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Grain Sorghum Production in Missouri

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Grain sorghum, commonly called "milo" is a feed grain crop on many Missouri farms. Missouri is not considered a part of the "sorghum belt" but harvested acreage has never been less than 200,000 in the past decade. Missourians harvested 636,000 acres in the "corn blight" year of 1971, and 380,000 acres in 1972.

Grain sorghum is providing an additional crop choice in the Southeast Missouri Delta, where intensive use of soybeans is increasing soybean disease problems. It offers an escape from Western corn rootworm damage if this insect seriously threatens the corn crop.

Corn and grain sorghum use much the same growing season, have many similarities in production methods, and are used for many of the same purposes. Choice of which crop to grow depends largely on differences in adaptive abilities and yielding abilities under different soil and climatic conditions.

Corn has yielded more than sorghum in Missouri. For the 1968-1972 period, the average state yield for corn was 79 bushels per acre, compared to 66 bushels for sorghum. This comparison may be somewhat biased because some grain sorghum is grown on fields not considered the best corn land.

Field trials have indicated a greater response to high fertility for corn, and an advantage for sorghum over corn under low fertility conditions.

It is well known that sorghum is superior in drouth resistance. It is not drouth proof—but does have the ability to approach dormancy in dry spells, and then make remarkable recovery and decent yields when rains come. Even so, the crop does respond well to irrigation.

Sorghum also has demonstrated more ability than corn to withstand excessive moisture. This seems to apply both to standing water and to flood water. Observations are that established sorghum may produce a portion of a crop even after several days of flooding covering the entire plant - if it has not headed, and if the weather is cool when the water recedes. Sorghum appears to be easily damaged if heads are covered by flood waters.

Sorghum has other favorable attributes. It is cheaper to produce than corn. One may harvest with the same equipment as used for small grains and soybeans - although the need for drying the grain after harvest may be greater than for corn.

Good quality sorghum grain is good feed. The feeding quality and the test weight per bushel may vary more than for corn, probably because it is more often grown under adverse conditions. The composition of good quality grain compares well with corn and wheat as the following results of one test indicate.

Percentages

Crop	Water	Ash	Protein	Fat	Fiber	Carbohydrates
Kafir	9.70	1.76	13.13	3.80	1.54	70.30
Milo	9.39	1.64	12.50	3.18	1.52	71.88
Corn	10.04	1.55	10.39	5.20	2.09	70.69
Wheat	10.62	1.82	12.23	1.77	2.36	71.18

Grain sorghum does need to be cracked or coarsely ground or processed otherwise for efficient digestion by most classes of livestock. Feeding trials have indicated that grain sorghum has somewhat lower feeding value, pound for pound, than corn. This varies with different classes of livestock and with different feeding rations. As a cash crop, it sells for less per pound in Missouri than corn.

Sorghum can affect the crop that follows in rotation. The sugars in the roots of sorghum at maturity range from 15 percent to over 55 percent on a dry matter basis, whereas corn roots range from 4.5 percent to less than 10 percent. These sugars furnish the energy for a rapid multiplication of soil microorganisms that compete with the following crop plants for available nitrogen in the soil, which can result in retarded crop growth. This condition lasts for only a few months, or until the sorghum residues are decayed. Nitrogen fertilizers applied to the following crop helps overcome this problem. On a long-time basis, sorghum is hard on the land only in

the same way as other non-legume crops—in proportion to the amount of plant food that is removed with the crop.

Sorghum does deplete soil moisture to a greater extent than most other crops. Its larger fibrous root system is highly efficient 3 to 4 feet deep, although it may root as deep as 6 to 9 feet. And the persistent growth continues removing moisture until a killing frost.

Production Practices

Seedbed - Prepare the soil in much the same manner as for corn and other row crops. A well prepared, firm, clean seedbed is important in obtaining stands, since seed is relatively small. Sorghum often germinates rather slowly, and the small seedlings compete poorly with weeds for the first few weeks after planting. A smooth seedbed makes for better weed control from chemical applications and cultivation. Plant seed only 1 to 2 inches deep.

