.5 is considered most desirable for maximum availability of nutrients for potatoes. However, potato scab will usually be more serious at high pH levels. There will normally be less scab when the pH is between 5.0 to 5.2. Potatoes grown for chipping should be grown at the higher pH and those for fresh market at the lower pH if scab is a problem.

It is suggested that one-half the fertilizer used at planting be broadcast prior to planting and disked in. Band the remaining fertilizer 2 to 3 inches to the side and slightly below the seed piece. Fertilizer should not come in contact with the seed piece. Sidedress with 50 to 75 pounds of actual nitrogen (N) per acre when plants are 4 to 8 inches tall or at lay-by.

Harvesting and Handling

When to dig potatoes will depend on the price and method of selling. For local market, it may be desirable to dig before vines die back. Vines of potatoes grown for storage should be dead before digging. Potatoes dug when immature are very susceptible to skinning and bruising. Using chemical desiccants to artificially kill the plant tops will aid in earlier harvest and promote a firmer skin set. Growers often mow plants prior to harvest. Harvesters or diggers should have digger chain speed adjusted to minimize injury to tubers. Protect freshly dug potatoes from hot sun and drying winds.

Smaller-sized "new," or "gourmet," potatoes are often dug by hand.

If tablestock potatoes are to be stored and kept for long periods, the storage facility should be clean and sanitized. Potatoes should be held at 55°F for two weeks at a relative humidity of 90 percent, and then the temperature should be lowered to 40°F with a relative humidity of 85 to 90 percent.

Washing potatoes for fresh market is desirable. Chlorine at the rate of 150 to 200 parts per million should be added to the water to help destroy surface disease organisms. Potato tubers should dry before bagging, especially into plastic, to reduce chances of bacterial soft rot. Do not wash potatoes going into storage.

Sprouting in storage can be reduced by spraying potato plants while still in the field with maleic hydrazide. Apply to the plants when tubers are 1½ to 2 inches in diameter. Read the product label for directions and precautions.

Potatoes are marketed in a variety of containers with several grade specifications. Russet potatoes are usually packed in consumer packs, count cartons, or large institutional packs. The most valuable potatoes are generally 8- to 14-ounce tubers packed in 50-pound cardboard boxes, or "count cartons." Each carton has a number that tells how many tubers are in a box. These are sold to retail stores and restaurants and are typically used for baking. Red and white potatoes are sold in a wider range of sizes per container ("non-size" Grade A) including 5-, 8-, 10-, and 50-pound plastic, poly mesh, paper, and burlap bags. Prices for 50-pound cartons of graded U.S. No. 1 potatoes can triple those for 50-pound bags of U.S. No. 1 non-size potatoes.

New potatoes are usually B size (1½ to 2¼ inches in diameter) tubers, while "gourmet," "baby," or "creamer" potatoes may be even smaller (1 to 1½ inches in diameter). Fingerling potatoes are sorted by length and range from 2 to 3½ inches long. Specialty potatoes are often sold for premium prices and are packed in small mesh bags, vented poly bags, baskets, cartons, tray packs, or clamshells.

VARIETIES: Potatoes

Maturity	Variety	Comments
Early	Dark Red Norland	Red skinned, shallow eyes—very suitable for table and "new" potatoes.
	Red Gold	Light red skin, yellow flesh, good yields of high quality tubers, not suitable for long term storage; some resistance to scab.
Early-midseason	Superior	White skinned, resistance to scab, tubers are oval to oblong, suitable for table use and chipping.
	Yukon Gold	Yellow flesh, round, smaller size, nice appearance and flavor, performance variable across state.
	Red Pontiac	Red skinned, readily available, easy to grow.
Midseason	Kennebec	White skinned, a good general purpose potato, best full season yields in KY.
	Russett Norkotah	White russet type, good baking-type potato.
	Red Lasoda	Red skinned, heat tolerant, readily available, not as attractive as some other red types.
FINGERLING TYPES		
Early-midseason	Russian Banana	White skin, light yellow flesh, long, thin shape, unique taste.
	Swedish Peanut	White skin, golden yellow flesh, shorter, teardrop shapes with shallow eyes, unique taste.

FERTILIZER: Potatoes

Soil Test Results (lb/A)		Fertilizer Needed (lb/A)
Phosphorus		**Phosphate (P_2O_5)**
Low	<31	181-240
Medium	31-60	91-180
High	61-80	61-90
Very High	>80	60
Potassium		**Potash (K_2O)**
Low	<201	251-300
Medium	201-300	101-250
High	301-450	51-100
Very High	>450	50
Nitrogen		**N**

Total of 150 lb N/A is recommended. Apply 75 to 100 lb N/A at time of planting and apply a sidedressing of 50 to 75 lb N/A when plants are 4 to 8 inches tall or at lay-by.

PESTICIDE SAFETY: Potatoes

	Signal[1]	Re-entry (hrs)	Harvest (days)[2]
INSECTICIDES			
Acramite 4 SC	C	12	14
Actara 25 WDG	C	12	14
Admire Pro	C	12	AP/7[5]
Assail 30 SG	C	12	7
Avaunt eVo 30 WDG	C	12	7
Belay 2.13SC	C	12	14
Beleaf 50 SG	C	12	7
Coragen 1.67 SC	-	4	14
Dimethoate 4 E	W	48	0[4]
Exirel 0.83 SE	C	12	7
Fulfill 50 WDG	C	12	14
Harvant 50 SL	C	4	7
Imidan 70 WP	W	24	7
Knack 0.83 EC	C	12	3
Malathion 8	C	12	0
Miteus 0.42 EC	W	12	7
Movento 2	C	24	7
Nurizma 2.5 SC	C	12	AP
Oberon 2 SC	C	12	7
Platinum 2 SC	C	12	AP
Portal XLO 0.4 EC	W	12	7
PQZ 1.87 SC	C	12	14
Radiant SC	C	4	7
Requiem 25 EC	C	4	0
Rimon 0.83 EC	W	12	14
Scorpion 3.5 SL	C	12	AP/7[5]
Sefina 0.42 SC	C	12	7
Sevin XLR Plus	W	12	7
Sivanto 1.67 SL	C	12	7
Torac 1.29 EC	W	12	14
Trident	C	4	0
Transform 50 WG	D	24	7
Vantacor 50 WG	-	4	14
Venom 70 SG	C	12	7[5]
Verimark 1.67 SC	-	4	AP
Restricted Use			
AgriMek 0.15 EC	W	12	14
Asana XL	W	12	7
Baythroid XL	W	12	0
Brigade 2 EC	W	12	21
Fastac 0.83 EC	W	12	1
Lannate 90 SP	DP	48	6
Mocap 15 G	DP	48	AP
Mustang Maxx	W	12	1
Permethrin 3.2 EC	C	12	14
Regent 4 SC	W	0	90
Thimet 20 G	DP	48	90
Vydate L	DP	48	7
Warrior II	W	24	7
FUNGICIDES			
Ariston	C	12	14
Azoxystrobin[4]	C	4	0
Blocker Flowable/4F	C	12	0
Botran	C	12	-

(continued)

PESTICIDE SAFETY: Potatoes *(continued)*

	Signal[1]	Re-entry (hrs)	Harvest (days)[2]
Cabrio Plus	C	24	14
Chlorothalonil[3]	D	12	7
Curzate 60 DF	W	12	14
Dexter Max	C	24	14
Elatus	C	12	14
Elumin	C	12	n/a
Endura	W	12	30
Evito 480 SC	C	12	7
Fixed coppers[3]	D	12/24[4]	0
Flint Extra	C	12	7
Fluazinam[4]	W	48	14
Fluoxastrobin[4]	C	12	7
Forum SC	C	12	4
Gavel 75 DF	C	48	14
Gem	C	12	7
Headline	W	12	3
Iprodione[4]	C	12	14
Luna Tranquility	C	12	7
Mancozeb[3]	C	24	14
Mefenoxam[4]	C	48	14
Metalaxyl[4]	C	48	14
Miravis Prime	C	12	14
Orondis Gold	C	4	14
Orondis Opti	D	12	7
Orondis Ultra	C	4	14
Previcur Flex	C	12	14
Priaxor	C	12	7
Provysol	C	12	7
Quadris Opti	W	12	14
Quadris Top	C	12	14
Quash	C	12	1
Ranman	C	12	7
Reason 500 SC	C	12	14
Revus	C	4	14
Revus Top	C	12	14
Ridomil Gold Bravo SC	W	48	14
Ridomil Gold Copper	D	48	14
Ridomil Gold MZ	C	48	14
Streptomycin[4]	C	12	n/a
Scala	C	12	7
Sulfur[3]	C	24	0
Tanos	C	12	14
Thiophanate-methyl[3]	C	12	21
Velum	C	12	7
Vertisan	W	12	7
Zampro	C	12	4
Zing!	C	12	7

1 W: Warning, C: Caution, D: Danger; P: Poison
2 AP: At planting
3 Several formulations are marketed. See the general introduction for more details on fungicides.
4 Safety information varies by product; read the label carefully.
5 PHI dependent on application method.

INSECT CONTROL: Potatoes[1]

Insecticide	Product Amt/A	Seasonal Limit/A	Comments and Other Restrictions
AT PLANTING SOIL APPLICATION			
Wireworms, Flea Beetles, Colorado Potato Beetle, Aphids: Do not use a foliar spray of Actara, Assail, Belay, Provado, or Venom following a soil application of Admire, Belay, Platinum, or Venom.			
Admire Pro	5.7 to 8.7 fl oz	8.7 fl oz	For Colorado potato beetle, aphids, leafhoppers, and flea beetles.
Belay 2.13 SC	9 to 12 fl oz	12 fl oz	At planting or cultivation. Discontinue after 50% row cover.
Brigade 2 EC	9.6 to 19.2 fl oz	32 fl oz	Limit 2 applications. Allow 7 days between applications.
Mocap 15 G	1.4 lb/ 1000 row-feet	6 lbs/A	Limit one application. Incorporate immediately. Use at planting only.
Nurizma 2.5 SC	0.08 to 0.16 fl oz/ 1000 row-feet	At planting	Apply only as a 5-7" band at planting and cover completely with soil. For control of wireworms and white grubs.
Platinum 2 SC	5 to 8 fl oz	8 fl oz	Limit one soil application..
Regent 4 SC	3.2 fl oz	3.2 fl oz	In-furrow use only as a 5 to 7 inch band for wireworm. Do not band on surface.
Thimet 20 G	11.3 oz/ 1,000 row-feet	1 application	Not for flea beetles. Must incorporate granules.
Scorpion 35 SL	11.5 to 13.25 fl oz	13.25 fl oz	For Colorado potato beetle, leafhoppers, and flea beetles.
Verimark 1.67 SC	6.75 to 13.5 fl oz	13.5 fl oz	For Colorado potato beetle.
Venom 70 SG	6.5 to 7.5 oz	7.5 oz	For Colorado potato beetle, leafhoppers, and flea beetles.
FOLIAR TREATMENTS			
Grasshoppers			
Asana XL	5.8 to 9.6 fl oz	67.2 fl oz	-
Coragen 1.67 SC	2 to 5 fl oz	15.4 fl oz	Limit 4 applications. Allow five days between applications.
Dimethoate 4 E	0.5 to 1 pt	2 pt	Allow 7 days between applications.
Fastac 0.83 EC	3.2 to 3.8 fl oz	11.4 fl oz	Allow 4 days between applications.
Mustang Maxx	3.2 to 4 fl oz	24 fl oz	Allow 4 days between applications.
Warrior II	1.28 to 1.92 fl oz	7.68 fl oz	Allow 7 days between applications.
European Corn Borer			
Asana XL	5.8 to 9.6 fl oz	67.2 fl oz	-
Baythroid XL	1.6 to 2.8 fl oz	16.8 fl oz	Allow 5 days between applications.
Coragen 1.67 SC	3.5 to 7.5 fl oz	15.4 fl oz	Limit 4 applications. Allow five days between applications.
Exirel 0.83 SC	7 to 13.5 fl oz	61.5 fl oz	Allow 5 days between applications.
Fastac 0.83 EC	1.8 to 3.8 fl oz	11.4 fl oz	Allow 4 days between applications.
Mustang Maxx	1.76 to 4 fl oz	24 fl oz	Allow 4 days between applications.
Permethrin 3.2 EC	4 to 8 fl oz	32 fl oz	Allow 10 days between applications,
Radiant SC	6 to 8 fl oz	32 fl oz	Allow 7 days between applications. Limit 4 applications.
Rimon 0.83 EC	6 to 12 fl oz	24 fl oz	Allow 7 days between applications.
Warrior II	1.28 to 1.92 fl oz	7.68 fl oz	Allow 7 days between applications.
Colorado Potato Beetle, Flea Beetle: Colorado Potato Beetle is the key insect pest of potato. This pest has the ability to develop resistance to all major classes of insecticides. Do not tank mix insecticides with the same mode of action and frequently rotate among insecticides with different modes of action to discourage resistance. Treat when an average of more than 1 larva/adult is found per plant on plants less than 6 inches tall or when 2 or more larvae/adults are found on larger plants. [PB] IRAC Codes: Insecticides followed by the same number share the same mode of action.			
Actara 25 WDG (4A)	1.5 to 3 oz	6 oz	Allow 14 days between applications.
Admire Pro (4A)	1.3 fl oz	3.9 fl oz	Allow 7 days between treatments.
Agri-Mek 0.7 SC (6)	1.75 to 3.5 fl oz	10.25 fl oz	Make no more than two consecutive applications. Allow 7 days between applications.
Assail 30 SG (4A)	1.5 to 4 oz	16 oz	Limit 4 applications. Allow 7 days between applications.
Avaunt eVo 30 WDG (22)	3.5 to 6 oz	24 oz	Allow 5 days between applications. Limit 4 applications.
Belay 2.13 SC (4A)	2 to 3 fl oz	12 fl oz	Allow 7 days between applications. Do not apply after 50% row closure.
Coragen 1.67 SC (28)	3.5 to 7.5 fl oz	15.4 fl oz	Limit 4 applications. Allow five days between applications.
Exirel 0.83 SC (28)	5 to 13.5 fl oz	61.5 fl oz	Allow 5 days between applications.
Imidan 70 W (1B)	1.33 lb	6.67 lb	Machine harvested potatoes only. Allow 10 days between applications.
Radiant SC (5)	4.5 to 8 fl oz	32 fl oz	Allow 7 days between applications. Limit 4 applications.
Rimon 0.83 EC (15)	9 to 12 fl oz	24 fl oz	Allow 7 days between applications.

(continued on next page)

INSECT CONTROL: Potatoes[1] *(continued)*

Insecticide	Product Amt/A	Seasonal Limit/A	Comments and Other Restrictions
Scorpion 35 SL (4A)	2 to 2.75 fl oz	8 fl oz	Allow 14 days between applications.
Sevin XLR Plus (1A)	1 to 2 lb	6 qt	Allow 7 days between applications.
Sivanto Prime 1.67 SL (4D)	10.5 to 14 fl oz	28 fl oz	Allow 7 days between applications.
Torac 1.29 EC (21A)	14 to 21 fl oz	42 fl oz	Allow 14 days between applications. Limit 2 applications
Trident (11A)	3 to 6 qt	-	-
Venom 70 SG (4A)	1 to 1.5 oz	4.5 oz	Allow 14 days between applications.
Leafhoppers			
Actara 25 WDG	1.5 to 3 oz	6 oz	Allow 14 days between applications.
Admire Pro	1.3 fl oz	3.9 fl oz	Allow 7 days between treatments.
Asana XL	2.9 to 5.8 fl oz	67.2 fl oz	-
Assail 30 SG	1.5 to 4 oz	16 oz	Limit 4 applications. Allow 7 days between applications.
Baythroid XL	0.8 to 1.6 fl oz	16.8 fl oz	Allow 5 days between applications.
Belay 2.13 SC	2 to 3 fl oz	12 fl oz	Allow 7 days between applications. Do not apply after 50% row closure.
Dimethoate 4 E	0.5 to 1 pt	2 pt	Allow 7 days between applications.
Fastac 0.83 EC	1.8 to 3.8 fl oz	11.4 fl oz	Allow 4 days between applications.
Mustang Maxx	1.76 to 4 fl oz	24 fl oz	Allow 4 days between applications.
Permethrin 3.2 EC	4 to 8 fl oz	32 fl oz	Allow 10 days between applications.
Scorpion 35 SL	2 to 2.75 fl oz	8 fl oz	Allow 14 days between applications.
Sevin XLR Plus	1 to 1.5 qt	6 qt	Allow 7 days between applications.
Sivanto Prime 1.67 SL	7 to 14 fl oz	28 fl oz	Allow 7 days between applications.
Torac 1.29 EC	14 to 21 fl oz	42 fl oz	Allow 14 days between applications. Limit 2 applications
Transform 50 WG	1.5 to 2.25 oz	8.5 oz	Allow 7 days between applications. Limit 4 applications.
Venom 70 SG	1 to 1.5 oz	4.5 oz	Allow 14 days between applications.
Warrior II	0.96 to 1.6 fl oz	7.68 fl oz	Allow 7 days between applications.

