

# Dealing with Chemical Injury in Tobacco

*Gary Palmer, Andy Bailey, and J. D. Green, Department of Plant and Soil Sciences*

Chemical injury to tobacco can come from many sources, and any of these could result in reduced yield and quality or reduce marketability of the cured leaf:

- using unlabeled pesticides
- misapplication of labeled pesticides
- contaminated sprayers
- drift from pesticides applied to adjacent fields
- carry-over from pesticides sprayed on previous crops
- use of pesticide-contaminated water for irrigation
- water and soil runoff from treated fields
- trailers or wagons contaminated with non-tobacco pesticides used to haul transplants to the field.

## Pesticide Labels

Pesticide labels are designed to provide specific instructions that can prevent injury to crops near the intended target. They will warn of potential drift to sensitive crops and indicate other potential hazards. Some chemicals may require a waiting period before sensitive rotational crops like tobacco can be planted.

## Equipment Considerations

### Nozzles and Sprayers

Often little regard is given to sprayer nozzles from year to year. If inappropriate nozzles are used for pesticide application, they may cause irregular application, be more susceptible to drift, or produce excessive residues. It is often undesirable to use one set of nozzles for applications of different pesticides. Using the appropriate nozzles will assure better coverage and therefore better control. As a general rule, flat fan nozzles are recommended for most broadcast applications of herbicides. However, other nozzles may be more ap-



Tobacco fields with chemical drift damage like that above may recover or, as the case with some pesticides, may suffer permanent damage.

## Avoiding Chemical Injury

- Read all pesticide labels carefully, particularly restrictions regarding application rate, method, timing, maximum number of applications allowed per season, tank mixing, crop rotational intervals, and applications made near sensitive crops.
- Use appropriate nozzles and calibrate sprayers.
- Avoid planting in areas with potential for drift.
- Do not use fertilizer buggies that also may contain pesticide residue from impregnated fertilizer intended for other crops such as corn.
- Avoid nurse tanks that may have contained chemical mixtures.
- Clean sprayer between applications of potentially harmful chemicals and after last sucker control applications.
- Avoid irrigation water near roadways, railroad lines, and power lines.
- Dedicate a sprayer for tobacco use only.

propriate for spot spraying and for general weed control. Hollow cone nozzles are recommended for most insecticide and fungicide applications to ensure good coverage. Solid cone nozzles are now

recommended for sucker control applications instead of the old standard hollow cone nozzles which produce a mist that is too fine for proper rundown of the sucker control chemicals.

A sprayer should also be calibrated so that the rate of application can be assured. Proper application rates prevent potential crop injury and excessive residues and ensure optimum efficacy.

## Fertilizer Buggies

Most fertilizer dealers have fertilizer buggies that are designated for tobacco use only. Fertilizer buggies that have been used for spreading fertilizer impregnated with atrazine or other herbicides are a potential source of chemical injury in tobacco. Make sure that any fertilizer buggy used for spreading tobacco fertilizer is not contaminated with any other herbicide.

## Nurse Tanks

Nurse tanks used to fill transplanter tanks and spray tanks for tobacco production are potential sources of chemically contaminated water. Nurse tanks that have contained clean water only are advised.

If left unattended, nurse tanks can become contaminated accidentally by a back siphon from a spray tank containing pesticides. Nurse tanks filled from pesticide-contaminated water sources may be hard to decontaminate.

## Avoiding Pesticide Drift

Common sense should be used when planting tobacco. Consider potential applications that might be made to other crops in the area that could pose a drift hazard. Planting tobacco a row away from Roundup Ready® crops or crops that routinely receive treatments of growth regulators such as 2,4-D or dicamba is asking for trouble.

Tobacco is particularly sensitive to some herbicides and should be planted a considerable distance from crops that will be sprayed with those products. Because of the potential drift concerns, tobacco should be planted a reasonable distance away from rights-of-way that are routinely

sprayed to control brush or other vegetation. Fields located downwind from these situations may be at greater risk compared with those located upwind.

## Irrigation Water

Irrigation water could potentially contain harmful levels of chemicals due to runoff from agricultural use or from rights-of-way that are routinely sprayed to control brush or other vegetation. Testing the water is an option and could prevent costly damage to the crop.

Careful assessment of the area around irrigation sources may provide some level of assurance that drainage areas near the source have not been sprayed. On-farm ponds well away from crops or rights-of-way should be a safer source of irrigation water than those located near these areas. Chemical weed control in pastures that drain into irrigation ponds should be avoided.