Varieties - Performance of hybrid varieties is reported annually in College of Agriculture Special Reports on "Missouri Crop Performance." Don't judge varieties on the basis of only one test, but on a number of tests over several years. Yield is important, but other characteristics such as ability to stand, test weight, height, and relative time of maturity need to be considered.

An open head is likely to have less bird and insect damage and an advantage in drying. A good exsertion of the head above the leaves makes for easier combining and less trash in the combined grain.

Bird-resistant hybrids have a distinct advantage where such damage is likely. Apparently, this resistance is due to the presence of anthocyanogens which give a bitter taste to the grains during the milk and early dough stage when birds tend to feed on the grain in the field.

These anthocyanogens change to tannin as the grain matures, so the grain loses the bitter taste by the time it is fed to livestock. But there is considerable evidence that high tannin content lowers dry matter digestibility of the grain. Bird-resistant sorghums may have this disadvantage although not enough feeding tests are available to determine what this may be for each hybrid.

Planting Date - Sorghum is a warm weather crop and can't be planted as early as corn. Limited date-of-planting tests at Columbia, Mo., have had highest yields from mid-May plantings in some years, but in other years mid-June plantings gave higher yields. It appears that the earlier plantings do well in years when the crop is not affected by drought, but June plantings do better when drought hits in July.

Earlier fall harvest may minimize harvesting and drying problems, and insect problems are usually less on the earlier planted crops. The prevalence of sorghum midge in the southern one-fourth of the state almost makes early planting a must in that area. Irrigated sorghum apparently benefits from earlier planting.

If planting is delayed until early July, regular grain sorghum varieties are a poor crop choice as compared to soybeans. The extreme maturity effect that cool fall temperatures can have on sorghum may severely limit or prevent grain production. Shorter days hasten maturity of soybeans. Extremely short-season varieties could minimize this problem, although such varieties have not been adequately assessed in the state.

Row Width - Row spacing experiments at Columbia in 1968, 1970, and 1971 were consistent in giving higher yields as rows were closer together. The three-year average yields per acre for each row spacing were as follows:

Row Spacing	*Yield - Bus/Acre*
7 Inches	121.3
14 Inches	118.2
21 Inches	102.5
28 Inches	98.0
35 Inches	89.0

This yield advantage of narrow rows can be widely utilized since weeds in grain sorghum can be adequately controlled on many fields by using weed control chemicals and rotary hoes.

Planting Rate - No advantage was shown for increasing planting rates as rows were narrowed in the above experiments. This confirmed other experiments which have shown grain sorghum yields are affected by number of plants per acre rather than number of plants per row. Different planting rates included in the above experiments gave three-year average results as follows:

Planting Rate - Lbs/Acre	*Yield - Bus/Acre*
2	99.9
4	107.4
8	113.4
16	113.6

Despite the good results in these trials, avoid high rates such as 16 pounds per acre unless irrigation is available. Thick plantings are more likely to suffer from charcoal rot, and thus lodge more under drought conditions.

There has been little difference in total yield from about 30,000 to about 100,000 plants per acre without irrigation. Good germinating seed has usually given from 55 to 65 plants for each 100 seeds planted. This suggests planting 70,000 to 100,000 seeds per acre in expectation of obtaining some 40,000 to 60,000 plants with considerable leeway for a range of conditions for emergence.

Seed of hybrid sorghum varieties varies in size but average around 14,000 seeds per pound, so seed five to seven pounds per acre depending on seed size and germination percentage. Extremely drouthy soils call for only three to four pounds per acre.

Irrigated sorghum has done best at around 100,000 plants per acre, so seeding rates can well be increased to 12 to 15 pounds when the crop is to be watered.