1 Generic products available (Appendix G).

WEED CONTROL: Potato

Product Amt/A	lb A.I./A	Comments
1.5 to 2.9 pt Boundary 6.5 EC	0.98 to 1.9 s-metolachlor + 0.23 to 0.43 metribuzin	For control of most annual grasses and certain broadleaf weeds and yellow nutsedge. Apply after planting or after drag-off but before crop emergence. See Dual Magnum label for rotational crops restrictions. Dual Magnum may delay maturity and/or reduce yield of Superior and other early maturing potato varieties if cold, wet soil conditions occur after treatment. PHI = 60 days.
1 to 2 pt Dual II Magnum 7.6 E	0.95 to 1.9 s-metolachlor	For control of most annual grasses and certain broadleaf weeds and yellow nutsedge. Apply preplant incorporated, pre-emergence. Dual Magnum may delay maturity and/or reduce yield of 'Superior' and other early maturing potato varieties if cold, wet soil conditions occur after treatment. See label for incorporation directions. 60-day pre-harvest interval.
3.5 pt Eptam 7 E	3 EPTC	For control of annual grasses and broadleaf weeds and suppression of yellow nutsedge. Apply before planting. Incorporate immediately 2 to 3 inches. Superior variety is sensitive to Eptam under stress conditions.
1 to 2 pt Gramoxone Inteon	0.69 to 1.38 paraquat salt	For non-selective contact kill of annual grasses and broadleaf weeds and top-kill of perennial weeds. Apply up to ground cracking to emerged weeds but before crop emergence; may be used instead of drag-off operation for emerged weeds and before using pre-emergence herbicides. Add non-ionic surfactant 0.25% v/v. **Paraquat product labels require applicators to take an EPA-approved training every 3 years to mix, load, and apply paraquat.**
3.2 to 6.4 oz League	0.15 to 0.3 imazosulfuron	For non-selective control of broadleaf weeds, grass suppression and yellow nutsedge. Can be applied pre-emergence, post-emergence, or in sequential application.
1.5 to 2.5 lb Lorox 50 DF	0.75 to 1.25 linuron	For control of annual grasses and broadleaf weeds. Apply after planting but before crop emerges. Plant seed at least 2 inches deep. Best results if rainfall or irrigation is applied within 2 weeks of application.

(continued on next page)

WEED CONTROL: Potato *(continued)*

Product Amt/A	lb A.I./A	Comments
1 to 1.5 oz Matrix 25 WSG	0.016 to 0.023 rimsulfuron	For pre-emergence control of broadleaves and grasses. Apply immediately after hilling, drag-off, or reservoir tillage. 1⁄3 to 1 inch rainfall or irrigation is needed for activation. Do not use on potato grown for seed. Matrix can also be applied chemigation. See label for details.
14 to 18 fl oz Outlook 6 E	0.6 to 0.8 dimethenamid-p	For pre-emergence control of broadleaves and grasses. Apply after planting or after drag-off or as chemigation. Leave a 35 foot untreated buffer and avoid applying near endangered plant populations in and around the following counties: Barren, Boone, Hardin, Laurel, Rockcastle, Wolfe. PHI = 40 days.
0.5 to 2.5 pt Poast	0.09 to 0.48 sethoxydim	For control of actively growing grasses only. Use high rate on Johnson grass. PHI = 30 days. Max. rate of 2.5 pt/application and 5 pt/season.
1.5 to 3.0 pt Prowl H2O	0.71 to 1.43 pendimethalin	For control of annual grasses and broadleaf weeds. Can be applied pre-emergence after planting or after drag-off. Can be applied early post-emergence to plants up to 6 inches tall only if plants are not under stress from cold/wet or hot/dry conditions.
16 to 22 fl oz Roundup WeatherMax 5.5L	0.69 to 0.94 glyphosate-salt	For non-selective post-emergence control of annual and perennial grasses and broadleaf weeds. Use only AMS 1 to 2% v/v. Adding a non-ionic surfactant can reduce weed control effectiveness. Min. 30 days before planting any non-labeled crop.
9 to 32 fl oz Select Max	0.07 to 0.24 clethodim	For selective post-emergence control of annual grasses and suppression of perennial grasses. Add crop oil 1% v/v or 1 to 2 qt/A liquid fertilizer or AMS to enhance control of difficult grasses. PHI = 30 days.
0.3 to 1.3 lb TriCor 75 DF	0.2 to 1 metribuzin	For control of annual grasses and broadleaf weeds. Apply pre-emergence broadcast after planting. Do not incorporate. Can be used post-emergence (0.3 to 0.6 lb/A) or as a split-application not to exceed 1.3 lb/A per season on white-skinned varieties (except Atlantic, Chip Belle, Bel Chip, and Shepody) that are not early maturing. Do not use on early maturing or red-skinned varieties. PHI = 60 days.
1.25 to 2 pt Treflan HFP 4 E	0.62 to 1 trifluralin	For pre-emergence control of annual grasses and broadleaf weeds. Apply and incorporate after planting but before emergence, following drag-off, or after potato plants have fully emerged.
2.3 fl oz Weedone LV4 3.84 EC	0.07 2,4-D	For selective post-emergence control of broadleaf weeds. This is a low volatility formulation of 2,4-D. Still, caution should be exercised near sensitive crops such as tomato and grape. For use on fresh market red potatoes only. Crop response depends on variety. Apply in 5 to 25 gal water/A to plants in the pre-bud stage (about 7 to 10 inches high) and a second application about 10 to 14 days later.
Pre-Harvest Vine Killing		
10 lb Copper Sulfate Crystal	10 copper sulfate	To enhance vine-kill, use in 10 to 100 gal water. Can be mixed with diquat to enhance vine kill.
3.2 qt Defol 750	6 sodium chlorate	To defoliate plants, apply 10 days before harvest in 10 to 20 gal water/A. Do not apply under conditions of extreme heat during the middle of the day.
1 to 2 pt Reglone	0.25 to 0.5 diquat	For non-selective contact kill of grasses and broadleaf weeds and top-kill of perennial weeds. Apply to mature potato vines as a pre-harvest desiccation treatment in 20 gal water/A. Make a second application within 5 days if necessary. Include non-ionic surfactant 0.25% v/v. PHI = 7 days.
21 fl oz Rely 280	0.27 glufosinate	Do not use on potatoes grown for seed. Max. 1 application/season. PHI = 9 days.

DISEASE CONTROL: Potatoes

Product	FRAC Code[1]	PHI[2] (days)	Amt/A	Seasonal Limits/A	Comments
Black leg, Seed-piece Rots, Tuber-borne Diseases					
Streptomycin[4]	25	n/a	8 oz/100 gal	1 app	Seed piece treatment.
Elumin	22	n/a	8 oz	2 apps	Pink rot and Pythium leak. In furrow banded spray at seeding followed by side dress.
Dithane M45 and mancozeb[5] generics	M	14	1.25 lb per 50 gal water		Seed-piece treatment. There are multiple Dithane formulations and mancozeb generics on the market. See label for use and rates.
Maxim MZ	12/M	14	0.5 lb/cwt	1 app	Seed piece treatment.
MetaStar and metalaxyl[5] generics	4	14	4 to 8 pts		Pink rot and Pythium leak. Preplant and surface application.

(continued on next page)

DISEASE CONTROL: Potatoes *(continued)*

Product	FRAC Code[1]	PHI[2] (days)	Amt/A	Seasonal Limits/A	Comments
Orondis Gold	49/4	14	27.8 oz	1 app	For pink rot and Pythium leak. In open furrow application.
Ridomil Gold SL and mefenoxam[5] generics	4	14	.42 fl oz per 1000 row ft		Pink rot and Pythium leak. In furrow and foliar application. Also manages storage rots if applied aerially at flowering.
Black Scurf, Rhizoctonia Stem Canker					
Blocker Flowable, Blocker 4F	14	0	5.2 to 10.4 fl oz[4]	1 app	Use as an in-furrow spray at planting. Rate is dependent on row spacing; see label for directions.
Elatus	11/7	14	0.34 to 0.5 oz/ 1,000 linear ft	1 app	In-furrow spray at planting.
Headline and pyraclostrobin[5] generics	11	3	0.4 to 0.8 fl oz[4]		Rhizoctonia diseases. In-furrow.
Moncut 70 DF	7	0	0.7 to 1.1 lb	1 app	In-furrow application.
Quadris and azoxystrobin[5] generics	11	14	0.4 to 0.8 fl oz per 1000 ft row	1 app	In-furrow or post-emergence. There are multiple Quadris formulations and azoxystrobin generics on the market. See label for rates.
Vertisan	7	7	0.7 to 1.6 fl oz[4]	1 app	Rhizoctonia diseases. In-furrow.
Early Blight, Late Blight, White Mold (Sclerotinia Blight)					
Aftershock and fluoxastrobin[5] generics	11	7	2 to 3.8 fl oz	22.8 fl oz	
Ariston	M/27	14	2.0 pt	17.5 pt	
Bravo and chlorothalonil[4] generics	M	7/14			Early/late blight. There are multiple Bravo formulations and chlorothalonil generics on the market. See label for rates.
Cabrio Plus	11/M	14	2 to 2.9 lb	17.4 lb	
Copper, fixed coppers	M	0			Early/late blight. See label for mixing instructions and tank-mix precautions.
Curzate 60 DF	27	14	3.2 oz	7 apps	Late blight only. Must be tank-mixed with a fungicide from FRAC Group M.
Dexter Max	M/11	14	1.6 to 2.1 lb	16 lb	
Dithane M45 and mancozeb[5] generics	M	14	0.5 to 2 lb	14 lb	Early/late blight. There are multiple Dithane formulations and mancozeb generics on the market. See label for rates.
Elumin	22				
Endura and boscalid[4] generics	7	30	2.5 to 10 oz	20.5 oz or 4 apps	Early blight and white mold.
Flint Extra	11	7	3 to 3.8 oz	23 oz	Early and late blight. Tank mix with a protectant fungicide for late blight.
Omega 500 and fluazinam[5] generics	29	14	5.5 to 8 fl oz	56 fl oz	Late blight, white mold.
Forum SC	40	4	4 to 6 fl oz	30 fl oz	Late blight. Must be tank-mixed with another product labeled for late blight.
Gavel 75 DF2	22/M	14	1.5 to 2 lb	6 apps	Early/late blight.
Gem	11	7	6 to 8 oz	6 apps	Early/late blight.
Headline and pyraclostrobin[5] generics	11	3	6 to 12 fl oz[6]	6 apps	
Luna Tranquility	7/9	7	11.2 fl oz	33.6 fl oz	Early blight, white mold.
ManKocide[3]	M	14	1.5 to 5 lb	see footnote	Early/late blight.
Miravis Prime	7/12	14	9.2 to 11.4 oz	34.2 oz	Early blight and white mold.
Orondis Opti	49/M	7	1.75 to 2.5 pt	10 pt	Do not use with any other Orondis product.
Orondis Ultra	49/40	14	5.5 to 8.0 oz	32 oz	Late blight. Do not use with any other Orondis product.
Presidio	43	7	4 fl oz	12 fl oz	Late blight.
Previcur Flex	28	14	0.7 to 1.2 pt	6 pt	Early/late blight.

(continued on next page)

DISEASE CONTROL: Potatoes *(continued)*

Product	FRAC Code[1]	PHI[2] (days)	Amt/A	Seasonal Limits/A	Comments
Priaxor	7/11	7	4 to 8 fl oz	24 fl oz	
Provysol	3	7	3 to 5 oz	15 oz	Foliar fungal diseases.
Quadris and azoxystrobin[5] generics	11	14	6 to 15.5 fl oz	120 fl oz	Early/late blight. There are multiple Quadris formulations and azoxystrobin generics on the market. See label for rates.
Quadris Opti	11/M	14	1.6 pt	6 apps	Early blight/late blight.
Quadris Top	11/3	14	8 to 14 fl oz	55.3 fl oz	Early blight.
Quash	3	1	2.5 to 4 oz	4 apps	Early blight, white mold.
Ranman SC	21	7	1.4 to 2.75 fl oz	10 apps	Late blight.
Reason	11	14	5.5 to 8.2 fl oz	24.6 fl oz	Early blight/late blight.
Revus	40	14	5.5 to 8 fl oz	32 fl oz	Late blight only. Use a spreader/penetrant surfactant. Must be tank-mixed with a fungicide NOT in FRAC Group 40.
Revus Top	40/3	14	5.5 to 7 fl oz	28 fl oz	Early/late blight only. Use a spreader/penetrant surfactant.
Ridomil Gold Bravo SC	4/M	14	2.5 pt	3 apps	Early/late blight.
Ridomil Gold Copper	4/M	14	2 lb		Late blight.
Ridomil Gold MZ2	4/M	14	2.5 lb		Early/late blight.
Rovral and iprodione[5] generics	2	14	1 to 2 pt	4 apps	Early blight and white mold.
Scala	9	7	7 fl oz	35 fl oz	Early blight. Tank-mix with another fungicide labeled for early blight.
Tanos	11/27	14	6 to 8 oz	6 apps	Early/late blight. Tanos must be tank-mixed with a fungicide from FRAC Group M appropriate for the target disease.
Topsin M and thiophanate-methyl[5] generics	1	21	1 to 1.5 lb	4 lbs	White mold. Apply before row closure.
Velum Prime	7	7	6.5 fl oz	13.7 fl oz	Early blight and white mold, also nematodes. Apply as an in-furrow spray.
Vertisan	7	7	10 to 24 fl oz	72 fl oz	Early blight and white mold.
Zampro	40/45	4	11 to 14 fl oz	3 apps	
Zing!	M/22	7	32 to 34 fl oz	8 apps	

1 Products with numerical FRAC codes must be alternated or tank-mixed with products that have a different FRAC code to discourage resistance development. See product label for maximum number of consecutive applications allowed. Refer to the table on pages 22-24 for more information on FRAC codes.
2 Pre-harvest interval.
3 Observe seasonal limits for mancozeb.
4 Per 1,000 row-feet.
5 Generic products available (Appendix F). Amounts and seasonal limits per acre are product dependent.
6 Use higher rate when pressure is severe.

Root Crops

(Beets, Carrots, Parsnips, Radishes, Turnips)

Planting and Culture

Plant in rows 18 to 24 inches apart and ½ inch deep. Seed 8 to 10 pounds per acre for bunching. Seed will germinate between 40° and 85°F. Optimum temperature is 65° to 75°F. Color and quality are best when the plant develops during cool temperatures (50° to 60°F, see Appendix K). The sugar content of beets will be lower when grown in warm weather, and they will have a lighter color. Hot weather produces white bands in the roots. Beets are sensitive to soil acidity and should be grown at a pH between 6.2 and 7.0.

Plant in rows 18 to 24 inches apart and ¼ to ½ inch deep. Seed 2 to 4 pounds per acre. Seed are often variable in germination and emergence, resulting in non-uniform stands. Seed germinate slowly, and it is necessary to maintain adequate moisture. Select deep, sandy loam soils for best results. Carrots generally are misshapen when grown on heavy or rocky soils. Prepare soil deeply. Use low raised beds.

Plant in rows 18 to 24 inches apart and ¼ to ½ inch deep. Seed 2 to 3 pounds per acre. Prepare soil similarly to that for carrots. Always use new seed, because germination of seed 1 year or older is poor.

Plant seed in rows 15 inches apart and ¼ to ½ inch deep. Plant 12 to 15 seed per foot of row. Seed 10 to 15 pounds per acre. Seed germinate in three to four days at a soil temperature of 65°F or above. Best quality and shape of roots are attained when the crop grows and matures at 50° to 65°F.

Plant seed in rows 14 to 18 inches apart with seed 2 to 3 inches apart in the rows and ¼ to ½ inch deep. Plant 1 to 2 pounds of seed per acre. Best quality and yields are obtained under moderately cool temperatures. See also the "Greens" chapter.

Fertilizing

The soil pH should be between 6.0 and 6.8. Boron may become a limiting element for root crops. Apply Borax at the rate of 20 pounds per acre (2 pounds actual Boron) if necessary as indicated by soil test results.

Carrots tend to develop forked roots on heavy or rocky soils.

Harvesting

All root crops should be harvested when mature but before they become woody and tough. Wash roots carefully and package according to market requirements. Store at 32°F and 90 to 95 percent relative humidity.

VARIETIES: Root Crops

Variety	DTM[1]	Comments
BEETS[2]		
Avalanche	45	White color, sweet flavor; intermediate resistance to Cercospora leaf spot
Boro	51	Dark red, excellent flavor, widely adapted; tops are resistant to foliar blights
Red Ace (hybrid)	53	Early maturing, attractive, very smooth skin, excellent quality roots and greens, very sweet, heat resistant.
Kestrel (hybrid)	53	Excellent appearance and taste of cooked and raw roots and cooked greens, uniform size and shape, very sweet.
Red Cloud (hybrid)	53	Excellent appearance and sweet taste raw, good roasted taste, excellent cooked greens.
Merlin (hybrid)	55	Excellent appearance and taste of cooked and raw roots and cooked greens, uniform size and shape, lower Cercospora leaf spot incidence.
Chioggia Guardsmark	60	Attractive red and white zoned interior.
Ruby Queen	60	Attractive, excellent quality, very sweet, excellent for processing.
Touchstone Gold	60	Specialty gold fleshed beet, excellent flavor, lower germination percentage, low Cercospora leaf spot incidence.
Taunus	65	Very uniform smooth skinned, attractive long cylindrical beet for slicing, excellent flavor cooked, easy cleaning, low Cercospora leaf spot incidence.
CARROTS[3]		
Napoli	33	Nantes type, slightly tapered, 7 inch carrots
Mokum	54	Early, Nantes type, slender with slight taper, 6 inch carrots
Sugarsnax (hybrid)	68	Mid-season, Imperator hybrid, with a deep orange interior.
Purple Haze	73	Purple exterior, orange interior, Imperator hybrid good for markets, AAS winner.
PARSNIPS[4]		
Lancer (hybrid)	110	Slim, smooth roots, high quality (for trial).
Harris Model	120	Smooth, white roots.
RADISHES[5]		
Small round types		
Cherry Belle	24	Open-pollinated; popular variety
Roxanne	24	Good heat resistance, less pithiness when large; uniform roots

(continued on next page)

VARIETIES: Root Crops *(continued)*

Variety	DTM[1]	Comments
Crunchy Royale	25	Bright red, uniform, works best under cool conditions
Cook's Custom Blend	27	Mixture of four root colors and different shapes
Pink Beauty	29	Uniform roots, medium tops, resists pithiness
Sparkler	30	Two-tone round root, mild taste
Oriental Radishes		
Minowase Summer Cross	50	Long white daikon, mild flavor, juicy and tender, *Fusarium* resistant, stands heat, fall crop.
April Cross	60	Long white daikon, slow to bolt.
Misato Rose	60	Round, 4 inches in diameter, white with light green shoulders and a dark pink interior; very tender, pungent skin, mild and sweet interior, excellent for eating fresh, garnishing, and pickling. Fall production only, plant in August or September.
Tae Baek	70	Korean radish, short white barrel-shaped roots with a green shoulder, somewhat pungent, for heavier soils, highly disease tolerant, fall crop.
TURNIPS[6]		
Hakurei (hybrid)	38	Early, all white, best harvested young (2 inch diameter).
Royal Crown (hybrid)	45-50	Purple top, attractive roots and tops.
Just Right	50-70	All white roots, moderate turnip flavor, excellent tasting greens.

