



PRODUCTION OF SWEET SORGHUM FOR SYRUP IN KENTUCKY

*Morris J. Bitzer, Grain Crops Extension Specialist
Part one of a two-part series*

Sweet sorghum syrup has been produced in the United States since colonial days. Some sweet sorghum syrup has at one time or another been produced in every one of the contiguous 48 states. Sweet sorghum is grown extensively for syrup production in the southeastern states. Kentucky is one of eight states in the Southeast and Midwest producing about 90% of the total U.S. output.

The first statistical record of sorghum syrup produced in Kentucky was in 1899 when 21,982 acres were grown and 1,277,206 gal of syrup were produced. From 1937-1946, average sweet sorghum acreage in Kentucky was 13,000 acres with a syrup production of 875,000 gal at an average value of \$1.50/gal. During the years 1949-1958, only 4,000 acres were grown annually and by 1960, acreage had decreased to 2,000 acres. The value of syrup in 1960 was about \$2.50/gal. This downward trend continued until 1972, when sugar prices greatly increased. From fewer than 500 acres in 1972, acreage has steadily increased to over 3000 acres in 1994. At an average of \$18/gallon and 150 gallons per acre, sweet sorghum syrup produced in Kentucky in 1994 was worth over \$8 million; yet the current acreage is estimated to be just over one-half of Kentucky's potential.

Most of the syrup for the commercial market is produced by relatively small or intermediate-size producers who sell in their local regions. The average producer grows 1 to 2 acres with the largest Kentucky producers growing over 30 acres. Community projects involving one or more counties are becoming more common. The syrup for an entire community is processed at a central plant that is owned by an individual, corporation, or cooperative. Although the acreage is small, sweet sorghum constitutes a meaningful cash crop capable of netting over \$2000/acre for most of its producers.

The name "sweet sorghum" is used to identify varieties of sorghum, *Sorghum bicolor* (L.) Moench, that are sweet and juicy. Sweet sorghum is grown for syrup or forage, whereas some other sorghums, such as kafirs and milos, are grown for grain. The term "sorghum molasses" is a colloquial expression incorrectly applied to sorghum syrup. Molasses is a by-product of the sugar crystallization from sugarcane juice.

The primary objective for growing sweet sorghum for syrup is to obtain the highest possible yield of good-quality syrup at the lowest cost. Yield and quality of syrup are influenced by varieties, diseases, insects, weeds, soil-type, climatic conditions, cultural practices, and processing methods.

Sweet Sorghum Varieties Best Adapted to Kentucky

The best sweet sorghum varieties for your farm should have the following desirable characteristics: (1) produce a high yield of medium to large stalks per acre, (2) have strong, erect growth so it will not readily lodge, (3) contain a high percentage of extractable juice, (4) contain juice with a high total soluble solids (Brix) content, mostly sugars, (5) resist diseases, (6) tolerate drought, (7) tolerate excessive water, and (8) produce a high-quality syrup. Varieties will differ greatly in these qualities and in their adaptation to various soil and climatic conditions.

Most varieties are susceptible to one or more of the sweet sorghum diseases prevalent in Kentucky. These diseases are a serious problem of the older varieties that have been grown for several years. A good variety should be resistant to Kentucky's major sweet sorghum diseases: leaf anthracnose, stalk red rot, and maize dwarf mosaic. Diseases can cause losses that range from a slight reduction in yield and quality of syrup to a total crop loss.

A desirable variety will produce high-quality syrup that has a light-amber color, a mild, sweet flavor (little or no tang), a high viscosity with a low starch content, and no or limited crystallization. It should also mature and be ready for harvest well in advance of the first killing frost. Select a variety that is adapted to the growing season in your area. Most of the new and improved varieties recently released possess most of the above characteristics. However, since most of the recently released varieties were bred in Mississippi, some of these varieties mature too late for our area. The most recently released variety that is best adapted to growing conditions in Kentucky is Della.

Della, a mid-season variety with good disease resistance, was developed by Bob Harrison, Virginia Polytech-

nic Institute, and released in December 1991. Della matures about one week earlier than Dale and about 6 days later than Sugar Drip. Della is a backcross of Dale to an earlier maturing line. It is resistant to anthracnose and maize dwarf mosaic and is moderately susceptible to bacterial stripe. Della does not resist lodging as much as Dale and is more variable in plant height. It is similar to Dale in syrup quality. The biggest advantage of Della is that it matures one week earlier than Dale and thus would let you start cooking a little earlier in the fall.

Dale, a mid-to-late season variety with superior disease resistance, was developed at the U.S. Sugar Crops Field Station, Meridian, Miss. Dale matures about 3 weeks earlier than the older varieties, Sart and Wiley, which are late for Kentucky, and about 14 days later than Sugar Drip. Dale is resistant to leaf anthracnose, stalk red rot, and maize dwarf mosaic. The medium-sized stalks of Dale grow upright and straight and are covered with a waxy bloom. The good standing ability of Dale is one of its strong assets. The stalks are juicy and sweet and produce a high yield of syrup per ton of stalks (Table 1).