Fertilization - Grain sorghum, like other crops, requires adequate fertility to produce high yields. Nitrogen requirements are slightly lower than corn, and comparable yields can usually be produced with about three-fourths the amount of N which would be suggested for corn on the same land. Phosphate requirements are essentially the same. Potash needs are higher. Fertilizer applications should provide about one-third more potash than for corn. A soil test is suggested as the most accurate way to determine fertilizer needs on fields where grain sorghum is to be grown. Apply fertilizer materials in the same manner as for corn.

Lime is essential on acid soils, where grain sorghum is to be grown, if high yields are desired. In such situations lime will make more efficient use of the fertilizer. Grain sorghums are not as sensitive to soil zinc deficiencies as corn. On soils in the Delta region where zinc problems have been observed in corn, the production of grain sorghum may be an alternative to consider.

Weed Control

Cultivation is done much as for corn. Chemical weed control can be especially beneficial during the first few weeks after planting when sorghums grow slowly. Chemical weed control recommendations, published annually, may be obtained from UMC Guide 4348 "Recommendations for Weed Control in Sorghum," available at County University Extension Centers.

Insect Pests

The major insect problems with grain sorghum appear to be confined to the western half and the southern one-fourth of the state.

The *thief or kafir ant,* a small, yellowish to orange-red ant, is one of the main causes of poor seed germination, especially over the western portion of the state. This problem can easily be controlled with any registered seed treatment insecticide, thoroughly mixed with the seed prior to or at the time of planting.

Other soil insect pests are not known to cause widespread, serious injury to sorghums, although there are annually a few individual field problems involving *cutworms* and/or *wireworms.* The major problem with control efforts where either of these two pests regularly occur is that none of the recommended, preplant, broadcast, incorporated soil insecticides are currently registered for use on sorghum soils, and therefore, should not be used for this purpose.

A strain of the *greenbug,* a very small, yellowish-green aphid, readily attacks grain sorghums from the time of germination into August. Colonies of these aphids may be found on the underside of the lowest leaves sucking the plant sap and injecting a toxin which kills the tissue around the point of feeding.

Greenbugs should be controled anytime they occur on seedling sorghums, while plants in the preboot to heading stage may lose two or more of the lowest leaves before controls are economical. Natural enemies, including wasp parasites and lady beetle predators usually bring this problem under control by mid-August. Don't confuse the greenbug with the bluish-green corn leaf aphids, seldom of economic importance, which are found in the whorls.

The greatest production loss is caused by those insects which attack the heads from the time of bloom until the seed is fully colored. The *sorghum midge,* a tiny orange bodied fly, begins its damage by laying eggs in the blooms. The maggot or larval stage eats out the new seed leaving a fully developed head with very little or no grain. *Sorghum webworm* larvae, hairy, tannish-green worms with four reddish-brown stripes down the back, and the larvae of the *corn earworm* or *cotton bollworm* eat out the developing seed by feeding both on and within the seed heads. These insects are of primary concern over the southern fourth of the state.

Planting early and selecting a loose-headed variety usually enables one to escape damage by these head feeding insects. Check with your University Extension Center for the latest specific insecticide recommendations.

Sorghum Diseases and Control

Sorghums are attacked by several diseases than can reduce yields and cause heavy losses. They should be recognized and control measures used whenever possible.

Four general types of diseases are: 1) those that reduce stands through seed and seedling rots; 2) those that attack the leaves and decrease the value of the plants for forage; 3) those that attack the heads and prevent normal grain formation; and 4) those that cause root and stalk rots and prevent normal development and maturity of the entire plant.

Some sorghum varieties may be resistant to one or more of the four types of diseases, while others may be particularly susceptible to certain types.

Seed Rots and Seedling Diseases - Seed rots are most severe when the soil is cold and wet after planting. To germinate properly, sorghum seed requires a relatively warm soil (above 70° F.). If soils are cold, seeds fail to germinate readily and rots occur from various seed-borne and soil inhibiting fungi - e.g. species of *Fusarium, Aspergillus, Rhizopus, Rhizoctonia, Penicillium* and *Helminthosporium.* Most of these fungi are aggressive in cold and wet soils and can cause poor emergence.

