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Grain Sorghum (Milo) Production in Kentucky

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Grain Sorghum (Milo) Production in Kentucky

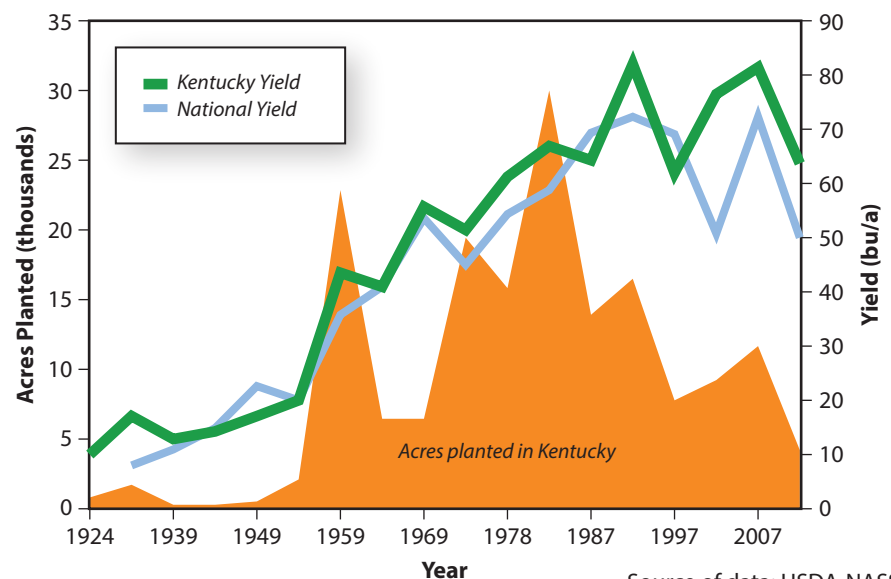
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Figure 1. Grain sorghum (*Sorghum bicolor*)

Grain sorghum (*Sorghum bicolor*) (Figure 1) can be used for a variety of purposes including animal feed, unleavened breads, cakes, wallboard, starch, dextrose, brooms, ethanol, high quality wax, and alcoholic beverages. Grain sorghum produced in Kentucky is most commonly used for animal feed and was first grown here in the 1920s. Although acreage in Kentucky has fluctuated considerably over the years, yields have generally exceeded the national average since the 1970s (Figure 2), indicating that grain sorghum is an option for producers interested in diversifying grain crop operations.

Figure 2. Grain sorghum acreage and yield in Kentucky from 1924 to 2012 and average national yield from 1934 to 2012.



Source of data: USDA-NASS
(www.nass.usda.gov)

Cultural Practices

Site Selection

Grain sorghum can be produced on a variety of soils. It is a drought-tolerant plant that can be grown on shallow, less productive soils with low water-holding capacity. In these environments, grain sorghum yields can be better than corn yields, although typically they equal corn yields. The advantage of grain sorghum in these environments is that it can be more profitable than corn because fewer inputs are required.

Grain sorghum yields increase as the soil productivity and water-holding capacity increases. On highly productive, deep soils with high water-holding capacity the yield potential for grain sorghum is greatest. Grain yield of corn in these environments is also high, which results in corn profitability exceeding grain sorghum profitability.

Hybrid Selection

Potential yields, maturity, stalk strength, and disease resistance should be considered when selecting a grain sorghum hybrid. As with any crop, a hybrid with high yield potential is always desired. Full-season maturity hybrids are preferred for their high yield potential compared to short-season hybrids, assuming the crop is planted in May. If planting is delayed into June, especially mid-June or later, a short-season hybrid should be considered. Selecting hybrids with low lodging scores (high stalk strength) is important because this indicates that the hybrid is less likely to fall over in stressed environments. Anthraxnose stalk rot (the primary stalk rot disease) and charcoal rot resistance are also very important to help reduce the risk of lodging.

Good seedling vigor and physical characteristics such as head exertion and head type should also be considered when selecting grain sorghum hybrids. Head exertion is the distance between the sorghum head and the top leaf (Figure 3). Head exertion can vary from 0 to 8 inches. At harvest maturity, leaves near the top of the plant may still be green. Heads with little to no exertion will require a desiccant before harvest.

There are three head types: compact, semi-compact, and open. Compact head types may be more susceptible to head diseases, because grain is much closer together. The close proximity of grain allows for more moisture to remain in between the seeds and creates a better environment for disease development. Compact heads make scouting for insects more difficult as well. Furthermore, in-field grain drying may take longer with compact heads. The semi-compact and open heads are easier to scout and treat for insects. In addition, grain dries more quickly to harvest moisture and heads may be less susceptible to diseases with the semi-compact head hybrids.