1 Days to Maturity
2 (Chenopodiaceae) goosefoot family: Beta vulgaris Crassa group.
3 (Apiaceae) carrot family: Daucus carota var. sativa.
4 Pastinaca sativa.
5 (Brassicaceae) mustard family: Raphanus sativus.
6 Brassica rapa Rapifera group.

FERTILIZER: Root Crops

Soil Test Results (lb/A)		Fertilizer Needed (lb/A)
Phosphorus		**Phosphate (P_2O_5)**
Low	<31	121-180
Medium	31-60	61-120
High	61-80	1-60
Very High	>80	0
Potassium		**Potash (K_2O)**
Low	<201	101-150
Medium	201-300	51-100
High	301-450	1-50
Very High	>450	0
Nitrogen		**N**

Apply 50 lb of actual nitrogen (N)/A. Broadcast all fertilizer and disk into soil thoroughly before seeding.

PESTICIDE SAFETY: Root Crops

	Signal[1]	Re-entry (hrs)	Harvest (days)
FUNGICIDES			
Beets			
Azoxystrobin[2]	C	12	0
Cabrio EG	C	12	0
Fixed coppers[2]	D	12/24	1
Fontelis	C	12	0
Luna Sensation	C	12	7
Luna Tranquility	C	12	7
Metalaxyl[2]	W	48	0
Merivon	W	12	7
Miravis Prime	C	12	7
Presidio	C	12	7
Pristine	C	12	0

(continued)

PESTICIDE SAFETY: Root Crops *(continued)*

	Signal[1]	Re-entry (hrs)	Harvest (days)
Propiconazole[2]	W	12	14
Quadris	C	4	0
Ridomil Gold SL	C	48	0
Reason 500 SC	C	12	14
Sulfur[2]	C	24	0
Switch 62.5WG	C	12	7
Tebuconazole[2]	C	12	7
Trifloxystrobin[2]	C	12	7
Uniform	C	0	-
Carrots			
Azoxystrobin[2]	C	4	0
Azoxystrobin + Propiconazole	W	12	14
Cabrio EG	C	12	0
Chlorothalonil[2]	D	12	0
Endura	W	12	0
Fixed coppers[2]	D	12/24	0
Flint Extra	C	12	7
Fluazinam[2]	W	48	7
Fontelis	C	12	0
Inspire Super	C	12	7
Iprodione[2]	C	24	0
Luna Sensation	C	12	7
Luna Tranquility	C	12	7
Merivon	W	12	7
Mefenoxam[2]	C	48	0
Metalaxyl[2]	W	48	0
Miravis Prime	C	12	7
Presidio	C	12	7

(continued on the next page)

PESTICIDE SAFETY: Root Crops *(continued)*

	Signal[1]	Re-entry (hrs)	Harvest (days)
Pristine	C	12	0
Propiconazole[2]	W	12	14
Quadris Opti	W	12	0
Quadris Top	C	12	7
Ranman	C	12	14
Reason 500 SC	C	12	14
Ridomil Gold Bravo SC	W	48	7
Ridomil Gold Copper	D	48	7
Sulfur[2]	C	24	0
Switch 62.5WG	C	12	7
Tebuconazole[2]	C	12	7
Trifloxystrobin[2]	C	12	7
Parsnips			
Azoxystrobin[2]	C	4	0
Cabrio EG	C	12	0
Chlorothalonil[2]	D	12	10
Fontelis	C	12	0
Luna Sensation	C	12	7
Luna Tranquility	C	12	7
Merivon	W	12	7
Mefenoxam[2]	C	48	0
Metalaxyl[2]	W	48	0
Miravis Prime	C	12	7
Presidio	C	12	7

(continued)

PESTICIDE SAFETY: Root Crops *(continued)*

	Signal[1]	Re-entry (hrs)	Harvest (days)
Pristine	C	12	0
Reason 500 SC	C	12	14
Switch 62.5WG	C	12	7
Trifloxystrobin[2]	C	12	7
Uniform	C	0	-
Radish			
Azoxystrobin[2]	C	4	0
Cabrio EG	C	12	0
Fontelis	C	12	0
Luna Sensation	C	12	7
Luna Tranquility	C	12	7
Merivon	W	12	7
Mefenoxam[2]	C	48	0
Metalaxyl[2]	W	48	0
Miravis Prime	C	12	7
Presidio	C	12	7
Pristine	C	12	0
Quilt	W	12	14
Reason 500 SC	C	12	14
Ridomil Gold Copper	D	48	7
Switch 62.5WG	C	12	7
Trifloxystrobin[2]	C	12	7
Uniform	C	0	-

1 W: Warning, C: Caution, D: Danger; P: Poison
2 Several formulations are marketed. See the general introduction for more details on fungicides.

PESTICIDE SAFETY: Root Crops

	Signal[1]	Re-entry (hrs)	Harvest (days)				
			Beets	Carrots	Parsnips	Radishes	Turnips
INSECTICIDES							
Actara 25 WDG	C	12	7	7	7	7	7
Admire Pro	C	12	7/21[2]	7/21[2]	7/21[2]	7/21[2]	7/21[2]
Beleaf 50 SG	C	12	3	3	3	3	3
Blackhawk 36 WG	C	4	3	3	3	3	3
Coragen 1.67 SC	-	4	1	1	1	1	1
Exirel 0.83 SE	C	12	1	1	1	1	1
Intrepid 2 F	C	12	1	1	1	1	1
Knack 0.83 EC	C	12	3	3	3	3	3
Malathion 8	C	12	7	7	7	7	-
Movento 2 SC	C	24	-	7	-	-	-
Platinum 2 SC	C	12	AP	AP	AP	AP	AP
Radiant SC	C	4	7	3	3	3	3
Requiem EC	C	4	0	0	0	0	0
Sevin XLR Plus	W	12	7	7	7	7	7
Sivanto Prime 1.67 SL	C	12	7	7	7	7	7
Transform 50 WG	DP	24	7	7	7	7	7
Vantacor 5 SC	-	4	1	1	1	1	1
Verimark 1.67 SL	-	4	AP	AP	AP	AP	AP
Restricted Use							
Asana XL	W	12	-	7	-	7	-
Baythroid XL	W	12	0	0	0	0	0
Brigade 2 EC	W	12	1	21	21	21	21
Diazinon AG500	C	24	14	14	-	14	-

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PESTICIDE SAFETY: Root Crops *(continued)*

	Signal[1]	Re-entry (hrs)	Harvest (days)				
			Beets	Carrots	Parsnips	Radishes	Turnips
Diazinon 50 W	C	24	3	3	-	3	-
Fastac 0.83 EC	D	12	1	1	1	1	1
Lannate 90 SP	DP	48	0/10[2]	1	-	-	-
Mustang Maxx	W	12	1	1	1	1	1

- Indicates crop does not appear on label.
1 W: Warning, C: Caution, D: Danger; P: Poison.
2 PHI depends on the method of application.

INSECT CONTROL: Root Crops[1]

Insecticide	Product Amt/A	Seasonal Limit/A	Comments and Other Restrictions
Aphids			
Actara 25 WDG	1.5 to 3 oz	8 oz	Allow 7 days between applications.
Admire Pro	1.2 fl oz	1.2 or 3.7 fl oz	Allow 5 days between applications.
Beleaf 50 SG	2 to 2.8 oz	8.4 oz	Allow 7 days between applications.
Exirel 0.83 SC	13.5 to 20.5 fl oz	61.5 fl oz	Allow 5 days between applications.
Malathion 8	1.25 pt	3 applications	Allow 7 days between applications.
Movento 2 SC	5 fl oz	10 fl oz	Allow 7 days between applications.
Tranform 50 WG	0.75 to 1.5 oz	8.5 oz	Allow 7 days between applications.
Sivanto Prime 1.67 SL	7 to 14 fl oz	28 fl oz	Allow 10 days between applications.
Armyworms			
Coragen 1.67 SC	3.5 to 7.5 fl oz	15.4 fl oz	Allow 3 days between applications.
Fastac 0.83 EC	3.2 to 3.8 fl oz	11.4 fl oz	Allow 4 days between applications.
Intrepid 2 F	8 to 16 fl oz	64 fl oz	Allow 14 days between applicatons.
Lannate 90 SP	0.5 to 1 lb	4 or 7 lb	-
Radiant SC	5 to 10 fl oz	34 fl oz	Allow 4 days between applications.
Cutworms			
Asana XL	5.8 to 9.6 fl oz	96 fl oz	-
Baythroid XL	1.6 to 2.8 fl oz	14 fl oz	Allow 7 days between applications.
Brigade 2 EC	5.12 to 6.4 fl oz	25.6 fl oz	Allow 7 days between applications.
Mustang Maxx	1.24 to 4 fl oz	24 fl oz	Allow 4 days between applications.
Flea Beetles			
Actara 25 WDG	1.5 to 3 oz	8 oz	Allow 7 days between applications.
Admire Pro	1.2 fl oz	1.2 or 3.7 fl oz	Allow 5 days between applications.
Asana XL	5.8 to 9.6 fl oz	96 fl oz	Radishes only.
Baythroid XL	1.6 to 2.8 fl oz	14 fl oz	Allow 7 days between applications.
Blackhawk 36WG	1.7 to 3.3 oz	14.4 oz	Allow 7 days between applications.
Brigade 2 EC	5.12 to 6.4 fl oz	25.6 fl oz	Allow 7 days between applications.
Exirel 0.83 SC	13.5 to 26.5 fl oz	61.5 fl oz	Allow 5 days between applications.
Fastac 0.83 EC	1.8 to 3.8 fl oz	11.4 fl oz	Allow 4 days between applications.
Mustang Maxx	1.76 to 4 fl oz	24 fl oz	Allow 4 days between applications.
Sevin XLR Plus	0.5 to 1 qt	6 qt	Limit 6 applications. Allow 7 days between sprays.
Leafhoppers: Treat fields and field margins to control these disease vectors. Beginning when plants are 3 inches tall.			
Actara 25 WDG	1.5 to 3 oz	8 oz	Allow 7 days between applications.
Admire Pro	1.2 fl oz	1.2 or 3.7 fl oz	Allow 5 days between applications.
Baythroid XL	1.6 to 2.8 fl oz	14 fl oz	-
Fastac 0.83 EC	1.8 to 3.8 fl oz	11.4 fl oz	Allow 4 days between applications.
Lannate 90 SP	0.5 to 1 lb	4 or 7 lb	-
Mustang Maxx	1.76 to 4 fl oz	24 fl oz	Allow 4 days between applications.
Sevin XLR Plus	0.5 to 2 qt	6 qt	Allow 7 days between sprays. Limit 6 qt/A.
Sivanto Prime 1.67 SL	7 to 14 fl oz	28 fl oz	Allow 10 days between applications.
Transform 50 WG	1.5 to 2.25 oz	8.5 oz	Allow 7 days between applications.
Plant Bugs			
Mustang Maxx	3.2 to 4 fl oz	24 fl oz	Allow 4 days between applications.
Sevin XLR Plus	1 to 2 qt	6 qt	Limit 6 applications. Allow 7 days between sprays.
Crickets, Sowbugs			
Baythroid XL	1.6 to 2.8 fl oz	14 fl oz	Allow 7 days between applications.

1 Generic products available (Appendix G).

WEED CONTROL: Root Crops

Product Amt/A	Lb A.I./A	Comments
0.5 to 1.6 fl oz Aim 1.9 EW	0.008 to 0.025 carfentrazone	For contact post-emergence control of annual broadleaf weeds and suppression of annual grasses. Can be applied as a preplant, pre-transplant burndown, or before crop emerges to actively growing weeds up to 4 inches tall. Can also be applied post-emergence as a directed hooded application between crop rows. Use min. 10 gal water/A and crop oil 1% v/v. Max. rate 6.1 fl oz/A. PHI = 0 days.
2 to 4 pt Caparol 4L	1 to 2 prometryn	Carrot only. Can be applied pre-emergence and or post-emergence over the top. Apply up to three applications of at the rate of 2 to 4 pt/A per application. Apply one pre-emergence at 2 to 4 pt/A. Make one post-emergence application at up to 4 pt/A or two post-emergence applications each at a maximum of 2 pt/A. Make post-emergence applications through the 6 leaf stage of carrot development in a minimum of 20 gallons of water per acre. When applying to emerged weeds add 2 qt of a nonionic surfactant (NIS) to 100 gal of spray mixture (0.5%) v/v. Restrictions: (1) Do not apply within 30 days of harvest. (2) Do not exceed 8 pt/A of Caparol 4L Herbicide per crop cycle. (3) Do not make more than 3 applications per crop cycle.
6 to 14 lb Dacthal W-75	4.5 to 10.5 DCPA	Radish only. For pre-emergence control of annual grasses and small-seeded broadleaves. For radish apply at seeding or up to 3-leaf stage. Soil should be clean-cultivated before application. Apply in 20 to 30 gal water/A. PHI = 25 days.
1 pt Fusilade-DX 2E	0.25 fluazifop-p	Carrot only. For selective post-emergence control of annual grasses and suppression of perennial grasses. Include 1% v/v crop oil or 0.25% v/v non-ionic surfactant/A. PHI = 45 days. Max. rate is 48 fl oz/A.
2 to 4 pt Gramoxone Inteon	0.67 to 1.35 paraquat salt	Carrot only. For non-selective contact kill of annual grasses and broadleaf weeds and top-kill of perennial weeds. Apply preplant, pre-emergence, or before transplanting in min. 10 gal water/A. Apply banded or broadcast. Use higher rate for heavy weed infestations. Use non-ionic surfactant 0.25% v/v. **Paraquat product labels require applicators to take an EPA-approved training every 3 years to mix, load, and apply paraquat.**
1.5 to 3 lb Lorox 50 DF	0.75 to 1.5 linuron	Carrot and parsnip only. For control of annual grasses and broadleaf weeds. Apply post-emergence as a non-directed spray to carrots > 3 inches tall. Apply before annual grasses exceed 2 inches high and before broadleaves exceed 6 inches high. Check label regarding varietal tolerance. Do not apply when temperature is above 85°F. PHI = 14 days.
0.5 to 2.5 pt Poast	0.09 to 0.49 sethoxydim	For control of actively growing grasses only. Use high rate on Johnson grass. PHI = 60 days. Max. rate of 2.5 pt/application and 5 pt/season.
2.0 pt Prowl H2O	0.95 pendimethalin	Carrot only. For pre-emergent control of most annual grasses and some broadleaf weeds. Apply as a broadcast application as a post plant treatment prior to crop and weed emergence. May be applied at layby at 2.0 pt/A as a directed spray between rows. Do not allow to come in contact with plants or severe injury will result. PHI = 60 days.
16 to 22 fl oz Roundup WeatherMax 5.5L	0.69 to 0.94 glyphosate-salt	For non-selective post-emergence control of annual and perennial grasses and broadleaf weeds. Use only AMS 1 to 2% v/v. Adding a non-ionic surfactant can reduce weed control effectiveness. Min. 30 days before planting any non-labeled crop.
3 to 10% v/v Scythe	0.13-0.39 pelargonic acid	For non-selective post-emergence control of annual and perennial grasses and broadleaf weeds. Beet, carrot, parsnip, radish, turnip.
9 to 16 fl oz Select Max	0.07 to 0.12 clethodim	For selective post-emergence of actively growing annual grasses and suppression of perennial grasses. Add crop oil 1% v/v. Max. 16 fl oz/ application. Min. 14 days between applications. PHI = 30 days.
1.25 to 2 pt Treflan HFP 4 E	0.6 to 1 trifluralin	Carrot and radish only. For control of annual grasses and broadleaf weeds. Apply and incorporate in spring before planting.
0.3 lb TriCor 75 DF	0.2 metribuzin	Carrot only. For control of annual grasses and broadleaf weeds. Apply broadcast over the tops to plants with 5 to 6 true leaves but before weeds are 1 inch tall. A second application can be made 3 weeks later. Do not apply within 3 days of stress conditions such as cool, wet and cloudy weather or hot days or after any other chemical to avoid injury. PHI = 60 days.