## Pesticide Carry-Over

Chemical damage to tobacco crops is common where applications of other pesticides precede applications made to a tobacco crop using the same sprayer. A routine cleaning of spray equipment between applications should help prevent chemical injury. For example, in years where tobacco crops are variable in size, sucker control treatments containing maleic hydrazide (MH) may be applied to one crop prior to an application of an insecticide to a much smaller crop. Small amounts of sucker control chemicals left in the sprayer can cause considerable damage to tobacco that is too small for sucker control applications. This applies also to crops sprayed the following year when the last spray the previous year was an application of MH. Any amount of residual MH left in the tank can potentially harm the next crop that is sprayed.

Dedicating a sprayer only for tobacco use will reduce potential chemical injury but will not always eliminate problems. Some chemicals used in tobacco production can cause injury if sprayed at the wrong time. The potential from MH has been mentioned, but Spartan is another example of a potential problem. If the sprayer is not thoroughly cleaned, residual chemical left in a sprayer from a pre-plant application of Spartan can injure tobacco when the sprayer is used for a post-transplant application of another pesticide.

In addition, never use sprayers that are primarily used to control broadleaf weeds in fencerows or for other general broadleaf weed control. Follow label directions for specific information on cleaning sprayer equipment.

## Evaluating Chemical Injury

Chemical injury to tobacco can come from many sources, but the most common is from herbicides. However, excessive rates or high concentrations of other pesticides or fertilizers can also cause leaf damage. Rule out disease, nutrient, or environmental problems first, if possible, by comparing symptoms to known disease symptoms, checking soil pH, and considering recent weather events. If an herbicide is suspected, compare symptoms to weed species growing within the damaged area. When looking outside of the crop area, realize that leaf distortion in vegetation is common and could be caused by insect feeding or other natural phenomena.

Some of the most common chemical injury symptoms seen in tobacco are due to drift from spray applications made to nearby crops or unwanted vegetation. Chemicals from the following classes are frequently to blame: growth regulators or synthetic auxins, triazines, acetolactate synthase inhibitors (ALS-type), glyphosate, and chlorophyll inhibitors.

## Growth Regulators or Synthetic Auxins

Growth regulators or synthetic auxins are used for weed control in crops and as broadleaf control on pastures and rights-of-way. They include phenoxys like 2,4-D, benzoic acids like dicamba (Banvel, Clarity, etc.), and pyridine carboxylic acids like picloram (Tordon and various) and triclopyr (Garlon, Remedy and others), or combinations of these and similar products.

Symptoms may include any combination of the following: strappy leaves, thickened leaves, exaggerated leaf tip, ruffled leaf edges, “cobra-head” effect near the leaf tip, twisting of the stalk, and thickened main stem.

Symptoms may range from being restricted to those leaves developing at the time of exposure (as is the case with 2,4-D) to persisting through the growth of the plant causing extensive damage (as is common with picloram).

## Triazines

Triazines are used primarily in corn production and include atrazine and simazine. Symptoms from root uptake of triazine herbicides are generally more pronounced between secondary veins and are comprised of light brown dead leaf tissue on older leaf tissue. Yellow or dead leaf tissue occurring along the margins of leaves is also a typical symptom of triazine injury in tobacco. Secondary veins may retain some yellow or green tissue along the vein.

Tobacco rotated into a field that was in corn the previous year where a triazine herbicide such as atrazine was used should be tested for the presence of triazine in the early spring prior to planting. A soil sample with less than 0.05 ppm of total triazine



Injury from triazines.

Source: *Burley Tobacco Field Manual*, R.J. Reynolds Tobacco Company.



Injury from growth regulators or synthetic auxins.



Injury from acetolactate synthase inhibitors.

residue would indicate that it is safe to plant tobacco. Residue levels between 0.05 and 0.19 ppm would indicate a potential for injury, but symptom development might depend on weather conditions. Levels at 0.2 ppm and above indicate that injury is likely, and tobacco should not be planted. Instructions for submitting a sample for a triazine test are available through your local county Extension office. Symptoms of foliar uptake from drift or direct sprays may look similar to those of a contact herbicide.

## Acetolactate Synthase Inhibitors (ALS-Type)

Acetolactate synthase inhibitor (ALS-type) herbicides include products such as Accent, Beacon, Exceed, Lightning, Pursuit, and several others. Symptoms can vary depending on the type of exposure. A spray drift can cause restriction of the main leaf stem causing the leaf to have a ruffled appearance at the base.

A mottled appearance in which bright yellow spots may appear on leaves where spray droplets contacted the leaf surface is another indication of ALS injury.

Carry-over from a previous crop, while less common, may result in clubbed roots. In most cases, tobacco can recover without significant loss unless a more direct spray drift has occurred.

## Glyphosate

Glyphosate (Roundup and others) is used as a non-selective broad-spectrum weed control herbicide in grain crops or for general weed control on fencerows and as a spot spray for johnsongrass.

Symptoms on tobacco include bands of light yellow to almost white and small white spots along leaf veins (see detail arrow on following figure). These symptoms can be confused with other herbicide products such as clomazone (Command) or mesotrione (Callisto).