Selecting good hybrids will help maximize yield potential in a field. The University of Kentucky does not conduct a grain sorghum variety testing program. The University of Missouri is the only neighboring institution that does; results of those trials can be accessed at <http://varietytesting.missouri.edu/sorghum/>

[results.htm](#). In addition to these hybrid trials, obtain information from the seed company and talk to other producers who are growing sorghum to get their preferred hybrids. Be sure to consider information and data that are collected across multiple locations, environments, and years to ensure that hybrids planted have the greatest yield potential and lowest lodging and disease potential.

Seed Treatments

Seed safener treatments such as Concep III® (fluxofenin) and Screen® (flurazole) greatly increase the number of herbicides that can safely be used in grain sorghum production. (Weed control is discussed below.) Several fungicide and insecticide seed treatments may also be used to protect against seed and seedling diseases and insect pests. Specialists from nearby states, such as Missouri, recommend using fungicide seed treatments for grain sorghum if planting early into cool or poorly drained soils or if planting late so that seedlings will be emerging and secondary roots developing during periods of high temperatures. Grain sorghum insecticide seed treatments are essential for most of the deep south regions. In Kentucky insecticide seed treatments likely are not necessary *unless* plantings occur mid-June or later or if sugarcane aphid becomes an established, problematic pest or an annual migrant pest in Kentucky. (Sugarcane aphid was verified in Kentucky in 2015; however the implications of this finding are unclear at this time.)

Planting Date

Grain sorghum seed germinates rapidly when soil temperatures in the top 2 inches of the soil profile are around 70°F. Grain sorghum seed can be planted when soil temperatures are 60° to 65°F and warm weather is expected to continue after planting. In Kentucky, sorghum yields are typically greatest when the crop is planted from May 1 to June 1. Within this planting window insect pests are less damaging, adequate rainfall during vegetative stages typically occurs, and lower rainfall totals during bloom (July) can reduce head diseases. Later planting dates are very common in Kentucky and result in lower yields and higher grain

moisture at harvest. If grain sorghum is planted after wheat harvest there must be adequate soil moisture for seed germination and seedling establishment. It also requires more scouting for sorghum midge and fall armyworm. Short-season hybrids are preferred when planting sorghum late.

Row Spacing

Grain sorghum is produced in various row spacings, which can be dictated by equipment availability. Row spacing studies in Missouri and Illinois have not produced consistent results. In general as row spacing narrows the time to canopy closure and competition with weeds should decrease. In addition grain sorghum produced in 15- or 7.5-inch rows usually has less of a problem with plant lodging. Much of the grain sorghum produced in Kentucky is planted in 15-inch rows. Although the data are preliminary, it appears that narrower row spacings may help control sugarcane aphid.

Planting Depth

Typical planting depths range from ¾ inch to 1¼ inches deep. Depths of about ¾ to 1 inch should be considered early in the season when soils have adequate moisture and soil temperatures are around 60° to 65°F. Depths of 1 to 1¼ inches can be considered later in the season when soil temperatures exceed 70°F and soil moisture is limited in the upper ¾ inch of soil. Grain sorghum planted deeper than 1¼ inches may not emerge or will emerge very slowly.

When adjusting planting depth it is very important to make sure that adequate seed-to-soil contact is achieved to ensure uniform plant emergence. Make sure that the furrow is covered and closed. Open furrows will greatly reduce seed-to-soil contact, which can delay seedling emergence.

Plant Population

Plant populations are very important because too high populations can cause lodging and reduce yield while too low populations can result in large populations of weeds and lower grain yield. A seeding rate of 60,000 seeds per acre should result in adequate yields for Kentucky. However, seeding rate recom-

recommendations from mid-south states range from 40,000 to 120,000 plants per acre. Researchers at the University of Illinois found that yield was one bushel greater per acre when seeded at 120,000 plants per acre versus 60,000 plants per acre. Mississippi State University recommends a medium seeding rate of 50,000 to 60,000 plants per acre while the University of Arkansas recommends 50,000 plants per acre in dryland, non-irrigated environments. As with narrower row spacing denser populations may help control sugarcane aphid, though the data are tentative.

Growth Stages

There are several different grain sorghum growth stage systems. One system developed by R.L. Vanderlip follows a 0–9 scale. Another system ranges from 0 through 11.5. Yet another system is simplified with only three stages: I–III. Defining characteristics of these three grain sorghum growth stages are presented in Table 1. Figures 3 through 6 illustrate some key growth stages.

Regardless of the system used, the critical point about grain sorghum growth stages is to understand which system is being used. This understanding is essential for correct timing of pesticide applications and for reducing potential injury of the grain sorghum plant caused by off-label applications.