DISEASE CONTROL: Root Crops

Product	FRAC Code[1]	PHI[2] (days)	Amt/A	Seasonal Limits/A	Comments
BEETS, RADISH, TURNIPS, PARSNIPS					
Damping-off (Pythium)					
MetaStar and metalaxyl[3] generics	4	0	4 to 8 pt	1 app	Preplant or at planting. May be applied through drip irrigation. Will control white rust on radish.
Presidio	43	7	3 to 4 fl oz	12 fl oz	May be applied through drip irrigation at planting.
Reason 500 SC	11	14	5.5 to 8.2 fl oz	24.6 fl oz	Not for radish. Suppression only.
Ridomil gold and mefenoxam[3] generics	4	0	1 to 2 pt	2 pt	Preplant and at planting. May be applied through drip irritation.
Downy Mildew					
Bravo and chlorothalonil[3] generics	M	0			Parsnip. There are multiple Bravo formulations and chlorothalonil generics on the market. See label for rates.
Copper, fixed coppers[3]	M	0			Beets. See label for rates, mixing instructions, and tank-mix precautions. Some products are approved for greenhouse use.
Leaf Spots (*Alternaria*, Anthracnose, *Cercospora*), Rust, White Rust					
Bravo and chlorothalonil[3] generics	M	0			Parsnip. There are multiple Bravo formulations and chlorothalonil generics on the market. See label for rates.
Cabrio and pyraclostrobin[3] generics	11	0	8 to 16 oz	3 apps	
Copper, fixed coppers[3]	M	0			Cercospora leaf spot on beets. See label for rates, mixing instructions, and tank-mix precautions. Some products are approved for greenhouse use.
Endura and boscalid[3] generics	7	0	4.5 to 7.8 oz	23.4 oz	
Flint Extra	11	0	2.0 to 4.0 oz	8 to 12 oz	Lower seasonal limit for radishes.
Fontelis	7	0	16 to 30 fl oz	61 fl oz	
Gem 500SC	11	7	1.9 to 2.9 fl oz	4 apps	
Luna Sensation	7/11	7	4.0 to 7.6 fl oz	23 fl oz	
Luna Tranquility	7/9	7	11.2 fl oz	54.7 fl oz	
Merivon	7/11	7	4 to 5.5 fl oz	3 apps	
Miravis Prime	7/12	7	6.8 oz	20.4 oz	
Pristine	7/11	0	8 to 10.5 oz	63 oz	
Quadris and azoxystrobin[3] generics	11	0	6 to 15.5 fl oz	120 fl oz	There are multiple Quadris formulations and azoxystrobin generics on the market. See label for rates and application detail.
Quilt	3/11	7	10.5 to 14 fl oz	55 fl oz	Cercospora leaf spot on radish only.
Reason 500 SC	11	14	8.2 fl oz	24.6 fl oz	Alternaria leaf blight. Not for radish.
Ridomil Gold Copper	4/M	0	2 lb	4 apps	White rust on radish. See label for rates and rotation instructions.
Sulfur[3]	M				Beets. Phytotoxicity may occur when sulfur is applied when temperatures exceed 90°F.
Switch 62.5WG	9/12	7	11 to 14 oz	56 oz	For Alternaria leaf blight, apply every 7 to 10 days. Make only two applications on radish.
Tilt and propiconazole[3] generics	3	7	3 to 4 fl oz	16 fl oz	
CARROTS					
Damping-off, Seed Rot, Root Rots, Southern Blight					
MetaStar and metalaxyl[3] generics	4	0	4 to 8 pt	1 app	Preplant or at planting. May be applied through drip irrigation.
Presidio	43	7	4 fl oz	12 fl oz	*Pythium* diseases. Can be applied in-furrow or side-dressed after emergence.

(continued on next page)

DISEASE CONTROL: Root Crops *(continued)*

Product	FRAC Code[1]	PHI[2] (days)	Amt/A	Seasonal Limits/A	Comments
Quadris and azoxystrobin[3] generics	11	0			There are multiple Quadris formulations and azoxystrobin generics on the market. See label for rates and application detail.
Reason 500 SC	11	14	8.2 fl oz	24.6 fl oz	Cavity spot (*Pythium*). Do not use a spreader/ sticker. Alternate with mefenoxam.
Ridomil Gold SL and mefenoxam[3] generics	4	7	4 to 8 pt	1 app	*Pythium* diseases. May be applied through drip irrigation.
Ridomil Gold Bravo SC	4/M	7	1.5 to 2.5 pt	4 apps	*Pythium* diseases. See label for rates and rotation detail.
Ridomil Gold Copper	4/M	7	2 lb		*Pythium* diseases.
Foliar Diseases (Alternaria, Cercospora Leaf Spots, Leaf Blights)					
Bravo and chlorothalonil[3] generics	M	0			There are multiple Bravo formulations and chlorothalonil generics on the market. See label for rates.
Cabrio and pyraclostrobin[3] generics	11	0	8 to 12 oz	3 apps	
Copper, fixed coppers[3]	M	0			See label for rates, mixing instructions, and tank-mix precautions. Some products are approved for greenhouse use.
Endura and boscalid generics	7	0	4.5 oz	5 apps	Alternaria leaf blight.
Flint Extra	11	7	2.0 to 2.9 oz	11.5 oz	
Fontelis	7	0	16 to 30 fl oz	61 fl oz	
Inspire Super	3/9	7	16 to 20 oz	80 oz	
Luna Sensation	7/11	7	4.0 to 7.6 fl oz	23 fl oz	
Luna Tranquility	7/9	7	11.2 fl oz	54.7 fl oz	
Merivon	7/11	7	4 to 5.5 fl oz	3 apps	
Miravis Prime	7/12	7	6.8 oz	20.4 oz	
Omega 500 and fluazinam[3] generics	29	7	16 fl oz	4 apps	
Pristine	7/11	0	8 to 10.5 oz	6 apps	Will suppress southern blight.
Rovral and iprodione[3] generics	2	0	1 pt	10 pts	Alternaria blight.
Tilt and propiconazole[3] generics	3	14	4 fl oz	16 fl oz	
Quilt Xcel and propiconazole + azoxystrobin[3] generics	3/11	14	14 fl oz	56 fl oz	
Quadris and azoxystrobin[3] generics	11	0	9 to 15.5 fl oz	120 fl oz	There are multiple Quadris formulations and azoxystrobin generics on the market. See label for rates and application detail.
Quadris Opti	11/M	0	2.4 pt	6 apps	
Quadris Top	11/3	7	12 to 14 fl oz	56 fl oz	
Sulfur[3]	M				Phytotoxicity may occur when sulfur is applied when temperatures exceed 90ºF.
Switch 62.5 WG	9/12	7	11 to 14 oz	56 oz	Alternaria leaf blight.

1 Products with numerical FRAC codes must be alternated or tank-mixed with products that have a different FRAC code to discourage resistance development. See product label for maximum number of consecutive applications allowed. Refer to the table on pages 22-24 for more information on FRAC codes.

2 Pre-harvest interval.

3 Generic products available (Appendix F). Amounts and seasonal limits per acre are product dependent.

Sweetpotatoes

Bindweed family (Convolvulaceae): *Ipomoea batatas*

Planting and Culture

Sweetpotatoes grow best on medium to light sandy soils that are well drained and relatively low in nitrogen, although they can be grown successfully on heavier soils. Regardless, sweetpotatoes should not be grown on the same land more often than once every three years.

Good soil preparation is important for successful production of sweetpotatoes. The soil organic matter content should be maintained by turning under small grain cover crops.

The commercial grower often produces his own transplants (slips) by bedding 10 to 12 bushels of sweetpotatoes for each acre of plants to be set. The sweetpotatoes are usually bedded about seven weeks before the field setting date in early June (see Appendix K). Use only disease-free sweetpotatoes. They should be treated to reduce surface-borne disease problems before being placed in the bed. Do not cut sweetpotato seed pieces as you would potatoes. Cutting will often result in disease and will not result in a greater number of slips.

In preparing the bed, the roots are usually placed by hand so they are close together but not touching. Ordinarily, one bushel will cover 16 to 20 square feet of bed surface. The roots should be covered with 3 to 4 inches of sand or fine soil, then watered.

Soil preparation begins with deep plowing and repeated disking until a fine plant bed is prepared. Sandy soil should be ridged about 10 inches high before planting. On heavier soils that do not drain quickly, the ridges should be 12 to 14 inches high.

The best transplanting results are obtained by using freshly pulled plants. True "slips" will have been pulled from the sweetpotato and may have some roots. Often, to reduce risk of soilborne diseases, cuttings of vines are used instead of slips. Cuttings are taken 1 to 2 inches above the soil line and will have no roots when set. Slips may be set by hand, but most commercial Kentucky growers use a one-row tobacco setter that applies about ½ pint of water with each slip. Large commercial growers use a two-row plant setter. A starter solution is preferred to water. Add 3 pounds of 10-52-17 fertilizer to 50 gallons of water and use about ½ pint of this starter solution per slip (plant).

Rows should be spaced 40 to 44 inches apart and plants should be spaced in the row every 10 to 12 inches. A spacing of 10 inches apart within row and 44 inches between rows requires about 13,400 plants to set an acre. Replace missing plants to avoid oversized roots.

Fertilizing

Sweetpotatoes grow well at a soil pH of 5.0 to 6.0. Broadcast all fertilizer and disk into soil well before transplanting.

Harvesting

Sweetpotatoes continue to grow until the vines are killed by frost. Therefore, you should harvest the crop when the greatest number of 8- to 10-ounce potatoes are found in the hill. Sample digging will provide this information. A good practice is to mow the vines before harvesting. The crop can then be harvested with less damage to the potatoes. Use a turn plow or a potato digger to expose the roots with the least possible injury. Plow out one row at a time and pick up the potatoes. Grade potatoes in the field and place them in containers that are to be put in storage. For large-scale production, mechanical harvesting machinery can be used economically.

Curing and Storing

Stack crates or baskets in the storage space. Place them 6 to 8 inches off the floor and 12 to 15 inches from the walls to allow for adequate ventilation. Curing requires seven to 10 days if the temperature can be maintained at 80° to 85°F with 70 to 90 percent relative humidity. After curing is completed, the potatoes should be kept in a place as near 55°F as possible with a relative humidity of 85 percent. Higher market prices occur during the winter months and usually permit the grower with a stored crop to increase profits substantially.

Preparing for Market

If the crop is to be sold, the potatoes should be graded to meet the buyer's requirements. They should be prepared for market by cleaning, either by brushing or washing, and waxing before packing in crates or baskets. A box of sweetpotatoes on the wholesale market often weighs 40 to 44 pounds.

VARIETIES: Sweetpotatoes

Variety	DTM[1]	Comments
Beauregard	90	Copper skin, deep orange flesh, slow to sprout, moist flesh, very high yield, must harvest on time or roots will get too large.
Hernandez	90-100	Bright orange skin, orange moist flesh, long tapered root.
O'Henry	90-100	White skin, cream flesh, uniform shape, very high yield.
Covington	110	Rose colored skin, orange flesh, very uniform and high quality roots, strong vines.
Japanese/ Murasaki	100-105	Purple skin, dry-white flesh, good yields, strong skin, for farmers markets.

1 Days to Maturity

FERTILIZER: Sweetpotatoes

Soil Test Results (lb/A)		Fertilizer Needed (lb/A)
Phosphorus		**Phosphate (P_2O_5)**
Low	<31	121-180
Medium	31-60	61-120
High	61-80	1-60
Very High	>80	0
Potassium		**Potash (K_2O)**
Low	<201	251-275
Medium	201-300	101-250
High	301-450	51-100
Very High	>450	50
Nitrogen		**N**

Apply 30 to 50 lb/A of actual nitrogen (N).

PESTICIDE SAFETY: Sweetpotatoes

	Signal[1]	Re-entry (hrs)	Harvest (days)[2]
INSECTICIDES			
Actara 25 WDG	C	12	14
Admire Pro	C	12	125
Assail 30 SG	C	12	7
Avaunt eVo 30 DG	C	12	14
Belay 21.3 SC	C	12	14
Beleaf 50 SG	C	12	7
Coragen 1.67 SC	-	4	14
Exirel 0.83 SE	C	12	7
Fulfill 50 DF	C	12	14
Harvanta 50 SL	C	4	7
Intrepid 2 F	C	4	7
Knack 0.86 EC	C	12	7
Malathion 8	W	12	3
Miteus 0.42 EC	W	12	7
Movento 2	C	24	7
Nurizma 2.5 SC	C	12	AP
Oberon 2 SC	C	12	7
Platinum 2 F	C	12	AP
PQZ 1.87 SC	C	12	14
Portal XLO 0.4 EC	W	12	7
Radiant SC	C	4	7
Rimon 0.83 EC	W	12	14
Scorpion 35 SL	C	12	7[4]
Sefina 0.42 SC	C	12	7

continued

PESTICIDE SAFETY: Sweetpotatoes *(continued)*

	Signal[1]	Re-entry (hrs)	Harvest (days)[2]
Sevin XLR Plus	W	12	7
Sivanto Prime 1.67 SL	C	12	7
Transform 50 WG	D	24	7
Torac 1.29 EC	W	12	14
Venom 70 SG	C	12	7
Verimark 1.67 SL	-	4	N/A
Restricted Use			
AgriMek 0.7 SC	W	12	14
Baythroid XL	W	12	0
Brigade 2 EC	W	12	21
Exirel 0.83 SE	C	12	7
Fastac 0.83 EC	D	12	1
Mustang Maxx	W	12	1
Vydate L	DP	48	AP
Warrior II	W	24	7
FUNGICIDES			
Aprovia Top	W	12	14
Azoxystrobin[3]	C	4	14
Botran 75 W[4]	C	12	0
Botran 5F[4]	C	12	0
Endura	W	12	10
Fluazinam[2]	W	12	30
Fluoxastrobin[2]	C	12	7
Headline SC	W	12	3
Luna Tranquility	C	12	7

continued

PESTICIDE SAFETY: Sweetpotatoes *(continued)*

	Signal[1]	Re-entry (hrs)	Harvest (days)[2]
Maxim 4 FS	C	0	0
Mertect 340 F	C	12	0
Metalaxyl[3]	W	48	0
Miravis Prime	C	12	7
Miravis Top	C	12	14
Orondis Gold	C	4	5
Presidio	C	12	7
Provysol	C	12	7
Quadris Top	C	12	14
Quash	C	12	1
Ranman	C	12	7
Reason 500 SC	C	12	14
Ridomil Gold EC/SL	C	48	0
Scala SC	C	12	17
Scholar SC	C	0	0
Switch 62.5 WDG	C	12	7
Uniform	W	0	AP
Velum Prime	C	12	7
Vertisan	W	12	7

1 W: Warning, C: Caution, D: Danger; P: Poison
2 AP: At planting.
3 Several formulations are marketed. See the general introduction for more details on fungicides.
4 PHI dependent on application method.

INSECT CONTROL: Sweetpotatoes[1]

Insecticide	Product Amt/A	Seasonal Limit/A	Comments and Other Restrictions
SOIL APPLICATION			
Wireworms			
Belay 2.13 SC	9 to 12 fl oz	12 fl oz	At transplanting or cultivation.
Brigade 2 EC	3.2 to 9.6 fl oz	32 fl oz	At cultivation.
	9.6 to 19.2 fl oz	32 fl oz	Preplant only.
Nurizma 2.5 SC	0.08 to 0.16 fl oz/ 1000 row feet	At planting	Apply as a 5 to 7 inch band at planting and cover completely with soil. For wireworms and whute grubs.
FOLIAR APPLICATION			
Flea Beetles, Tortoise Beetles			
Actara 25 WDG	1.5 to 3 oz	6 oz	Allow 7 days between applications.
Baythroid XL	1.6 to 2.8 fl oz	16.8 fl oz	Limit 2.8 fl oz per 5-day interval. For flea beetles.
Belay 2.13 SC	2 to 3 fl oz	12 fl oz	Allow 7 days between applications. For flea beetles.
Brigade 2 EC	2.1 to 6.4 fl oz	32 fl oz	Limit 2 applications. Allow 21 days between applications.
Exirel 0.83 SC	13.5 to 20.5 fl oz	61.5 fl oz	Allow 5 days between applications.
Harvanta 50 SL	10.9 to 16.4 fl oz	49.2 fl oz	Limit 3 applications. Allow 5 days between applications.
Mustang Maxx	1.76 to 4 fl oz	24 fl oz	Allow 4 days between applications.
Sevin XLR Plus	0.5 to 1 qt	6 qt	Limit 6 applications. Allow 7 days between sprays.
Warrior II	1.28 to 1.92 fl oz	7.68 fl oz	-
Leafhoppers			
Actara 25 WDG	1.5 to 3 oz	6 oz	Allow 7 days between applications.
Baythroid XL	0.8 to 1.6 fl oz	16.8 fl oz	Limit 2.8 fl oz per 5-day interval.
Belay 2.13 SC	2 to 3 fl oz	12 fl oz	Allow 7 days between applications.
Fastac 0.83 EC	1.8 to 3.8 fl oz	11.4 fl oz	Allow 4 days between applications.
Malathion 8	1 to 1.5 pt	2 applications	Allow 7 days between applications.
Miteus 0.42 EC	2 pt	4 pt	Allow 7 days between applications.
Mustang Maxx	1.76 to 4 fl oz	24 fl oz	Allow 4 days between applications.
Portal 0.4 EC	2 pt	4 pt	Limit 2 applications. Allow 7 days between applications.
Sivanto Prime 1.67 SL	7 to 14 fl oz	28 fl oz	Allow 7 days between applications.
Transform 50 WG	1.5 to 2.25 oz	8.5 oz	Limit 4 applications. Allow 14 days between applications.
Torac 1.29 EC	14 to 21 fl oz	42 fl oz	Limit 2 applications. Allow 14 days between applications.
Warrior II	0.96 to 1.6 fl oz	7.68 fl oz	-
Sweetpotato Weevil			
Baythroid XL	1.6 to 2.8 fl oz	16.8 fl oz	Limit 2.8 fl oz per 5-day interval.