Table 1. Yield of Sweet Sorghum Varieties at Blairsville, GA, and Quicksand, KY.¹

Location and Variety	Stripped stalks	Syrup/ton of stalks	Syrup/acre
	Tons/acre	Gallons	Gallons
Blairsville, GA			
Brandes	18.7	11.7	219
Dale	18.6	13.1	243
Theis	17.9	11.6	208
Williams	19.9	16.6	328
Quicksand, KY			
Brandes	19.0	11.7	222
Dale	20.0	13.9	278
Theis	20.1	13.1	262
Williams	13.4	10.9	146

¹Freeman et al., 1986. USDA Agr. Handbook No. 611.

Dale normally has enough starch in its juice to give desirable syrup body, but not enough to interfere with syrup processing. The syrup from Dale has a mild sorghum flavor, good amber color, and excellent quality. The syrup does not readily gel. Dale should be your first choice as a variety in Kentucky.

Sugar Drip is a mid-season variety of unknown origin. Sugar Drip matures about 14 days earlier than Dale. It is a good variety for late planting. The stalks of Sugar Drip are shorter and smaller barreled than those of Dale and have lower juice yield. Under good growing conditions, lodging in Sugar Drip may hinder harvesting. Sugar Drip is very susceptible to most sorghum diseases, particularly stalk red rot and maize dwarf mosaic. Several producers have lost an entire crop from these diseases. However, under ideal growing conditions, it does produce an excellent quality syrup.



A good stand of Dale compared to 2 older varieties

M81E is a late-maturing variety that matures about 10 days later than Dale in Kentucky. It was released from the U.S. Sugar Crops Field Station, Meridian, Mississippi, and is similar to Dale in height and lodging resistance. M81E is resistant to leaf anthracnose and stalk red rot but is susceptible to maize dwarf mosaic. The yield of juice and syrup from M81E is generally superior to Dale. The syrup has a mild sorghum flavor, amber color, and excellent quality. This variety should be transplanted using the float system in most areas of Kentucky to ensure maturity before frost. It appears to be more susceptible to a light frost than the other varieties.

Simon is a very early-maturing variety of unknown origin. It matures about 7 days earlier than Sugar Drip. It has a fairly small stalk, low juice yield, and is susceptible to most sorghum diseases. The only advantage for Simon in Kentucky is for very late plantings where Sugar Drip will not mature. Simon is better adapted to areas north of central Indiana and Ohio. It has performed well in Wisconsin, Minnesota, and New York. It does produce a high quality syrup.

Theis and Brandes are two late-maturing varieties that mature at least 2-3 weeks later than Dale and are not adapted to Kentucky. Other varieties are still being grown by several individual producers but seed is not readily available. Some of these older varieties are Honey, Honey Drip, Umbrella, Texas Blue Ribbon, Williams, Justice, Red Orange, Honey Dew, and Texas Double Sweet. Several of these are probably the same variety and are very susceptible to the diseases prevalent in the sweet sorghum producing areas.

Before buying seed, consult your county Extension office about the availability of seed in your area. Choose your variety carefully and buy the best pure seed available.

Cultural Practices

Yield and quality of sweet sorghum syrup and the ease of handling the crop are affected by the soil type, crop rotation, fertilization practices, plant density, plant maturity as a function of planting date, and stage of maturity at harvest time.

Land Selection

Many different soils are used for the production of sweet sorghum, but a soil that has good physical characteristics and good fertility produces the best yield. In general, loam and sandy loam soils are best for the growth of sweet sorghum for syrup production. However, most of the well-drained silt loams in Kentucky will produce excellent sweet sorghum when properly fertilized.

Soils high in organic matter are thought to have a detrimental effect on syrup quality. The field should have good surface drainage and the soil should be deep and moderately to well drained. Shallow soils or soils very low in organic matter may be droughty. Ample moisture during the growing season is important for good yields of stalks and juice. Clayey soils usually produce poor stands, poor yields, and poor syrup.

Sweet sorghum usually fits into most common crop rotation systems. You can successfully grow sweet sorghum following a corn or soybean crop. The plant residue should be chopped in the fall and plowed under early in the spring so that it deteriorates before you seed the sweet sorghum. Sweet sorghum should not be grown on land following a tobacco crop.

Fertilization

Fertilizer requirements for sweet sorghum depend on the fertility levels of the field in which it is grown. Soil tests should be taken to determine what kind and amounts of fertilizer should be used. Nitrogen is particularly needed on most soils and exerts the greatest effect on yields.

Clay soils may produce a good sweet sorghum crop with a moderate amount of fertilizer. Sandy soils may require more fertilizer for good growth. Apply lime to soils that have a pH below 6.0 to correct soil acidity. Lime requirements are similar to those for corn.