Nutrient Management

As with most crops, grain sorghum requires proper nutrient management for maximum yield. It is always best to collect soil samples well in advance of planting to allow sufficient time for field nutrient status determination and nutrient applications. In most cases, soil sampling every other year will be sufficient to ensure proper soil conditions. In extreme cases where soil conditions are outside optimal ranges for crop production, annual soil testing may be necessary.

Lime, phosphorus, and potassium applications should be determined based on soil tests results and the most current version of AGR-1: *Lime and Nutrient Recommendations* (<http://www2.ca.uky.edu/agc/pubs/agr/agr1/agr1.pdf>). Nitrogen (N) rate recommendations range from 50 to 125 pounds N per acre. The high rate,

Table 1. Identifying characteristics of three key growth stage systems of grain sorghum hybrids and cumulative growing degree days (GDD) for short- and full- season hybrids

Growth Stage			Cumulative GDD (F)		Identifying Characteristics
0-9	0-11.5	I-III	Short Season Hybrid	Full Season Hybrid	
	0.0	I			Planting
	0.1	I			Seed starts to take up water
	0.5	I			Radicle emerges from seed
	0.7	I			Coleoptile emerges from seed
	0.9	I			Leaf at coleoptile tip
0	1	I		200	Emergence. Coleoptile visible at soil surface
	2	I			First leaf visible
1	3	I	500	500	Collar of third leaf visible
2	4	I	660	660	Collar of fifth leaf visible
3	5	II	924	1365	Growing point differentiation (panicle initiation)
	5.1	II			Main stem and one tiller
	5.9	II			Main stem with several tillers
	6	II			Stem elongation (late vegetative stage)
4	7	II	1287	1470	Final (flag) leaf visible in whorl of plant
5	8	II	1683	1750	Boot. Head extended into flag leaf sheath
	9	II			Panicle visible
6	10	III	1848	1995	Flowering (half of the plants in a field are flowering)
	11.1	III			Grains at milk stage
7	11.2	III	2211	2310	Soft dough
8	11.3	III	2508	2765	Hard dough
9	11.4	III	2673	3360	Physiological maturity (black layer). Maximum dry matter accumulation (seed moisture approximately 30%)
	11.5	III			Mature grain (seed moisture approximately 15%)

Sources: Vanderlip, R.L. 1993. How a sorghum plant develops. Kansas State University Agricultural Experiment Station and Cooperative Extension Service. <http://www.ksre.k-state.edu/bookstore/pubs/s3.pdf>; Dahlberg, J., E. Roemer, J. Casten, G. Kilgore, and J. Vorderstrasse (eds). 2010. United Sorghum Checkoff Program Mid-South Production Handbook. http://sorghumcheckoff.com/wp-content/uploads/2012/07/Mid-South-Guide_03_22_2012_FINAL.pdf; Espinoza, L., and J. Kelley. 2004. MP 297 Grain Sorghum Production Handbook. University of Arkansas Cooperative Extension Service, <https://www.uaex.edu/publications/PDF/MP297/MP297.PDF>.

125 pounds N per acre, is recommended for poorly drained soils, and the 50 pounds N per acre rate is recommended when grain sorghum will be produced in a field that was in pasture for five or more years. Nitrogen rates can be reduced by 25 pounds N per acre if two-thirds of the N is applied 4 to 6 weeks after planting. For exact nitrogen recommendations consult AGR-1.

Recognizing nutrient deficiencies in grain sorghum can be difficult because their symptoms can resemble diseases. To determine whether a problem is a nutrient deficiency or a disease, first

observe the pattern of affected plants within the field. In most cases, nutrient deficiencies will be widespread, whereas diseases are typically more sporadic or isolated within the field. Proper diagnoses may require submitting soil and tissue samples for nutrient analysis as well as using diagnostic testing for diseases, such as those tests performed by the University of Kentucky's Plant Disease Diagnostic Laboratory. Many commercial laboratories will conduct soil and tissue analyses. (The University of Kentucky does not offer tissue testing services.) To diagnose a suspected nutrient issue, collect samples

(soil and possibly tissue) from the affected area and samples from non-affected areas (healthy plants) from the same field.

Both nitrogen and potassium deficiency will begin in older leaves (lower on the plant) as a pale green or yellow color that develops into a brown color and will move up the plant as severity increases. The patterns of nitrogen and potassium deficiency differ. Plants with moderate nitrogen deficiency will be pale green or yellow and eventually turn brown. In severe cases plants can be stunted. Yellowing begins at the tips of older leaves and will turn brown along the main leaf vein while remaining green at the leaf edge giving the discolored area of the leaf a “V” shape. Potassium-deficient plants will begin as pale green or yellow and then turn brown on the leaf margins; the brown expands toward the main leaf vein as symptoms progress.