1 Generic products available (Appendix G).

WEED CONTROL: Sweetpotatoes

Product Amt/A	Lb A.I./A	Comments
0.5 to 1.6 fl oz Aim 1.9 EW	0.008 to 0.025 carfentrazone	For contact post-emergence control of annual broadleaf weeds and suppression of annual grasses. Can be applied as a preplant, pre-transplant burndown, or before crop emerges to actively growing weeds up to 4 inches tall. Can also be applied post-emergence as a directed hooded application between crop rows. Use min. 10 gal water/A and crop oil 1% v/v. Max. rate 11.6 fl oz/A. PHI = 7 days.
1.3 to 4 pt Command 3ME	0.48 to 1.5 clomazone	For preplant incorporated or pre-emergence control of annual grasses and broadleaves. Use a maximum of 1.5 pt/A in a single application after transplanting and before weed emergence. PHI = 95 days, 125 days if more than 3.3 pt was applied.
6 to 14 lb Dacthal W-75	4.5 to 10.5 DCPA	For pre-emergence control of annual grasses and small-seeded broadleaves. May be sprayed over transplants (slips). Layby applications can be made up to 6 weeks after transplanting.
2 to 4 lb Devrinol 50 DF	1 to 2 napropamide	For control of annual grasses and broadleaf weeds. Apply before transplanting and water-in or incorporate to a depth of 1 to 2 inches in 10 to 50 gal water/A. Can be applied immediately after transplanting. To avoid injury, do not replant with crops not specified on the label for 12 months if using the 4-lb rate. Only herbicide approved for slip (transplant) beds.
1 pt Fusilade-DX 2E	0.25 fluazifop-p	For selective post-emergence control of annual grasses and suppression of perennial grasses. Include 1% v/v crop oil or 0.25% v/v non-ionic surfactant/A. PHI = 55 days. Max. rate is 48 fl oz/A.

(continued on next page)

WEED CONTROL: Sweetpotatoes *(continued)*

Product Amt/A	Lb A.I./A	Comments
16 to 22 fl oz Roundup WeatherMax 5.5L	0.69 to 0.94 glyphosate-salt	For non-selective post-emergence control of annual and perennial grasses and broadleaf weeds. Use only AMS 1 to 2% v/v. Adding a non-ionic surfactant can reduce weed control effectiveness. Min. 30 days before planting any non-labeled crop.
9 to 32 fl oz Select Max	0.07 to 0.24 clethodim	For selective post-emergence of actively growing annual grasses and suppression of perennial grasses. Add crop oil 1% v/v. PHI = 30 days.
0.5 to 1 oz Valor 51DG	0.024 to 0.032 flumioxazin	For post-emergence control of broadleaf weeds and yellow nutsedge. For use on 'Beauregard' variety only. Apply 2 to 5 days before transplanting. Do not use greenhouse-grown transplants. Max. rate 2.5 oz/A.

DISEASE CONTROL: Sweetpotatoes

Product	FRAC Code[1]	PHI[2] (days)	Amt/A	Seasonal Limits/A	Comments
Damping-off (*Pythium*) and early season diseases					
Elumin	22	n/a	8 oz	16 oz	Preplant or at planting for Pythium diseases.
MetaStar and metalaxyl[3] generics	4	0	4 to 8 pt	1 app	Preplant or at planting for Pythium diseases. May be applied through drip irrigation.
Orondis Gold 200	49	5	4.8 to 9.6 fl oz	1 app	For pink rot and Pythium leak. Apply over seed pieces in open furrow.
Presidio	43	7	3 to 4 fl oz	12 fl oz	Can be applied as a drench or through drip irrigation at planting; soil-directed applications can be made during the season.
Ranman	21	7	0.42 fl oz/1,000 linear ft	10 total apps	In-furrow.
Ridomil Gold and mefenoxam[3] generics	4	0	1 to 2 pt	2 pt	Preplant or at planting.
Uniform	4/11	-	0.34 fl oz/1,000 linear ft	1 app	In-furrow spray for Rhizoctonia seedling blight and/or Pythium damping off and root rot.
Vertisan	7	7	0.7 to 1.6 fl oz/1,000 linear ft	1 app	In-furrow treatment for Rhizoctonia diseases.
Foliar Diseases					
Aftershock and fluoxastrobin[3] generics	11	7	2 to 3.8 fl oz	22.8 fl oz	
Aprovia Top	7/3	14	10.5 to 13.5 oz	27 oz	Spreading/penetrating adjuvant recommended.
Cabrio and pyraclostrobin[3] generics	11	0	8 to 16 oz	48 oz	
Headline and pyraclostrobin[3] generics	11	3	6 to 12 fl oz[3]	72 fl oz	
Luna Tranquility	7/9	7	11.2 fl oz	54.7 fl oz	
Miravis Prime	7/12	7	6.8 oz	20.4 oz	
Miravis Top	3/7	14	13.7 oz	56 oz	
Omega 500 and fluazinam[3] generics	29	14	5.5 to 8 fl oz	56 fl oz	White mold.
Provysol	3	7	3 to 5 oz	15 oz	
Quadris and azoxystrobin[3] generics	11	0	6 to 15.5 fl oz	6 app	
Quadris Top	11/3	14	8 to 14 fl oz	55.3 fl oz	
Quash	3	1	2.5 to 4.0 oz	4 apps	Make first application prior to row closure.
Ranman	21	7	1.4 to 2.75 fl oz	10 total apps	
Reason	11	14	5.5 to 8.2 fl oz	16.4 fl oz	
Scala	9	17	7 fl oz	35 fl oz	
Switch 62.5 WG	9/12	7	11 to 14 oz	56 oz	

(continued on next page)

DISEASE CONTROL: Sweetpotatoes *(continued)*

Product	FRAC Code[1]	PHI[2] (days)	Amt/A	Seasonal Limits/A	Comments
Velum Prime	7	7	6 to 6.84 oz	13.7 oz	White mold. Apply in-furrow or as side dress. Also nematode suppressive.
Vertisan	7	7	10 to 24 fl oz	72 fl oz	Make initial application at row closure.
Scurf, Black Rot, Sclerotinia Blight, Post-harvest Rot					
Botran 75 W Botran 5F	14	0	2 lb/15 gal water 2.4 pt/15 gal water	1 app	Seed dip. For control of scurf, dip seed in solution for 10 to 15 seconds and plant immediately. Discard unused solution daily.
Botran 75 W Botran 5F	14	0	4.8 oz/1,000 row-feet 5.73 fl oz/1,000 row-feet	1 app	Plant bed application. For control of Sclerotinia blight, spray or sprinkle solution over bedded seed before covering.
Botran 75 W Botran 5F	14	0	0.5 to 1 lb/100 gal water 1.2 pt/100 gal water	1 app	Post-harvest dip. Dip harvested tubers in solution, or spray; do not rinse after treatment. Use low rate for dip. For suppression of rhizopus rot.
Endura	7	10	5.5 to 10 oz	20 oz	Sclerotinia.
Maxim 4 FS	12	0	0.08 to 0.16 oz/cwt	1 app	Seed dip.
Mertect 340 F	1	0	3.3 qt/100 gal water	1 app	Seed dip.
Scholar SC		0	16 to 32 fl oz/100 gal	1 app	Postharvest dip.
Vertisan	7	7	10 to 24 fl oz	72 fl oz	Make initial application at row closure.

1 Products with numerical FRAC codes must be alternated or tank-mixed with products that have a different FRAC code to discourage resistance development. See product label for maximum number of consecutive applications allowed. Refer to the table on pages 22-24 for more information on FRAC codes.
2 Pre-harvest interval.
3 Use higher rate when pressure is severe.

Tomatoes

Nightshade family (Solanaceae): *Solanum esculentum*

For information on tomatoes see “Fruiting Vegetables” section on page 86

Appendix A

Production and Marketing Information Online

Internet websites contain an incredible wealth of useful information of interest to commercial vegetable growers in Kentucky and surrounding states. Below is a list of topics from over 50 websites considered to be of particular value to commercial growers. Links to these sites can be found at:

http://www.uky.edu/hort/documents-list-commercial-vegetable

Warning!

Use this information with caution and at your own risk. You should be very careful about using any variety, fertilizer, or pesticide recommendation from another region or distant state. Some pesticides may be legal only for use in that particular state or production region. Varieties that perform well in another state may or may not perform well in Kentucky.

Remember that Internet addresses sometimes change. Those listed here worked as of November, 2019.

University of Kentucky Martin-Gatton College of Agriculture, Food and Environment

University of Kentucky Martin-Gatton College of Agriculture, Food and Environment: Provides links to most UK agriculture departments and their publications.

- http://www.ca.uky.edu/

Horticulture Department: Has most of UK's vegetable crop publications linked under "Commercial Horticulture" and "Vegetables".

- http://www.uky.edu/hort/

Department of Entomology: Fact sheets on Kentucky's vegetable insect and mite pests.

- https://entomology.ca.uky.edu/entfacts/

Center for Crop Diversification: Provides research updates, profiles of promising new crops, and marketing information for Kentucky.

- http://www.uky.edu/Ag/CCD/

Ag. Weather Center: An excellent source of current and historical weather information.

- wwwagwx.ca.uky.edu/

Vegetable Production Guidelines for Commercial Growers: This publication (ID-36) and most other UK extension publications available online.

- http://www.uky.edu/hort/documents-list-commercial-vegetable

Integrated Pest Management (IPM) guidelines: Detailed production information and pest management strategies for Kentucky sweet corn, cabbage, peppers, and pumpkins.

- http://ipm.ca.uky.edu/vegetableipm

Vegetable and Melon Enterprise Budgets for Kentucky: These interactive crop budgets provide average costs and returns for most vegetable crops and allows users to enter their own cost and price figures to instantly estimate returns per acre.

- http://www.uky.edu/ccd/tools/budgets

General Vegetable Production Information from Other States

Southeastern U.S. Vegetable Crop Handbook: A collaboration of several Southeastern U.S. states contains useful production information.

- https://www.growingproduce.com/southeasternvegetablecrophandbook/

University of Florida: Extensive vegetable production information, petiole sap testing for nitrogen nutrition, alternative crops, newsletter, and Florida transplant producers.

- http://edis.ifas.ufl.edu/topic_commercial_vegetable_production

Mississippi State University Greenhouse Information: Links to Greenhouse Tomato Handbook, Starting Vegetable Transplants, and to other sources of information on greenhouse vegetable production and pest management.

- http://extension.msstate.edu/agriculture/crops/commercial-horticulture

Weekly Vegetable IPM and Other Newsletters

Kentucky Pest News: Access to the current and back issues of KPN.

- http://plantpathology.ca.uky.edu/extension/kpn

Illinois Fruit & Vegetable News: Produced at the University of Illinois.

- https://ipm.illinois.edu/ifvn/

Organic Vegetable Production

Appropriate Technology Transfer for Rural Areas (ATTRA): A number of extensive online organic vegetable production guides.

- https://attra.ncat.org/horticultural.html#Vegetables

Resources for CSA Producers from the USDA: Information on organic food production, sustainable agriculture and community supported agriculture (CSA).

- https://pubs.nal.usda.gov/csa-resources-farmers

USDA National Organic Program (NOP): Links to new NOP standards.

- https://www.ams.usda.gov/about-ams/programs-offices/national-organic-program

Kentucky Organic Certification: Kentucky Department of Agriculture's organic certification program (forms and information).

- http://kyagr.com/marketing/organic-marketing.html

Production and Marketing Information Online Continued

University of Kentucky: Information on organic crop certification.

- http://www.uky.edu/ccd/production/system-resources/organic

Sustainable Agriculture Research and Education (SARE): A grower focused organization that is affiliated with land grant universities around the country. Excellent resource for growers.

- http://www.sare.org/

Marketing and Market Prices

UK's Marketing Options for Commercial Vegetable Growers: Publication # ID-134; this is written with tobacco growers in mind. It compares and contrasts most of the available produce marketing options.

- http://www2.ca.uky.edu/agcomm/pubs/id/id134/id134.pdf

Kentucky Horticulture and New Crops Marketing: A number of other marketing fact sheets for vegetable and fruit crops.

- http://www.uky.edu/ccd/marketing

USDA Wholesale Price Information: The same wholesale prices plus specialty, auction, and farmers' market reports.

- https://www.ams.usda.gov

Kentucky Farmers' Markets: Kentucky Department of Agriculture provides information on farmers' markets throughout the state.

- http://www.kyagr.com/marketing/farmers-market.html

USDA Grading Standards: Fruit and vegetable grading standards.

- https://www.ams.usda.gov/grades-standards/vegetables

USDA Direct Marketing Home Page: The USDA hosts this site.

- https://www.nal.usda.gov/main

Kentucky Department of Agriculture: Includes links to Horticultural Division, Organic Certification, and KY Produce Shipper's Directory. Information about Kentucky's vegetable marketing cooperatives, a Farmers' Market Directory, and guidelines for "Kentucky Proud" logo program.

- kyagr.com

KDA Country Store: The Department of Agriculture helps Kentucky producers build their own website and hosts those sites at no charge.

- http://kyagr.com/buyky/webpage-builder.html

Kentucky Farm Bureau: Provides a link to its map and directory of Kentucky Certified Roadside Farm Markets.

- kyfb.com

Post-harvest and Food Safety (handling, cooling, grading, packaging, etc.)

Kentucky Department of Agriculture Good Agricultural Practices (GAP) Program: Good food safety information specific to Kentucky growers.

- http://www.kyagr.com/marketing/GAP.html

Cornell University Food Safety: Some of the best information on food safety and good agricultural practices for growers is available in the publication: Food Safety Begins on the Farm–A Grower's Guide. Excellent resource.

- https://gaps.cornell.edu/educational-materials/

Appendix B

Secondary Nutrients and Micronutrients

Calcium—Calcium levels in soils vary with soil pH and cation exchange capacity (CEC). To avoid developing soil conditions that may lead to low levels of available calcium and low calcium uptake by some crops, have soil tested frequently. Apply lime to obtain the recommended soil pH at least six months before growing the crop. See the publication "Lime and Fertilizer Recommendations" (AGR-1) for lime rates to achieve desired pH changes.

Magnesium—Magnesium levels in Kentucky soils range from very high (loess-derived soils) to somewhat low (some sandstone-derived and recently cleared soils). Magnesium is included as part of the routine soil test. For vegetable crops, a test level of 80 pounds per acre is considered the minimum, and 200 pounds per acre is recommended for staked tomatoes and muskmelons. If both lime and magnesium are needed, dolomitic lime should be applied. If dolomitic lime is not available or when lime is not needed and magnesium is recommended, other sources of magnesium such as magnesium oxide or Epsom salts (magnesium sulfate) are available for broadcast or row application. Refer to the "Vining Crops" chapter for magnesium application rates. Magnesium deficiencies are readily identifiable in many plants. Typically deficiencies show up as interveinal chlorosis on older leaves.

Iron, Copper, Manganese—For horticultural crops, we have not measured consistent responses to soil-applied iron, copper, or manganese. To verify a suspected deficiency of iron, copper or manganese, have an analysis of plant tissue appropriate for the crop carried out with a commercial lab through your county Extension agent. Responses to foliar applications of iron, copper, or manganese, after diagnosis of a deficiency, have been superior to soil applications. Many deficiencies of iron, copper and manganese show similar signs as magnesium deficiencies (ie. interveinal chlorosis); however, typically micronutrient deficiencies appear first in new growth, whereas magnesium deficiencies will tend to first appear in older growth.

Sulfur—We have not measured a response to sulfur application on horticultural crops in Kentucky. However, cole crops established early in the spring on soils that tend to be cool and moist may be susceptible to low amounts of available sulfur. A meaningful and suitable soil test for sulfur is not available in Kentucky because of several factors affecting available sulfur levels in soils. It is suggested that sulfur-containing fertilizer be used where cole crops are to be grown as they are high sulfur users.

Boron—Yield responses to boron have been observed only for certain crops under some conditions. A boron soil test is available in Kentucky upon request through your county Extension agent. Boron should only be applied when soil test boron is less than 1 pound per acre. Boron is normally applied at the rate of 1 to 2 pounds of actual boron per acre.

Zinc—Zinc deficiency in snap beans and sweet corn may be significant in Central and South-central Kentucky. The test for zinc is now included in the routine soil test. The results of this test, in conjunction with soil test results for pH and phosphorus, can help farmers make needed applications of zinc fertilizer. When zinc is recommended and equipment is available, banding can reduce costs by two-thirds over a broadcast application. Zinc sulfate (36% Zn) is usually applied at 30 to 90 pounds per acre when broadcast. Chelated zinc (14%) can be applied at 15 to 40 pounds per acre. For a foliar spray, use chelated zinc at 3⁄4 to 1 pound in 100 gallons of water. See also the "Fertilizing" section of the "Sweet Corn" chapter.

Appendix C

Conversion Tables for Use of Pesticides on Small Areas

LIQUID MATERIALS

Approximate Rate Per:	Recommended Rate/A							
	1 pt	1 qt	2 qt	1 gal	25 gal	50 gal	75 gal	100 gal
1,000 sq ft	¾ tbs	1½ tbs	3 tbs	6 tbs	4½ pt	4½ pt	7 qt	9 qt
100 sq ft	¼ tsp	½ tsp	1 tsp	2 tsp	1 cup	1 pt	1½ pt	1 qt

DRY MATERIALS

Approximate Rate Per:	Recommended Rate/A										
	1 lb	2 lb	3 lb	4 lb	5 lb	6 lb	8 lb	10 lb	100 lb	200 lb	400 lb
1,000 sq ft	2¼ tsp	4½ tsp	2¼ tbs	3 tbs	4 tbs	4½ tbs	2⁄5 cup	½ cup	2¼ lb	4½ lb	9 lb
100 sq ft	¼ tsp	½ tsp	¾ tsp	1 tsp	1¼ tsp	1½ tsp	1¾ tsp	2 tsp	¼ lb	½ lb	1 lb

Appendix D

English Measurement Units

3 teaspoons (tsp)	=	1 tablespoon
2 tablespoons (tbs)	=	1 fluid ounce
16 tablespoons (tbs)	=	1 cup
8 fluid ounces (fl oz)	=	1 cup
2 cups (c)	=	1 pint
2 pints (pt)	=	1 quart
4 quarts (qt)	=	1 gallon (gal)

Appendix E

Fumigants For Vegetable Crops

See also "Soil Fumigants for Control of Nematodes and Soilborne Diseases" on page 21.