The basic recommendation on a well-drained silt loam soil with a medium fertility soil test level is to use a standard fertilizer with a 1:1:1 ratio to supply approximately 40 lb each of nitrogen (N), phosphate (P_2O_5), and potash (K_2O) per acre. Do not increase rates to over 50 lb/acre on low fertility soils. On high fertility soils, only nitrogen (not over 40 lb/acre) is required. Do not make heavy applications of manure just before planting and do not use additional fertilizer as a sidedress. Fertilizer should be broadcast and disked in before planting.

Date of Planting

Sweet sorghum is a warm-season crop that matures earlier under high temperatures and short days. It tolerates drought and high-temperature stress better than many crops, but it does not grow well under low temperatures.

The optimum time to plant sweet sorghum in Kentucky is from May 1 to May 20 for the full-season varieties, such as Dale, and before June 1 for earlier-maturing varieties. Soil temperature at a depth of 2 inches should be 65°F or

above for direct-seeded sorghum and 60°F for transplanted sorghum. Late plantings grow more rapidly than early plantings. However, when planted too late, plants may not mature before the first expected killing frost.

Seeding Rate and Row Width

Direct Seeding

Sweet sorghum should be seeded in 36-inch to 40-inch rows to make weed control and harvesting easier. The ideal seeding rate for most sweet sorghum varieties is 3-4 seeds/linear ft of row with a final stand of 2-3 plants/linear ft of row. If the sorghum is planted too thick, the canes will be spindly (less than 3/4-inch diameter) and yield less juice than the same tonnage of larger canes.

Small areas of one acre or less can be seeded by hand or with a small garden seeder using the plate designed for carrot seed. For larger areas, corn planters with plates are best. Pre-punched plates that will seed at these low rates cannot be purchased. You can buy blank plates that fit your planter and drill holes for the size of your seed. Contact your county Extension office for addresses of suppliers of blank plates and patterns for proper hole spacing.

Transplanting

By using the tobacco float system, transplanting sweet sorghum has become an important method of growing this crop. As compared to direct seeding, transplanting has two main advantages: (1) it will allow you to get your crop in the ground earlier on wet, colder soils and (2) plants will usually mature about 3 weeks earlier than normal. The same 200-cell tray, media, and float bed system that is used for tobacco is used for sweet sorghum. Consult your county agricultural Extension agent for details on how to construct the float bed.

Research has shown that 4 live plants per cell give the highest yield of sweet sorghum juice. For this reason it is



David Cooper, Extension agent in Menifee County, looks at a demonstration with chemical weed control (right-hand row) and without.

very important to seed your trays with high quality sorghum seed. Achieving 4 plants per cell will require seeding 4 or 5 seeds per cell depending on the quality of your seed. If you do not have high germinating clean seed, the seed should be floated in water to remove foreign material and light weight or poor quality seed.

To float seed, fill a washtub with water and then pour about 2 gallons of seed into the water and stir. The good seed will sink and all the trash and light weight seed will float on top. Pour off the water from the good seed. Spread the good seed out to dry. Never leave the seed in the water for over 10 minutes. You should now have seed of high enough quality for seeding 4 seeds per cell. How much seed you need to clean will depend on how many acres you are transplanting. It takes approximately 40 trays per acre, and about 2 lbs. of good, clean seed.

Fill the 200-cell tray with moistened fortified soil media. Use a specially built pegboard to push the media down about 1/2 inch from the top of the tray. Drop 4 seeds into each cell and cover the seed with fresh, moist media. A vacuum seed planting board will help to seed the trays. Now the trays are ready to be placed on the float bed. It takes from 2 to 3 weeks for the plants to grow 8 to 10 inches tall. The warmer the water and air, the quicker they will grow.

If you need to add fertilizer to your float bed water, you should add it in the same way as you would for tobacco transplants. At least 6.25 pounds of 20-10-20/1000 gallons of water is a good mixture to add. A cubic foot of water (length X depth X width = cubic feet) is equal to 7.25 gallons. When the plants are about 8 inches tall, transplant each plug in rows as you do tobacco with a tobacco transplanter spacing them from 18 to 24 inches apart. When transplanting, be sure that the top of the plug is completely covered with soil to prevent the plants from drying out.

The later-maturing varieties are the best to use for transplanting. Some problems such as damping off on the float bed and premature heading in the field have been encountered when using the early-maturing varieties. To

prevent damping off on the float bed, be sure to clean your trays thoroughly each time they are used. Replacing the float bed water may be necessary if damping off still occurs.

Weed Control

The best way to control weeds is through cultivation. Start cultivating when plants are 4-5 inches tall. Transplanted sorghum may be cultivated 3 or 4 days after setting in the field. Weed competition is greatly reduced with transplants because they shade out weeds much quicker than do direct-seeded plants. As plants grow larger, be careful not to prune off the roots with cultivation.

There are no recommended herbicides available at this time for chemical weed control. However, several states are requesting a new label for the use of propazine at 2.0 lb active ingredient/acre on sweet sorghum. Check with your county Extension office for the latest situation on herbicide use for sweet sorghum.

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