Some fungi, especially species of *Pythium, Fusarium* and *Penicillium* attack young seedlings in early stages of development. Pre-emergence and post-emergence losses can sometimes be severe.

Seed rots and seedling blights may be controlled to a considerable extent by delaying seeding until soils are warm (above 70° F.) and by using fungicidal seed treatment. Most commercial seed comes already treated.

Diseases of the Leaves - Leaf diseases may range in severity from small, unimportant spots or stripes on the leaves to diseased areas that prematurely destroy the leaves. Relative severity varies with weather conditions, the disease organisms involved, and the susceptibility of the variety. Leaf diseases are generally favored by high temperatures and humid weather.

Bacterial leaf diseases are common in sorghums. They are favored by warm (75-80° F.) moist weather. Three bacterial diseases of sorghums are prevalent: bacterial stripe, bacterial streak, and bacterial spot.

Bacterial stripe is the most important and abundant of the three diseases. It is characterized by long, rather narrow and somewhat irregular red stripes, first seen on the lower leaves. The stripes range from ¼ to 9 inches or more in length and tend to be confined between the leaf veins. Drops or films of exudate that dry to thin crust-like scales occur on the stripes.

Bacterial streak occurs on the leaves as narrow, water-soaked, translucent streaks about ⅛ inch wide and 1 to 6 inches long. These streaks may occur on plants from the seedling stage to near maturity. Eventually, narrow, red-brown margins or blotches appear in the streaks. They may broaden into elongated oval spots with tan centers and narrow red margins.

Bacterial spot can be identified as small, circular to irregularly elliptical spots. As the spots mature they usually have light colored centers and are surrounded by red borders.

The bacteria causing leaf diseases are believed to carry over from one season to another on the seed, on infected plant residues, and occasionally on plant species that overwinter. The spread from one plant to another is by wind, splashing rain and insects.

Fungus leaf diseases common to sorghums are: rough spot, Anthracnose, Helminthosporium leaf blight, zonate leaf spot, gray leaf spot, target spot, sooty stripe, and rust.

Although several of the leaf diseases caused by fungi can be observed in any year, by far the most prevalent is the

leaf blight caused by *Helminthosporium turcicum.* It is the same fungus that attacks corn leaves. Along with seed rot and seedling blight, the fungus also infects leaves of older plants. The spots gradually enlarge and form long, elliptical areas ⅛ to ½ inch wide and several inches long. These spots may merge sufficiently to kill large leaf areas. When weather conditions are favorable, the disease spreads rapidly and can cause serious injury to leaves before the plant has matured. Reduced grain yields can result.

Recommended control measures for the leaf diseases are sanitation (covering crop residues after harvest), seed treatment, and use of resistant varieties.

Diseases Attacking the Heads - Smuts are practically the only diseases in which injury to the plant is confined almost entirely to the head of the plants. Covered kernel smut and loose kernel smut, the two types found in Missouri, are effectively controlled by properly treating the seed with fungicides. With the advent of commercially treated seed very few cases of smut on sorghum are seen.

Root and Stalk Diseases - Several root and stalk diseases occur in sorghum. These diseases usually do not become evident until the plants are almost mature.

Periconia root rot (milo disease) is caused by a fungus, *Periconia circinata,* and attacks the roots before the aboveground parts of the plants show any symptoms. Affected plants have water-soaked brown or reddish discoloration of the outer part of the roots. Once in a field the disease can build up. It may be spread by soil movements, carried in runoff or irrigation water, and by farm implements.

Weak neck, a condition of breaking over of the upper part of the stalks, was serious some years ago. It is largely a varietal characteristic that has been corrected through breeding of resistant varieties. Breaking over as a result of corn borer injuries should not be confused.