Trade Name	Common Name	Rate/A (gal)	Target Pests	Timing (Plant-back)[1]	Restricted Use	Re-Entry Interval
Chloropicrin	chloropicrin (99.5%)	10.9 to 12.8	nematodes, soilborne diseases	2 to 3 weeks	Yes	5 days
K-Pam HL	metam-potassium (54%)	15 to 62	weeds, nematodes, soilborne diseases	2 to 3 weeks	Yes	5 days
Telone II	1,3-dichloropropene (97.5%)	9 to 12	nematodes	1 to 2 weeks	Yes	5 days
Telone C-17	1,3-dichloropropene (81.2%) + chloropicrin (16.5%)	10.8 to 17.1	nematodes, soilborne diseases	1 to 2 weeks	Yes	5 days
Telone C-35	1,3-dichloropropene (63.4%) + chloropicrin (34.7%)	13 to 26	nematodes, soilborne diseases	2 to 3 weeks	Yes	5 days
Vapam HL or Sectagon-42	metam-sodium (42%)	37.5 to 75	weeds, nematodes, soilborne diseases	2 to 3 weeks	Yes	5 days

[1] *Dissipation of fumigants will be slower in cool, wet, or heavy soils. Under these conditions, allow more time for materials to escape soil, and aerate by tillage before planting. Failure to aerate fully can result in severe plant injury or death. If no fumigant odor is detected, aeration is generally sufficient.*

Appendix F

Generic and Alternative Fungicides

Active Ingredient	Generics	Manufacturer
Azoxystrobin Original Product: Quadris (Syngenta)	Acadia 2SC	Atticus
	Aframe	Syngenta
	Arius	Sipcam Agro USA
	AzoxyStar	Albaugh/Agri-Star
	Azoxystrobin 100 ST	
	Azoxyzone	LG Life Sciences
	Azteroid	Vive Crop Protection
	Dynasty	Syngenta
	Equation	FMC
	Gold Rush	Altitude Crop Innovations
	Heritage	Syngenta Professional Products
	Mazolin	AgBiome Innovations
	Satori	Loveland
	Tetraban	WinField United
	Trevo	Innvictis Crop Care
	Willowood Azoxy2SC	Willowood
Chlorothalonil Original Product: Bravo WeatherStik 720 SC (Syngenta)	Cercos	Sipcam Agro USA
	Chloronil 720	Syngenta
	Chlorothalonil 720 SC	Arysta
	Echo 720	SipcamAdvan
	Equus 720 SST	ADAMA
	Initiate 720	Loveland
	Praiz	WinField United
	Vabro	WinField United
	Original Product: Bravo Ultrex 82.5 WDG (Syngenta)	
	Echo 90 DF	SipcamAdvan
	Original Product: Bravo ZN (Syngenta)	
	Echo Zn	Sipcam Agro
	Initiate Zn	Loveland
Fludioxonil Original Product: Cannonball (Syngenta)	Cannonball	Syngenta
	Emblem	NuFarm
	Maxim	Syngenta
	Scholar	Syngenta
Fluoxastrobin Original Product: various	Aftershock	Loveland
	Evito	UPL
	Tepera	UPL
Fluazinam Original Product: Omega 500F (Syngenta)	Lektivar	AgBiome Innovations
	Omega 500F	Syngenta
Fosetyl-Al Original Product: Aliette (Bayer)	Aliette	Bayer
	Linebacker	Tessenderlo Kerley
Iprodione Original Product: Rovral 4F (Bayer)	Iprodione 4L AG	Arysta
	Meteor	United Phosphorus
	Nevado 4F	ADAMA
	Rovral 4F Fungicide	FMC

(continued on next page)

Generic and Alternative Fungicides Continued

Active Ingredient	Generics	Manufacturer
Mancozeb Original Product: Dithane (Dow)	Dithane F45	Corteva Agriscience
	Dithane M45	
	Fortuna	Agria Canada
	Koverall	FMC
	Manzate Max	UPL NA Inc.
	Manzate ProStick	UPL NA Inc.
	Penncozeb 80WP	UPL NA Inc.
	Potato Seed Treater	Loveland Products
	Roper DF	Loveland Products
	Roper DF Rainshield	Loveland Products
Mefenoxam Original Product: Ridomil Gold SL (Syngenta)	Anchor 3L ST	Albaugh
	Apron XL	Syngenta
	Ridomil Gold SL	Syngenta
	Thrive 4M	Albaugh
	Ultra Flourish	Nufarm
Metalaxyl Original Product: Metastar (LG LifeSciences)	Axyl-Shield ST	Sharda
	Metalaxyl 2E AG	Albaugh
	Metastar 2E	LG Life Sciences
	Xyler FC	Vive Crop Protection
Myclobutanil Original Product: Rally (Dow)	Rally 40WSP	Corteva Agriscience
	Sonoma 40WSP	Albaugh
Phosphorus Acid Original Product: ProPhyt (Helena)	Fosphite	Corteva
	Fungi-Phite	Verdesian
	K-Phite	Plant Food Systems
	Phostrol	Nufarm
Propiconazole Original Product: Tilt (Syngenta)	Arysta Propiconazole 41.8% EC	Arysta
	Bumper 41.8 EC	ADAMA
	Bumper ES	ADAMA
	Fitness	Loveland
	Marazo	AgBiome Innovations
	Omni	Helena
	Propiconazole 3.6 EC	Repar
	Propiconazole 41.8% EC	Helena Chemical
	Propicure	WinField United
	Propimax EC	Dow Agrosciences
	Propi-Star	Albaugh
	Shar-Shield PPZ	Sharda USA
	Slant	Atticus
	Tide Propiconazole 41.8% EC	Tide International USA
	Topaz	WinField United
	Vigil	Innvictis Crop Care
	Willowood Propicon 3.6EC	Willowood
Propiconazole + Azoxystrobin Original Product: Quilt Xcel (Syngenta)	Aquila	Atticus
	Avaris 2 XS	Helena
	AzoxyProp	Tigris
	Cover XL	Albaugh
	MiCrop	Albaugh
	Quilt Xcel	Syngenta
	Xiphosin	AgBiome Innovations

(continued on next page)

Generic and Alternative Fungicides Continued

Active Ingredient	Generics	Manufacturer
Sulfur Original Product: Various products and manufacturers	Cosavet DF	Sulphur Mills
	Microfine Sulfur	Loveland
	Microthiol Disperss	United Phosphorus
	Suffa	Drexel
	Sulfur 80	Arysta
Tebuconazole Original Product: Folicur 3.6F (Bayer)	Barrier	Real Farm Technologies
	Monsoon	Loveland
	Muscle	Sipcam Agro USA
	Onset 3.6L	Winfield Solutions
	Orius 3.6F	ADAMA
	Tebu-Crop 3.6F	Sharda USA
	Tebucon 3.6F	Repar
	Tebustar 3.6L	Albaugh/Agri-Star
	Tebuzol 3.6F	United Phosphorus
	Toledo	Rotam North America
	Willowood Teb 3.6 SC	Willowood
Thiophanate-methyl Original Product: Topsin M 70WDG, 70WP, WSB (United Phosphorus)	Cercobin	FMC
	Incognito 85 WDG	ADAMA
	Nufarm T-Methyl 70 WSB	Nufarm
	Thiophanate-Methyl 85WDG	ADAMA
	Original Product: Topsin 4.5FL (United Phosphorus)	
	Incognito 4.5F	ADAMA
	Nufarm T-Methyl 4.5F	Nufarm

Appendix G

Generic Insecticides

Active Ingredient	Generics	Manufacturer
Abamectin Original Product: Agri-Mek 0.15 EC (Syngenta)	Abacus 0.15 EC	Rotam
	Abamectin 0.7 SC	Willowood
	Abamex 0.15EC	Nufarm
	Abba 0.15 EC	Adama
	Abba Ultra 0.3 EC	Makhteshim
	Agmectin 0.15 EC	Tide
	AgriMek 0.7 SC	Syngenta
	Averland 0.7 FC	Vive
	Avow 0.15 EC	Innvictus
	Enterik 0.15 LV	Atticus
	Reaper 0.15 EC Reaper Advance 0.15 EC	Loveland
	Timectin 0.15 EC	Tide Intl.
Acephate Original Product: Orthene 90 SP (Valent)	Acephate 90 Prill	Adama
	Acephate 90 WDG, 90 WSB	Loveland, Tide
	Acephate 97 UP	United Phosphorous
	Acephate 97 WDG	Adama
	Bracket 90 WDG, 97 WDG	Winfield
	Livid 90 Prill, 97 Prill	Innvictus
	Orthene 97	Amvac
Acetamiprid Original Product: Assail 30 SG, 70 WP	Anarchy 30 SG, 70 WP	Loveland
	Arvida 30 SG, 70 WP	Atticus
	Azomar 30 SG	AgBiome Innovations
	Intruder Max 70 WP	United Phosphorous
	Quasar 8.5 SL	Atticus
Bifenazate Original Product: Acramite 50 WS	Actuate 2 SC	Atticus
	Banter 50 WDG, 4 SC	United Phosphorous
	Bifenamite 50 WDG, 4 SC	Agri Star
	Bifenazate 50 WDG, 4 SC	Willowood
	Bizate 50 WDG	Loveland
	Envenerate 4 SC	Atticus
	Floramite SC	OHP
	Vigilant 4 SC	McDermid
Bifenthrin Original Product: Brigade 2 EC, Capture 2 EC (FMC)	Battalion 2EC, 10 WSP, LFC	Atticus
	Bi-Dash 2 EC	Sharda
	Bifen 2 AG Gold	Direct AG Source
	Bifen 25% EC	Tacoma
	Bifender FC	Vive
	Bifenthrin 2 EC	Aceto, Willowood
	Bifenture 2 EC	United Phosphorous
	Discipline 2 EC	Amvac
	Fanfare 2 EC, ES	Adama
	Frenzy Veloz	Real Farm
	Lancer 2 EC	Albaugh
	Nirvana RTU	Innvictus
	Reveal 2 EC	Innvictus
	Seguro	Sharda
	Sniper 2 EC, LFR	Loveland
	Tundra 2 EC	Winfield
	Xpedient 2 Ec	Amvac
Carbaryl Original Product: Sevin 4L, 80 S, SL, XLR (Bayer)	Carbaryl 4 L	Drexel, Loveland

(continued on next page)

Generic Insecticides Continued

Active Ingredient	Generics	Manufacturer
Chlorfenapyr Original Product: Pylon 1 (BASF)	Piston 2	Atticus
Chlorpyrifos Original Product: Lorsban 4 E, 15 G, 75 WDG, Advanced 3.76 E (Dow AgroSciences)	Chloryrifos 4 E	Adama, Drexel, Nufarm
	Govern 4 E	Tenkos
	Hatchet 4 E	Dow AgroSciences
	Saurus 15 G	Helena
	Vesper 4 E	Innvictus
	Vulcan 3.76 E	Adama
	Warhawk 4 E	Loveland
	Whirlwind 4 E	Helena
	Yuma 4 E	Winfield
Cyfluthrin Original Product: Baythroid XL 1 EC, Renounce 20 WP (Bayer)	Tombstone 2 E	Loveland
	Tombstone Helios 2 E	Loveland
Cypermethrin Original Product: Ammo (discontinued)	Battery 2.5 EC	Winfield
	Cypermethrin 2.5 EC	TENKOZ
	Holster 2.5 EC	Loveland
	Up-Cyde 2.5 EC	UPL
Dinotefuran Original Product: Vemon 70 SG	Certador 0.89 SC	BASF
	Scorpion 35 SL	Gowan
Esfenvalerate Original Product: Asana XL 0.66 EC (Dupont)	S-FenvaloStar 0.66 EC	LG Life Sciences
Gamma-cyhalothrin Original Product: Proaxis 0.5 EC (Cheminova)	Declare Insecticide 0.5 EC	Cheminova
Hexythiazox Original Product: Hexygon, Onager, Savey (Gowan)	Hexamite 1E	Albaugh
	Hexcel 50 DF	Atticus
	Hexy 1 E, 2 E	Sharda
	Ruger 1 EC	Atticus
Imidacloprid Original Product: Admire Pro 4.6 F (Bayer)	Acronyx 4 F	Atticus
	Advise 2 FL	Winfield
	Alias 2 F, 4 F	Adama
	Imidacloprid 2 SC, 4 SC	Willowood
	Lada 2 F	Rotam
	Macho 2 FL, 4 F	Albaugh
	Malice 75 WSP	Loveland
	Midash 2 SC	Sharda USA
	Montana 2 F, 4 F	Rotam NA
	NuPrid 2 F, 2 SC, 4 F Max, 4.6 F	Nufarm
	Provoke 4 F	Innvictus
	Prey 1.6 F Sherpa 1.6 F Widow 2 F Wrangler 4 F	Loveland
	Viloprid FC 1.7	Vine Crop Protection

(continued on next page)

Generic Insecticides Continued

Active Ingredient	Generics	Manufacturer
Lambda-cyhalothrin Original Product: Karate 1 EC, Warrior with Zeon 1 ME, II 2 ME (Sygenta)	Cavalry II 2.08 SC	Growmark
	Firestone 1 CS	Altitude Crop Innovations
	Grizzly Z 1 CS	Winfield
	Kendo 1 EC	Helm
	Lambda-CY AG	Direct AG Source
	Lambda CY 1 EC	United Phosphorous, Willowood
	Lambda-Cyhalothrin 1 EC	Nufarm
	LambdaStar 1 EC, 1 CS	LG Life Sciences
	Lamcap II 1 CS	Syngenta
	Paradigm 1 VC	Winfield United
	Province II 2 SC	TENKOZ
	Ravage 1 EC	Innvictus
	Serpent 1 EC	Atticus
	Silencer 1 EC	Adama
Methomyl Original Product: Lannate SP, LV (Corteva)	Nudrin SP, LV	Rotam
	Lanveer LV	Innvictus
Methoxyfenozide Original Product: Intrepid 2 F (Corteva)	Inspirato 2 F	Atticus
	Insurgent 2 F	Altamont
	Invertid 2 F	Loveland
	Troubadour 2 F	Helena
	Turnstyle 2 F	UPL
	Vexer 2 F	Innvictus
	Zylo 2 F	UPL
Permethrin Original Product: Pounce 3.2 EC (not available) (FMC)	Arctic 3.2 EC	Winfield
	Perm-Up 3.2 EC	United Phosphorous
	PermaStar AG 3.2 EC	LG Life Sciences
	Permethrin 3.2 EC	Loveland, TENKoz, Helena
Pymetrozine Original Product: Fulfill 50 WDG (Syngenta)	Seville 50 WDG	Atticus
Pyriproxyfen Original Product: Distance, Knack 0.86 EC (Valent)	Cusack 0.86 EC	Atticus
	Farewell	Adama
	Reemit 0.86 EC	Atticus
Spinosad Original Product: Spinor 2 SC, Tracer 4 SC (Corteva)	Seduce	Certis
Thiamethoxam Original Product: Actara 25 WDG (Syngenta)	Artist 25 WDG	Sharda

Appendix H

Organic Manures and Fertilizers

Animal manure contributes more to the soil than just nitrogen, phosphorus, and potassium. Continued use of manure builds organic matter in soils and improves soil structure. This modification of soil structure helps improve water holding capacity, aeration, friability, and drainage. In addition, many trace nutrients needed for optimal plant growth are available from manure. Plant nutrients are also released more slowly and over a longer period of time than from most commercial fertilizers.

Disadvantages of using manure are the handling and transportation problems associated with large amounts of manure required to obtain sufficient quantities of nutrients for vegetables. The use of fresh manure may also introduce new weeds into fields since certain weed seeds remain alive even after passage through animals. Another concern is that the careless use of manure can expose fresh produce to human pathogens such as E. coli, which can cause serious illness. Food safety must be a primary consideration in any vegetable operation but especially where manure are being used.

General Considerations

Fresh Vegetables, Not Fresh Manure

Manure cannot be used fresh (raw) if you intend to plant directly into it; composting results in a more readily usable form of manure. Composting will also destroy many weed seeds that could otherwise be introduced into new fields or gardens. Composting requires that the temperature reach 131 to 170°F for at least 15 days, and the compost must be turned 5 times. For more information on the composting process, see UK Extension publication HO-75, *Home Composting: A Guide to Managing Home Organic Waste*. This guide along with other home and commercial vegetable publications are available from the Horticulture Department's website at uky.edu/Agriculture/Horticulture/homeveggies.html. If fresh manure is used on soil, it should be worked in as soon as possible or covered with other organic materials such as straw, hay, or grass clippings to prevent the loss of nitrogen through leaching. No fresh manure may be used during the year of harvest for certified organic production so you may want to plant a green manure or cover crop on this ground for the first year (see website above for information on Kentucky cover crops). See also kyagr.com/marketing/plantmktg/organic/index.htm for detailed information on organic certification in Kentucky. This allows soil microbes to start the decomposition process that regulates nutrient availability and prevents burning of young plant roots. It also substantially reduces the chance of produce *E. coli* and *Salmonella* contamination.

Caution: Fresh manure is best applied and plowed down the fall before planting. There should be at least 120 days between manure application and planting for vegetable crops in which the edible portion touches the ground.

Remember that some types of animal manure have higher nitrogen contents than others (see Tables 1 and 2). These include horse, sheep, chicken, and rabbit manure. These are sometimes referred to as "hot" and are best used after composting. Cow and hog manures are considered "cold" because of their lower nitrogen levels.