Injury from glyphosate.

**Chlorophyll Inhibitor**

Chlorophyll inhibitors like Callisto control broadleaf and certain grass weeds in corn. Callisto is quickly translocated and inhibits an enzyme that is essential to photosynthesis and plant growth. The general appearance is a whitening or chlorosis of the leaf tissue which may be confused with glyphosate or Command damage. (See Command under “Injury from Chemicals Labeled for Tobacco Use” below.)



Callisto damage in tobacco can look like glyphosate injury.

**Herbicides That Cause Contact Injury**

Herbicides that cause contact injury may produce similar symptoms. Gramoxone is used as a burn-down, contact-type chemical primarily in no-till production, which can also include no-till tobacco. Symptoms are generally confined to white spotting where spray droplets contact the leaf but could be typical contact burn if the tobacco suffered a more direct spray. Aim is another contact-type chemical that can cause damage to tobacco growing near sprayed areas.

For more information regarding mode of action, symptomology, weed control spectrum, and use of these and other herbicides, consult Kentucky Cooperative Extension publication AGR-6, *Chemical Control of Weeds for Kentucky Farm Crops*. Always read labeling prior to use of these or other pesticides.

**Injury from Chemicals Labeled for Tobacco Use**

Not all chemical injury is from pesticides intended for other crops or non-cropland uses. Chemicals used in tobacco may cause some crop injury to tobacco under these conditions:

- if applied at higher than labeled rates,
- if spray overlap occurs in the field, or
- if method or timing of application is different from that specified on the product label.

**Herbicides**

**Prowl** controls annual grasses and certain broadleaf weeds in tobacco. The main symptom to look for is restricted and nubby roots which may cause stunting. Symptoms are more common when plant roots are transplanted into the treated zone. Incorporation of the her-



Aim contact injury drift versus Gramoxone direct contact.

bicide deeper than 2 inches, excessive application, and cool soils can contribute. Tobacco has good tolerance and should recover.

**Command** controls broadleaf weeds and annual grasses in tobacco. Misapplication or excessive rainfall soon after application can cause the leaves of newly set tobacco to turn white. Tobacco is highly tolerant to this damage and should recover quickly.

**Spartan** controls broadleaf weeds, including morningglories, and yellow nutsedge in tobacco. Misapplications or overlapping spray patterns may cause damage to lower leaves. Leaves may appear spear-shaped rather than the characteristic lobe shape. Leaf etching is common with small dead spots that may coalesce to form larger spots that may fall out leaving a ragged appearance. Tobacco usually recovers very quickly and can tolerate all but the most severe damage. Tobacco exposed to a direct application of Spartan from a contaminated sprayer after

setting will exhibit the same foliar burning as would be expected from a contact-type herbicide. Spartan injury to tobacco may also occur following a heavy rainfall soon after transplanting. Heavy rainfall can splash soil containing Spartan onto lower leaves of young plants. This “splash” injury will look similar to the burning injury that would occur from a direct application.

### Fungicides

**Actigard** controls blue mold in tobacco but can cause plants to take on a yellow cast. This is a temporary yellowing as the tobacco is induced to resist blue mold. Do not spray this fungicide on tobacco that is less than 18 inches tall to reduce the chance of stunting.

**Quadris** has had specific exemptions for use in tobacco to control frogeye leaf spot and target spot. *Check current labeling prior to the use of this product in tobacco.* Quadris can cause a flecking on tobacco leaves similar to that caused by ozone and other air contaminants. Spots range in

size from pinpoint to slightly larger than ¼ inch in circumference and vary in color from a dull white to shades of olive brown. The degree of spotting appears to be influenced by weather conditions but does not affect yield or quality. Flecking injury following a Quadris application is more pronounced and much more common on burley tobacco than on dark tobacco.

**Ridomil** or **Ultra Flourish** is used for black shank control in tobacco and does not cause any damage if used as directed by the label. However, if misapplied in transplant water, tobacco may be stunted by high rates and may yellow between secondary veins. Dry conditions at transplanting also increase the chance for damage.

### Sucker Control Chemicals

Maleic hydrazide (MH) is a systemic tobacco sucker control chemical. MH is most damaging to tobacco when it accidentally comes in contact with a crop at a stage earlier than normally recommended. Leaves of exposed plants are typically very narrow and strappy in appearance. This may be referred to as Frenching. Although Frenching may



Command injury.



Yellowing from Actigard.



Spartan injury.



Quadris flecking.



a.



b.

MH injury: a) early season. b) late season.

cause tobacco to produce strappy leaves, it generally has other symptoms that can distinguish it from MH damage. MH levels that exceed labeled rates or MH that is applied multiple times can cause excessive bronzing and burning along margins of upper leaves, leaf deterioration, and unacceptable residue on the cured leaf. Reducing the rate and applying it in combination with other sucker control chemicals should improve control and reduce injury and residues.