Stalk rots are caused by at least four fungus species, the most commonly encountered are: Charcoal rot, *Macrophomina phaseoli;* Fusarium stalk rot, *Fusarium moniliforme;* Colletotrichum stalk rot, *Colletotrichum falcatum;* Rhizoctonia stalk rot, *Rhizoctonia solani.*

Charcoal rot is perhaps the most common, especially in seasons of moisture stress. At maturity, heads will be poorly filled from premature ripening and drying of stalks. Lodging can be extensive. Stalks are soft and discolored at the base, with the interior disintegrated and vascular fibers showing shredded appearance. Small black fruiting structures (sclerotia) may be found on the interior of the stalk up to the third or fourth joints, and also in the crown and main roots.

During periods of dry, warm weather this fungus disease as well as the other stalk rots can cause considerable destruction of stalk tissues that result in stalk breakage and lodging.

Fusarium stalk rot can be identified in dried, rotted and broken stalks by powdery masses of white spores. Microscopic examination is necessary for correct identification of the spores.

Colletotrichum stalk rot occurs in some varieties of sorghum. The fungus apparently enters the stalk directly through the rind and spreads rapidly in the interior of the stalk. It grows in the conducting tubes and vessels and thus interferes with movement of water and food materials, resulting in poor head and seed development. Lesions on the outside of diseased stalks usually have reddish to purplish-margins and whitish centers. Infected stalks have red or purplish-red interiors.

Rhizoctonia stalk rot is caused by a common soil-borne fungus that has a wide host range. This stalk rot differs from charcoal rot in that it first attacks the pith and produces a reddish discoloration, while the fibers remain as light streaks in the discolored pith. Later, sclerotia of the fungus may be found under the leaf sheath. The sclerotia of Rhizoctonia differ from those of the charcoal rot fungus in that they are somewhat large and are brown instead of black; they are outside rather than inside the stalk.

Control measures for the stalk rots are based on sanitation, crop rotation, avoiding excessive plant populations, and the use of resistant varieties.

A number of non-parasitic disorders occur in sorghums as responses to various environmental and varietal conditions. They can sometimes be confused with the parasitic diseases and may need specialized evaluation.

Harvesting and Drying

Grain sorghum can be combined at moisture contents as high as 26 percent. It is generally not advisable to start harvest this soon, because the crop is difficult and expensive to dry, commonly requiring around 60 percent more time in a crop drier than does corn of similar moisture content. So the 18 to 20 percent moisture stage, when the seeds have colored and begun to harden, is usually the earliest time to start combining. Being small-seeded with correspondingly less air space around the kernels in storage, the grain needs to be reduced to 13 percent moisture for winter storage and from 11-12 percent for long time storage.

Combine adjustments to clean the grain are important. Any high moisture debris may accumulate in pockets in storage and cause heating.

High moisture grain, combined near 24-26 percent moisture content, can be stored in air-tight silos. Since enzymatic action does occur in whole moist grain in storage that gives some improvement in digestibility, it is desirable to store as whole grain, and then roll or grind when it is removed from these silos for feeding. If the grain is stored in conventional silos or horizontal silos, grinding as the silo is being filled may be necessary to be able to pack enough to eliminate air. Pack well and cover these silos with plastic to prevent spoilage.

Grain sorghum tends to dry rather slowly in the field, and reabsorbs water during rainy humid periods. It often varies by 2 to 3 percent in moisture from early morning to late afternoon, so the best time to combine is usually in the afternoon. A lengthy stay in the field often results in heavy losses from lodging, weathering of the grain, and other causes, so drying on the farm or commercially is almost necessary.

Field drying (desiccation) of grain sorghum has not been reliable enough in Missouri to justify recommendation as a regular practice. Drying after combining is much more reliable. If desiccation should seem necessary in a wet fall season, information on possible treatments can be obtained from Area Agronomy Specialists.

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