Application

Composted manure can be broadcast and worked into fields or worked into rows and beds for various vegetable crops. A general recommendation for vegetable gardens is to broadcast poultry, sheep, cow, or horse manure at 25 to 100 pounds per 100 square feet (approximately 5 to 20 tons per acre). This amount may need to be supplemented with 1 to 2 pounds of a complete inorganic fertilizer such as 10-10-10. Organic growers can supplement with ground rock phosphate or raw bone meal to obtain phosphorus required (see below). For crops such as melons, squash, and cucumbers, composted manure can be worked directly into planting hills and mixed thoroughly with the soil.

Nutrient Contents

It is important to remember that nutrient contents in manure vary widely according to age of the animals, feed used, moisture content, degree of decomposition, and the amount of litter or bedding material mixed in with the manure. The only really accurate way of determining the nutrient content of the manure you are using is through laboratory analysis. You may need to adjust your application rates up or down according to what you know about the age, quality, and moisture content of the manure.

When buying or getting ready to spread manure, remember that moisture content greatly affects the total pounds of nutrients in a ton of material. For example, broiler manure at 25% to 30% moisture when removed from the house will contain about 34 pounds of nitrogen, 37 pounds of phosphate, and 31 pounds of potash per ton. But a ton of fresh manure at 75% moisture will contain only 27, 28, and 14 pounds of these nutrients, respectively. At 75% moisture you will be hauling around 1,500 pounds of water and only 500 pounds of solid material. Not all nutrients in manure are available to crops during the season of application. In poultry manure, for example, 90% of the N, most of the potassium, but only half of the phosphorus becomes available in the first year.

Because phosphorus in manure must decompose before it becomes available and because it is not very mobile in soil, broadcasting manure is not considered a very efficient

way of applying this element for establishment of vegetable crops. For poultry manure, phosphorus and potassium portions are considered to be about 50% to 75% as effective as they are in commercial fertilizers during the year of application; the remainder is released as the litter decomposes. Supplement manures with a complete inorganic fertilizer or with an organically approved material such as bone meal or ground rock phosphate.

How to Use and Convert Fertilizer Recommendations in this Publication

Plant nutrient requirements are provided in the "Fertilizer" tables under each crop in this publication. These nutrients are expressed in terms of the amounts of nitrogen (N), phosphorus or phosphate (P_2O_5), and potassium (K_2O) required by the crop. Amounts of phosphorus and potassium recommended vary according to what may already be present in the soil. For this reason, both conventional and organic growers should always have their soil tested, preferably in the fall or early spring. Soil test sample boxes and instructions are available from your county Extension office.

To calculate the amount of manure required for application on a sweet corn crop, for example, first find the suggested nutrient application rates in the "Fertilizer" table in the "Sweet Corn" chapter. **Warning:** Manure applications should never exceed the total nitrogen requirements of a crop in an attempt to satisfy phosphorus and potassium requirements—burning of the roots and leaves could occur.

Nitrogen First

We will choose nitrogen as our "priority" nutrient, which will be used to limit the total amount of manure to be used; i.e., we will calculate the manure requirements based only on the nitrogen recommendation. Although most manure high in nitrogen is also high in potassium (Tables 1 and 2), additional phosphorus may need to be obtained from other sources. Because soil and plant nitrogen tests are not widely used in Kentucky and because much of the nitrogen in soils is used or lost from one season to the next, we make a blanket recommendation of 80 to 100 pounds of N per acre for sweet corn preplant. When commercial fertilizers are used, this amount is applied before planting and is supplemented by a sidedressing of 40 to 50 pounds of N per acre when plants are about knee-high.

Consider the Source

Now consider the source, moisture content, and quality of the manure or organic material to be used. If we are using a dry or composted material containing little or no moisture, we should use Table 2 to make the necessary calculations.

Making Conversions

We have decided to use the lower N level of 80 pounds per acre because we feel our soil may still have some residual N from last year's bean crop that was grown on this plot. We have found a source of composted poultry manure and plan to use it as our nutrient source. To calculate the manure required to provide the required 80 pounds of nitrogen, look at Table 2 under poultry; the N content is 3.2%. Divide the 80 pounds by 3.2 = 25 and multiply the result by 100 = 2,500 pounds. This is the amount of poultry manure required to obtain the 80 pounds per acre of nitrogen recommended. To convert to tons, simply divide again by 2,000 (2,500 ÷ 2,000 = 1.25 tons).

In this example we will have obtained 80 pounds of nitrogen together with 130 pounds of phosphorus (P_2O_5) and 45 pounds of potassium (K_2O). The amount of P_2O_5, and K_2O are calculated for the 2,500 pounds of manure by multiplying 2,500 by the appropriate percentages in Table 2 and then dividing by 100. The amount of P_2O_5, for example, is 2,500 pounds x 5.2 = 13,000 divided by 100 = 130 pounds. For the amount of K_2O, multiply 2,500 pounds x 1.8 and then divide by 100 = 45 pounds.

Additional Phosphorus

Now suppose that the soil is very low in phosphorus and the soil test suggests applying 180 pounds of phosphorus. We have obtained 130 pounds of phosphorus from the poultry manure and need an additional 50 pounds, but we do not want to apply much more nitrogen.

Looking at Table 2 we decide to supply our phosphorus using raw bone meal, which is 22% P_2O_5 and 3% N. Dividing 50 pounds of P_2O_5 by 22 = 2.27 and multiplying by 100 = 227 pounds. Thus, 227 pounds of raw bone meal/acre will supply 50 pounds of P_2O_5. Performing a similar calculation for the N tells us that we will only obtain about 7 (6.8) pounds of N/acre using raw bone meal. Use this same means of calculation if additional potassium is needed.

Note: *Information in Tables 1 and 2 should be used only as guidelines. Nutrient contents for manures vary greatly. The figures represented are averages from a range of possible values.*

Table 1. Nutrients in FRESH animal manure.

Source	Water Content	Average Nutrient Composition (percent of fresh weight) N	P_2O_5	K_2O
Beef cattle	80	0.70	0.45	0.55
Dairy cattle	84	0.60	0.25	0.60
Horses	60	0.60	0.25	0.45
Hogs	75	0.50	0.35	0.65
Sheep	65	1.05	0.35	0.95
Laying hens	75	1.00	1.25	0.50
Broilers (litter)[1]	30	2.95	2.75	1.85

[1] *Some broiler producers use Roxarson and Nitarsone in their feed mixes as medications. Growers using litter containing these products cannot sell produce grown with this manure as certified organic in Kentucky.*

Table 2. Nutrient contents of DRY manures and organically approved fertilizer materials.

Source	Average Nutrient Composition (percent dry weight) N	P_2O_5	K_2O
Dairy cows	1.3	0.9	3.0
Feedlot cattle	1.7	1.2	3.0
Horse	2.3	0.9	1.7
Poultry	3.2	5.2	1.8
Sheep	3.5	1.4	3.5
Hogs	3.5	0.5	0.7
Goat	1.5	1.5	3.0
Rabbit	2.4	1.4	0.6
Tobacco stems[1]	1.5	0.5	7.0
Bat guano	10.0	2.0 to 4.0	0 to 2.0
Blood meal	13.0 to 14.0	2.0	1.0
Bone meal, raw	3.0	22.0	-
Bone meal, steamed	1.0 to 2.0	11.0 to 15.0	-
Cottonseed meal	6.0	0.4 to 3.0	1.5
Fish meal	10.0	6.0	-
Fish emulsion	5.0	2.0	2.0
Feather meal	12.0	0	0
Soybean meal	7.0	1.2	1.5
Tankage[1]	7.0	10.0	1.5
"Soft" rock phosphate	0	14.0 to 16.0	0
Greensand	0	0	3.0
Phytamin 800	7.0	0	0

[1] *Not cleared for certified organic production. Sewage sludge should not be used for vegetable crops because of possible heavy metal and E. coli contamination.*

Appendix I

Disinfection and Treatment of Vegetable Seeds

Hot Water Treatment (most vegetable seeds)

Seeds many vegetables can be soaked in hot water to reduce populations of seedborne bacteria and fungi. Germination may be reduced to some degree, so some experimentation with small seed lots should be carried out before treating large amounts of seed. Cucurbits other than cucumber may be severely harmed by hot water treatment and should be disinfected by other methods. In general, use fresh seed for this process, as research indicates that viability of older seed (more than 1 year old) is drastically reduced by treatment with hot water. Bacterial and fungal pathogens associated with the embryo will not be affected by hot water soaking (bacterial canker of tomato, for example, can infect the embryo of the tomato seed along with being associated with the seed coat), nor will TMV be eradicated.

Water temperature and soaking time differ by species (Table 1), and relatively tight control of temperature is critical to the success of this method. A water bath capable of holding temperature within a reasonable range is a required piece of equipment, along with a quality canning thermometer to monitor temperature. A 5-degree drop in ideal temperature may allow some pathogens to survive on seed, while a 5-degree increase in water temperature may kill some or all of the seed being treated. The same rigor should be observed for soaking time.

Guidelines published by the University of Illinois suggest that seed should be pre-warmed before beginning the actual hot water treatment. This can be done by placing seed in a weighted cheesecloth bag and soaking in 100°F water for 10 minutes. The bag may need to be squeezed to remove air bubbles—maximum contact of water and seed is critical.

For the next step, place the bag containing the pre-warmed seed into a water bath set to the temperature recommended for the vegetable seed being treated (Table 1). Water volume should be 5 to 10 times greater than the volume of seed being treated. For example, if you were treating approximately one cup of tomato seed, the capacity of the water bath should be 5 to 10 cups. Agitation of the water during the treatment cycle will help maintain a uniform temperature in the water bath. After the prescribed amount of time, remove seed and spread on paper towels to dry. A recommended seed treatment can then be applied to protect against soilborne pathogens.

Treatment of crops other than those listed may cause serious injury to seed.

Chlorine Bleach Treatment

Soaking seed in a solution of chlorine bleach has been shown to be effective in eradicating pathogens primarily borne on the surface of the seed, such as the bacteria that cause bacterial spot, speck, and canker of tomato. It is also reported that this method can also provide some control of seed-transmitted TMV. The soaking solution should be prepared by adding 1 quart of commercial bleach (sodium hypochlorite) to 3 to 4 quarts of water. Add a drop or two of dish detergent to decrease surface tension of the solution. Soak seed in solution for 1 minute, remove and rinse thoroughly with clean water. Spread seed on paper towels to dry. Seed can be treated with a recommended fungicide to protect against soilborne pathogens.

Trisodium Phosphate (TSP)

Tomato seed can be soaked in a 10% solution of TSP for 15 minutes to eradicate seed-transmitted TMV. Remove seeds, rinse, and spread evenly on paper towels to dry. Treat with approved fungicides if needed. Most home supply and paint stores carry TSP, which is used to clean walls and surfaces prior to painting and staining. As with the other methods, it is advisable to test this process on small batches of seed at first to make sure that there are no negative effects on germination.

Table 1. Recommended temperatures and soaking times for hot-water disinfection of selected vegetable seeds.

Vegetable Crop	Water Temp. (°F)	Soaking Time (min.)
Broccoli	122	20
Brussels sprout	122	25
Cabbage	122	25
Carrot	122	20
Cauliflower	122	20
Celery	118	30
Chinese cabbage	122	20
Collards	122	20
Cucumber	122	20
Eggplant	122	25
Garlic	120	20
Kale, Kohlrabi	122	20
Lettuce	118	30
Mint	112	10
Mustard, Cress, Radish	122	15
Onion (sets)	115	60
Pepper	125	30
Rape, Rutabaga	122	20
Shallot	115	60
Spinach	122	25
Sweetpotato (roots)	115	65
Sweetpotato (cuttings, sprouts)	120	10
Tomato	122	25
Turnip	122	20

Appendix J

Sprayer Calibration

To apply the right amount of material per acre, it is necessary to know how much liquid the sprayer is delivering per acre at a given speed and pressure. The following is a fast, simple method of calibrating a sprayer for broadcast application.

Ounce Calibrations Method:

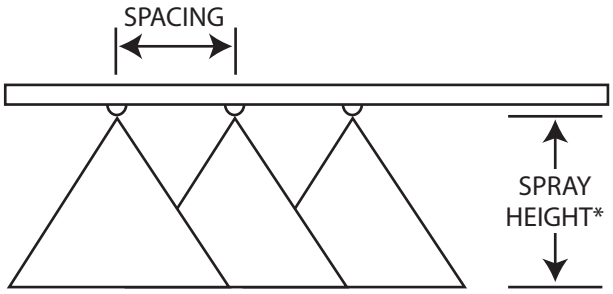
1. Using the spray calibration distance table, select the distance to catch discharge based on the row or nozzle spacing of your sprayer.
2. Measure that distance in the field to be sprayed.
3. Note the time in seconds spent to drive the measured distance at the desired throttle setting (constant speed).
4. Catch the nozzle discharge for the noted time (#3 above) in a measuring cup or other container graduated in fluid ounces.
5. The total discharge per row or nozzle spacing in fluid ounces is equal to the gallons per acre applied (at the constant speed used in #3).
6. Repeat for each nozzle or nozzle group to ensure equal distribution.

SPRAYER CALIBRATION (Distance)

Nozzle Spacing (inches)	Distance to Catch Discharge (feet)
40	102
38	107
36	113
34	120
32	127
30	136
28	146
26	157
24	170
22	185
20	204
18	227
16	255
14	291

TIP NO. (Strainer Screen Size)		Liquid Pressure in PSI	Capacity 1 Nozzle in GPM	Capacity 1 Nozzle in oz./ min.	GALLONS PER ACRE 20" SPACING				GALLONS PER ACRE 30" SPACING			
80° SERIES	110° SERIES				5 MPH	6 MPH	7 MPH	8 MPH	5 MPH	6 MPH	7 MPH	8 MPH
8001VS (100 Mesh)	11001VS (100 Mesh)	30	.09	11	5.1	4.3	3.7	3.2	3.4	2.9	2.5	2.1
		35	.09	12	5.6	4.6	4.0	3.5	3.7	3.1	2.6	2.3
		40	.10	13	5.9	5.0	4.2	3.7	4.0	3.3	2.8	2.5
		45	.11	14	6.3	5.3	4.5	3.9	4.2	3.5	3.0	2.6
		60	.12	15	7.3	6.1	5.2	4.6	4.9	4.0	3.5	3.0
80015VS (100 Mesh)	110015VS (100 Mesh)	30	.13	17	7.7	6.4	5.5	4.8	5.1	4.3	3.7	3.2
		35	.14	18	8.3	6.9	6.0	5.2	5.6	4.6	4.0	3.5
		40	.15	19	8.9	7.4	6.4	5.6	5.9	5.0	4.2	3.7
		45	.16	20	9.5	7.9	6.8	5.9	6.3	5.3	4.5	3.9
		60	.18	23	10.9	9.1	7.8	6.8	7.3	6.1	5.2	4.6
8002VS (50 Mesh)	11002VS (50 Mesh)	30	.17	22	10.3	8.6	7.4	6.4	6.9	5.7	4.9	4.3
		35	.19	24	11.1	9.3	7.9	6.9	7.4	6.2	5.3	4.6
		40	.20	26	11.9	9.9	8.5	7.4	7.9	6.6	5.7	5.0
		45	.21	27	12.6	10.5	9.0	7.9	8.4	7.0	6.0	5.3
		60	.25	32	14.6	12.1	10.4	9.1	9.7	8.1	6.9	6.1
8003VS (50 Mesh)	11003VS (50 Mesh)	30	.26	33	15.4	12.9	11.0	9.7	10.3	8.6	7.4	6.4
		35	.28	36	16.7	13.9	11.9	10.4	11.1	9.3	7.9	6.9
		40	.30	38	17.8	14.9	12.7	11.1	11.9	9.9	8.5	7.4
		45	.32	41	18.9	15.8	13.5	11.8	12.6	10.5	9.0	7.9
		60	.37	47	22	18.2	15.6	13.6	14.6	12.1	10.4	9.1
8004VS (50 Mesh)	11004VS (50 Mesh)	30	.35	45	21	17.2	14.7	12.9	13.7	11.4	9.8	8.6
		35	.37	47	22	18.5	15.9	13.9	14.8	12.3	10.6	9.3
		40	.40	51	24	19.8	17.0	14.9	15.8	13.2	11.3	9.9
		45	.42	54	25	21	18.0	15.8	16.8	14.0	12.0	10.5
		60	.49	63	29	24	21	18.2	19.4	16.2	13.9	12.1
8005VS (50 Mesh)	11005VS (50 Mesh)	30	.43	55	26	21	18.4	16.1	17.2	14.3	12.3	10.7
		35	.47	60	28	23	19.8	17.4	18.5	15.4	13.2	11.6
		40	.50	64	30	25	21	18.6	19.8	16.5	14.1	12.4
		45	.53	68	32	26	23	19.7	21	17.5	15.0	13.1
		60	.61	78	36	30	26	23	24	20	17.3	15.2
8006VS (50 Mesh)	11006VS (50 Mesh)	30	.52	67	31	26	22	19.3	21	17.2	14.7	12.9
		35	.56	72	33	28	24	21	22	18.5	15.9	13.9
		40	.60	77	36	30	25	22	24	19.8	17.0	14.9
		45	.64	82	38	32	27	24	25	21	18.0	15.8
		60	.74	95	44	36	31	27	29	24	21	18.2
8008VS (50 Mesh)	11008VS (50 Mesh)	30	.69	88	41	34	29	26	27	23	19.6	17.2
		35	.75	96	44	37	32	28	30	25	21	18.5
		40	.80	102	48	40	34	30	32	26	23	19.8
		45	.85	109	50	42	36	32	34	28	24	21
		60	.98	125	58	49	42	36	39	32	28	24

Sprayer Calibration Continued



*Adjust spray height in the field to overlap approximately 30% of each edge of pattern.