Local systemics including Prime+, Butralin, and Flupro are most often used in combination with MH for sucker control. They must come in contact with the sucker bud for control. Application made to a small leaf may cause some leaf distortion as that leaf expands. These symptoms are more common in flue-cured and dark tobacco than burley. Excessive application of these products can damage cover crops planted after the tobacco is removed.

Contact sucker control products or fatty alcohols including Off-Shoot T, Royal Tac M, Fair 85, Sucker Plucker, and others contain C8 and/or C10 fatty alcohols that physically burn young sucker growth at each leaf axil where the spray solution touches. Contacts are generally the safest type of sucker control material used

on tobacco. However, contact materials used at higher than recommended rates can burn the entire leaf axil and cause leaf drop. This is usually more of a concern in dark tobacco where contacts are applied as a stalk rundown using drop lines or hand sprayers. Avoid temperatures in excess of 90°F to reduce the chance of leaf drop when using fatty alcohols. Recommended rates for most contact sucker control products are 2 to 2.5 gal. per 50 gal. water (4 to 5% solution). Consult specific label instructions before applying a fatty alcohol.

### **Injury Mistaken for Chemical Injury**

Herbicides labeled for use in tobacco are often blamed for injury caused by other things. Manganese toxicity causes many symptoms that can be mistaken for chemical injury. At low pH, manganese in the soil solution becomes available to the plant at toxic concentrations; proper liming of soils according to soil tests and fertilization programs within recommended levels of nitrogen will largely prevent manganese toxicity. Tobacco may appear stunted and turn a pale or yellow color with secondary veins remaining green.

Maintaining a good soil pH (6.4-6.6) can avoid some herbicide persistence issues. Soils that are too acidic (<5.0) may increase persistence of some herbicides (Lightning, Pursuit, etc.), while a pH above 7.0 may cause greater persistence of other herbicides (Atrazine, Accent, Beacon, and Exceed).

Discing ground when it is too wet will result in a shallow “traffic pan” (compaction layer). Tobacco root growth will be confined to a depth of 4 to 6 inches, thereby keeping a high percentage of the roots in a chemically treated zone, increasing the likelihood of injury and making the plant more prone to drought stress.

Black root rot can cause stunting of tobacco and may produce patterns that are characteristic of chemical injury. Black root rot may cause tobacco to exhibit undulating or uneven growth within rows. In other situations, one row may be stunted beside rows on either side that are more normal in size, or outside rows may be normal while the rest of the tobacco is stunted. This may lead producers to believe that the stunted row received a double dose of chemical or that the outside row did not get as much chemical. However, if the field was enlarged from the previous year, the tobacco in that area will be essentially in new soil that may have less black root rot inoculum and, therefore, less stunting.



Local systemic leaf distortion.



Manganese toxicity.

## **Implications of Pesticide Residue on Tobacco**

Prior to the Fair and Equitable Tobacco Reform Act (FETRA) of 2004, tobacco producers were required to sign form MQ-38 which certified that the producer had used only labeled chemicals in accordance with their label directions for the production of their tobacco. Producers could legally sign MQ-38 even if drift from a neighbor had damaged the crop. There still was a possibility of the crop being rejected if chemical contamination was detected visually or by residue analysis. Now, there is more emphasis on accountability, traceability, and crop integrity.

A crop with chemical damage may be rejected by tobacco companies if they know that it has been exposed to an unlabeled product. Some of the chemicals that accidentally find their way into a crop may or may not leave lasting residue or symptoms of the exposure. Failing to disclose exposure to the buyer could have repercussions if the residue is detected after marketing the crop or if symptoms are noticed during the sale.

If legal action is considered by the producer of a damaged crop, the damaged crop must be maintained as if it is normal until all legal settlements have been determined. Failing to do so could lead to accusations of crop abandonment. If the courts decide that the main damage was due to neglect by the producer, the producer may not get any compensation for the loss suffered due to chemical dam-

age. Any production practice that is not considered a normal practice may be alleged to contribute to the damage, reducing the chance for a fair settlement. The use of illegal pesticides by the producer can totally derail any claims that damage from another chemical drift reduced the marketability of the crop. In this case, the crop was technically unmarketable after the first illegal pesticide application.

Good production practices such as choosing the right variety for the disease potential, maintaining good soil pH levels, proper fertilization, good weed control, proper time of transplanting, and good topping and harvesting practices all aid in securing a proper and fair settlement when litigation is necessary.

Mention or display of a trademark, proprietary product, or firm in text or figures does not constitute an endorsement and does not imply approval to the exclusion of other suitable products or firms.