SUGGESTED MINIMUM SPRAY HEIGHT	
SPRAY ANGLE	SPRAY HEIGHT 20" SPACING
80º 110º	17-19" 10-12"

Flat Fan Spray Tips

8002VS	Stainless Steel with VisiFlo color coding
8002-HSS	Hardened Stainless Steel
8002-SS	Stainless Steel
8002	Brass

Tee Jet™ is a registered trademark of Spraying Systems Co. of Wheaton, Illinois.

Appendix K

Earliest and Latest Vegetable Crop Planting Dates in Kentucky

As every vegetable grower knows, a week earlier (or later) on the market can sometimes make the difference between a highly profitable crop and a net loss. Information in the following tables is provided as an aid to planning. Table 1 lists earliest and latest safe planting dates for various vegetable crops based on experiences of growers in eastern, central, and western Kentucky; however, these are not absolute and it is always possible for killing frosts to occur later or earlier than the range of dates provided. Frosts are greatly influenced by small variations in topography and microclimate, and growers can best judge for themselves how prone their fields are to early or late frosts.

Table 2 provides average dates for the latest frosts in spring and the earliest frosts in the fall. These dates are based on 30-year averages from the Kentucky weather stations listed. Find the nearest station location in the list and use the dates found in the same row. These dates represent a 90% probability (nine years out of 10) that the last frost (at or below 32°F) will occur on or before the date listed for "Latest Spring Frost" or a 90% probability that the first frost will occur on or after the date listed for "Earliest Fall Frost."

Use this information with caution; small differences in landscape and elevation can result in later frosts in spring and earlier frosts in the fall. Local experience will help determine the best planting dates for various crops at your location. If pushing the boundaries of these frost dates, it is recommended to have row cover on hand in case of an unexpected frost.

Table 1. Earliest and latest safe field planting dates for Eastern, Central and Western Kentucky.

Crops	Earliest Date[1]			Latest Date[1,2]		
	Eastern	Central	Western	Eastern	Central	Western
Asparagus (crowns)	Mar 20	Mar 15	Mar 10			
Beans (snap)	May 1	Apr 25	Apr 10	Jul 15	Jul 25	Aug 1
Beans (lima)	May 10	May 1	Apr 15	Jun 15	Jun 20	Jul 1
Beets	Mar 20	Mar 15	Mar 10	Aug 1	Aug 10	Aug 15
Broccoli (transplants)	Apr 5	Mar 30	Mar 25	Jul 15	Aug 1	Aug 15
B. Sprouts (transplants)	Apr 10	Apr 5	Mar 30	Jul 1	Jul 15	Aug 1
Cabbage	Apr 1	Mar 25	Mar 15	Jul 1	Jul 15	Aug 1
Carrots	Apr 1	Mar 20	Mar 10	Jul 1	Jul 15	Aug 1
Cauliflower (transplants)	Apr 10	Apr 5	Mar 30	Jul 15	Jul 20	Aug 5
Chard	Apr 1	Mar 20	Mar 15	Jun 15	Jul 15	Aug 1
Collards	Mar 15	Mar 10	Mar 1	Aug 15	Aug 20	Aug 30
Sweet Corn	May 1	Apr 20	Apr 10	Jun 15	Jul 10	Jul 20
Cucumbers	May 10	May 5	Apr 25	Jun 15	Jul 1	Jul 15
Eggplant (transplants)	May 15	May 10	May 1	Jun 1	Jun 15	Jul 1
Kale	Apr 1	Mar 20	Mar 10	Jul 15	Aug 1	Aug 15
Kohlrabi	Mar 25	Mar 20	Mar 15	Jul 15	Aug 1	Aug 15
Lettuce (leaf)	Apr 1	Mar 25	Mar 15	Aug 1	Aug 15	Sep 1
Lettuce (bibb plants)	Apr 1	Mar 25	Mar 15	Jul 15	Aug 1	Aug 15
Muskmelons	May 15	May 10	Apr 25	Jun 15	Jul 1	Jul 15
Okra	May 15	May 10	Apr 20	Jul 1	Jul 15	Aug 1
Onions (sets)	Mar 15	Mar 10	Mar 1			
Onions (transplants)	Apr 1	Mar 25	Mar 15	Jun 15	Jul 1	Jul 15
Onions (seed)	Apr 1	Mar 20	Mar 10	Jun 1	Jun 15	Jul 1
Parsley	Apr 1	Mar 20	Mar 10	Jul 15	Aug 1	Aug 15
Parsnips	Apr 1	Mar 20	Mar 10	Jun 1	Jun 15	Jul 1
Peas	Mar 15	Mar 1	Feb 20			
Peppers (transplants)	May 20	May 10	May 1	Jun 15	Jul 1	Jul 15
Potatoes	Mar 20	Mar 15	Mar 15	Jun 15	Jul 1	Jul 15
Sweetpotatoes	May 20	May 10	May 1	Jun 1	Jun 10	Jun 15
Pumpkins	May 10	May 5	Apr 25	Jun 1	Jun 15	Jul 1
Radishes	Mar 15	Mar 10	Mar 1	Sep 1	Sep 15	Oct. 1
Rhubarb (crowns)	Mar 15	Mar 10	Mar 1			
Southernpeas	May 10	May 5	Apr 20	Jun 15	Jul 1	Jul 15
Snow Peas	Mar 15	Mar 1	Feb 20	Jul 20	Aug 1	Aug 8
Spinach	Mar 10	Mar 1	Feb 15	Aug 15	Sep 1	Sep 15
Summer Squash	May 15	May 10	Apr 20	Jul 15	Aug 1	Aug 15
Tomatoes (transplants)	May 15	May 5	Apr 20	Jun 1	Jun 15	Jul 1
Turnips	Mar 15	Mar 10	Mar 1	Aug 1	Aug 10	Aug 20
Watermelons	May 15	May 5	Apr 20	Jun 15	Jul 1	Jul 15
Winter Squash	May 15	May 10	Apr 20	Jun 15	Jul 1	Jul 15

[1] Dates are for direct seeding unless otherwise indicated under "Crops" column.
[2] Based on the average time to harvest for early maturing varieties; mid-season and late-maturing varieties need to be planted 15 to 30 days earlier than latest date. Most fall-planted crops require irrigation.

Earliest and Latest Vegetable Crop Planting Dates in Kentucky Cont.

Table 2. Average frost dates in Kentucky.

Weather Station	Latest Spring Frost	Earliest Fall Frost
Eastern		
Ashland	May 21	Sep 28
Barbourville	May 8	Oct 9
Baxter	May 6	Oct 9
Grayson	May 17	Sep 28
Heidelberg	May 12	Oct 4
Hyden	May 12	Oct 4
London Corbin Airport	May 7	Oct 1
Manchester	May 17	Sep 25
Middlesboro*	May 11	Oct 4
Monticello	May 6	Oct 3
Mount Vernon	May 10	Oct 3
Somerset	May 7	Oct 2
Stearns	May 12	Sep 29
West Liberty	May 22	Sep 25
Williamsburg	May 8	Oct 5
Bluegrass		
Bardstown	May 6	Oct 3
Berea College	Apr 29	Oct 6
Carrollton Lock	May 4	Oct 8
Cincinnati/Covington	May 6	Oct 5
Covington	May 9	Oct 4
Cynthiana	May 8	Oct 6
Danville	Apr 26	Oct 13
Dix Dam	Apr 25	Oct 12
Falmouth*	May 10	Sep 24
Farmers 2 S	May 10	Sep 30
Frankfort (Lock 4)	May 3	Oct 6
Lexington (Blue Grass Airport)	Apr 28	Oct 10
Maysville Sewage Plant	May 7	Oct 7
Mount Sterling	May 5	Oct 9
Shelbyville	May 14	Sep 22
Warsaw Markland Dam	May 9	Oct 3
Williamstown	Apr 26	Oct 6

Table 2. Continued

Weather Station	Latest Spring Frost	Earliest Fall Frost
Central		
Barren River Lake	Apr 29	Oct 5
Berheim Forest	May 12	Oct 2
Bowling Green	Apr 26	Oct 8
Bradfordsville	May 10	Sep 30
Cambellsville*	Apr 30	Oct 5
Glasgow	Apr 28	Oct 6
Greensburg	May 2	Oct 6
Hodgenville-Lincoln	May 2	Oct 6
Jamestown	Apr 28	Oct 9
Leitchfield	May 6	Oct 3
Louisville Airport	Apr 21	Oct 15
Mammoth Cave	May 10	Oct 1
Nolin River Lake	May 13	Sep 29
Rough River Lake	May 11	Sep 26
Scottsville	Apr 19	Oct 11
Summer Shade	May 6	Oct 4
Western		
Bardwell	Apr 21	Oct 3
Beaver Dam	Apr 28	Oct 3
Gilbertsville	Apr 17	Oct 16
Golden Pond	Apr 18	Oct 11
Henderson	Apr 20	Oct 7
Hopkinsville*	Apr 22	Oct 4
Lovelaceville	Apr 28	Oct 3
Madisonville	Apr 24	Oct 6
Mayfield	Apr 25	Oct 7
Murray	Apr 17	Oct 10
Owensboro*	Apr 23	Oct 5
Paducah (Barkley Regional Airport)	Apr 21	Oct 9
Princeton	Apr 25	Oct 6
Rochester Ferry	Apr 24	Oct 5
Russellville	Apr 26	Oct 6

**Weather station had missing data. Dates were estimated using data from surrounding stations.*

Appendix L

Relative Efficacy of Insecticides Against Common Arthropod Pests of Vegetable Crops in the Southeastern United States

Not all insecticides listed below are registered on all vegetable crops—check the label before applying to a specific crop.

Chemical class (IRAC)	Common name	Example Product	Greenhouse use	Flea beetles	Colorado potato beetle*	Cucumber beetles	Corn earworm*	European corn borer	Fall armyworm	Cabbage looper	Imported cabbageworm	Diamondback moth*	Squash vine borer	Beet armyworm*	Stink/Harlequin bugs	Squash bug	Aphids*	Thrips	Western flower thrips	Maggots	Whiteflies*	Cutworms	Wireworms	White grubs	Spider mites*	Broad mite
1A	carbaryl	Sevin		3	1	2	1	2	1	1	2	1	1	x	x	x	x	1	x	x	x	1	x	x	x	x
	methomyl	Lannate		1	x	x	2	2	2	2	2	2	x	1	2	2	1	3	2	x	x	x	x	x	x	x
1B	malathion	Malathion		2	1	2	1	1	1	1	2	1	1	x	1	1	1	1	x	1	x	1	x	x	x	x
	acephate	Orthene	No	x	x	x	1	3	2	1	2	x	x	x	x	x	2	2	x	x	x	2	x	x	x	x
	diazinon	Diazinon	No	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	2	x	1	2	1	x	x
	dimethoate	Dimethoate		2	x	1	x	x	x	x	x	x	x	x	2	1	3	3	2	x	x	x	x	x	x	x
3	permethrin	Pounce		2	1	2	2	2	1	2	3	1	3	x	1	2	1	1	x	x	x	2	x	x	x	x
	alphacypermethrin	Fastac		2	1	2	2	2	2	2	3	1	3	x	2	2	1	1	x	x	x	2	x	x	x	x
	zeta cypermethrin	Mustang Maxx		3	1	3	2	3	2	2	3	1	3	x	2	3	1	1	x	x	x	3	x	x	x	x
	beta cyfluthrin	Baythroid		3	1	3	2	3	1	2	3	1	3	x	2	3	1	1	x	x	x	3	x	x	x	x
	lambda cyhalothrin	Warrior		3	1	3	2	3	2	2	3	1	3	x	2	3	1	1	x	x	x	3	x	x	1	x
	esfanvalerate	Asana XL		2	2	2	2	2	1	2	3	1	2	x	1	2	1	1	x	x	x	2	x	x	x	x
	gamma cyhalothrin	Proaxis		3	1	3	2	3	2	2	3	1	3	x	3	3	1	1	x	x	x	3	x	x	x	x
	fenpropathrin	Danitol		2	x	2	2	2	1	1	3	1	2	x	3	3	1	1	x	x	X	2	x	x	1	x
	bifenthrin	Brigade/Capture		3	1	3	2	2	1	1	3	1	3	x	3	3	1	1	x	1	x	3	2	1	1	x
4A	imidacloprid	Admire		1	2	3	x	x	x	x	x	x	x	x	1	2	3	2	x	2	2	x	1	2	x	x
	acetamiprid	Assail		2	3	2	x	x	x	x	x	x	1	x	1	2	3	2	x	x	2	x	x	x	x	x
	clothianidin	Belay		3	3	2	x	x	x	x	x	x	x	x	2	2	2	x	x	2	1	x	1	2	x	x
	thiamethoxam	Platinum/Actara	No	3	2	2	x	x	x	x	x	x	x	x	2	2	3	1	x	2	2	x	1	1	x	x
	dinotefuran	Venom/Scorpion		3	3	2	x	x	x	x	x	x	x	x	3	3	1	2	x	x	2	x	x	x	x	x
4C	sulfoxaflor	Closer/ Transfrom	No	x	x	x	x	x	x	x	x	x	x	x	1	x	3	x	x	x	1	x	x	x	x	x
4D	flupradifurone	Sivanto Prime	No	x	x	x	x	x	x	x	x	x	x	x	x	2	3	x	x	x	3	x	x	x	x	x
5	spinosad	Blackhawk/Entrust	No	x	3	x	2	2	2	2	3	2	2	2	x	x	x	2	2	x	x	1	x	x	x	x
	spinetoram	Radiant	No	x	3	x	3	3	2	2	3	2	2	2	x	x	x	3	2	x	x	1	x	x	x	x
6	emamectin benzoate	Proclaim	No	x	x	x	2	2	2	3	3	3	2	3	x	x	x	x	x	x	x	1	x	x	1	x
	abamectin	AgriMek		x	3	x	x	x	x	x	x	x	x	x	x	x	x	2	1	x	x	x	x	x	3	3
7C	pyriproxyfen	Knack/Distance		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	2	x	x	x	x	x
9a	pyrifluquinazon	PQZ		x	x	x	x	x	x	x	x	x	x	x	x	x	3	x	x	x	2	x	x	x	x	x
9B	pymetrozine	Fulfill		x	x	x	x	x	x	x	x	x	x	x	x	x	3	x	x	x	1	x	x	x	x	x
10B	etoxazole	Zeal		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	2	x
11A	Bt	Dipel, various		x	x	x	1	1	1	2	3	1	1	1	x	x	x	x	x	x	x	x	x	x	x	x
		XenTari		x	x	x	1	1	1	2	2	2	1	2	x	x	x	x	x	x	x	x	x	x	x	x
15	novaluron	Rimon		x	3	x	3	3	3	2	3	1	2	3	1	1	x	2	2	x	1	x	x	x	x	x
16	buprofezin	Courier		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	2	x	x	x	x	x
18	methoxyfenozide	Intrepid		x	x	x	2	2	3	3	3	1	2	3	x	x	x	x	x	x	x	x	x	x	x	x
20B	acequinocyl	Kanemite		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	3	3
20D	bifenazate	Acramite/Floramite		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	3	x
21A	fenazaquin	Magister		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	1	x	x	x	2	2
	fenpyroximate	Portal		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	1	x	x	x	2	2
	tolfenpyrad	Torac		2	x	x	1	1	1	1	2	x	x	1	x	x	2	2	1	x	1	x	x	x	x	2
22A	Indoxacarb	Avaunt eVo		1	2	1	3	2	2	3	3	2	2	3	x	x	x	x	x	x	x	1	x	x	x	x
23	spiromesifen	Oberon		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	1	x	x	x	2	2
	spirotetramat	Movento	No	x	x	x	x	x	x	x	x	x	x	x	x	x	2	x	x	x	1	x	x	x	1	x
25	cyflumetofen	Nealta	No	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	2	x
28	rynaxypyr	Coragen		x	3	x	3	3	3	3	3	3	2	3	x	x	x	1	x	x	3	1	x	x	x	x
	cyantraniliprole	Exirel/Verimark	No	2	3	x	3	3	3	3	3	3	2	3	x	x	2	1	1	2	3	x	x	x	x	x
	cyclaniliprole	Harvanta	No	1	3	x	3	3	3	2	3	3	2	3	x	x	x	1	1	x	1	x	x	x	X	x
29	flonicamid	Beleaf		x	x	x	x	x	x	x	x	x	x	x	x	x	3	2	3	x	1	x	x	x	x	x

** Resistance may exist in some areas | x = Ineffective or insufficient data | 1 = Somewhat effective | 2 = Effective | 3 = Very Effective*

Notes

Notes

Notes

Pesticide Emergency Telephone Numbers

Pesticide Spills

If you have a pesticide spill and need information on how to handle this type of emergency, call:

911

and

Kentucky Environmental Response Team

(800) 928-2380

or

(502) 564-2380

Pesticide Exposures

If someone has been exposed to a particular pesticide, provide the physician with the following emergency number, which is designed to provide pharmacological information on pesticides to health professionals.

Kentucky Regional Poison Center

(800) 222-1222

In Metro Louisville, call:

(502) 589-8222

National Pesticide Information Center

(800) 858-7378

Provides general and scientific information on pesticides. This center operates seven days a week from 6:30 am to 4:30 pm Pacific Time excluding some holidays.

Cooperative Extension Service

Agriculture and Natural Resources
Family and Consumer Sciences
4-H Youth Development
Community and Economic Development

MARTIN-GATTON COLLEGE OF AGRICULTURE, FOOD AND ENVIRONMENT

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