The characteristic phosphorus deficiency for grain sorghum seedlings is purple leaves. It is not uncommon for purple upper leaves to occur early in the growing season due to cool environmental conditions. This transient phosphorus deficiency will disappear as temperatures increase and roots begin to grow. Larger grain sorghum plants with a mild phosphorus deficiency will be less vigorous with delayed maturity; young leaves will be dark green, have closer internodal

spacing, and possibly be shorter and more erect than normal. Phosphorus deficiency is typically noticed in younger (upper) leaves first and will move down the plant to older leaves as symptoms progress.

Weed Control

Weed control in grain sorghum can be challenging. First, there are a limited number of herbicides that are labeled for use in grain sorghum. Many of the labeled herbicides are selective, which means they control only specific species. In general most postemergence herbicides are labeled for use on very small weeds, which makes scouting very important in grain sorghum production. To achieve the highest possible grain sorghum yield, fields with low weed pressure should be selected. Fields infested with johnsongrass (*Sorghum halapense*) or shattercane (*Sorghum bicolor*) should be **avoided**. Because these are closely related plant species, chemical control is difficult. In addition, johnsongrass can harbor plant pathogens and insect pests that can negatively impact grain sorghum yields.

In conventional tillage systems the best options for weed control are field cultivation and chisel plowing followed by herbicide applications. In no-till production systems weed control programs that include herbicides for “burndown”

of existing vegetation are crucial. For the most updated herbicide options for grain sorghum production consult AGR-6: *Chemical Control of Weeds for Kentucky Grain Crops* (<http://www2.ca.uky.edu/agc/pubs/agr/agr6/agr6.htm>).

Harvest Aids

Some chemicals such as glyphosate or sodium chlorate are labeled for applications prior to harvesting grain sorghum. These allow for a more timely harvest of the crop and limit yield losses due to lodging, birds, insects, diseases of the head, and weather. These treatments desiccate (kill) living grain sorghum tissue, help control weeds, and allow harvest to occur more quickly than if not applied. These should be applied only after the grain sorghum has reached physiologic maturity and seed moisture content is less than 30 percent. Follow the label for preharvest interval (i.e. time between chemical application and grain harvest) and avoid harvest delays after the preharvest interval in order to avoid stalk decay and lodging. Note that harvest aids or desiccants may enhance lodging in fields infested with charcoal rot.

Insect Management

Insect management is essential when producing grain sorghum in Kentucky because there are several insect pests that can negatively impact grain sorghum



Figure 3. Grain sorghum hybrid with a large head exertion (distance between the bottom of the sorghum head and the flag [top] leaf)



Figure 4. Grain sorghum plant at boot growth stage. Note the swollen flag leaf sheath of the right plant and the swollen leaf sheath and visible panicle of the left plant.



Figure 5. Emerging grain sorghum panicles



Figure 6. Grain sorghum kernels at hard dough stage (left) and at black layer (right)

yield and quality. Insect pests are generally divided into two groups: those that effect the grain directly and are indirect feeders, and those that feed on the leaves and stalks and generally reduce the vigor of the plant and the flow of nutrients to the grain heads.

The most common insect pests of grain sorghum seedlings and plants are aphids. Greenbug, corn leaf, yellow sugarcane, and—beginning in 2015—sugarcane aphids can be found in Kentucky-grown grain sorghum. These pests have piercing-sucking mouth parts with which they suck the sap from plants. Their digestive systems are somewhat inefficient, which results in their defecation of large amounts of a sticky, sugar-rich liquid called honeydew. Honeydew coats the leaves and stalks leaving them sticky, which can interfere with harvest and support the growth of a black-colored “sooty mold” which can cover the leaves and disrupt photosynthesis. Historically, aphid damage is rarely significant. Yellow sugarcane aphid (YSA) and sugarcane aphid (SCA) are major pests of grain sorghum in the deep south, and both can occur in Kentucky. YSA is a native insect found over the American South and Midwest. SCA is a non-native invasive species that appears to be unable to survive the winter as far north as Kentucky. Typically significant damage has not been reported

from any of the aphids, though it may be too early to know how SCA will fit into Kentucky’s production system.

Currently SCA is expected to be an annual migrant moving from Texas/Louisiana northward each year. The timeliness of planting and thus grain maturity and the variable annual arrival date of SCA will likely vary from year to year making it difficult to predict in what years the pest will be a problem. This variability magnifies the need for scouting early and often. In 2015 some grain sorghum fields were sprayed, largely to prevent gumming up combines with honeydew. Populations in some fields were greater than the 50 to 125 aphids per leaf for a 50-leaf sample and were treated, but most of these fields were near maturity and not treated. In Kentucky SCA was found as far east as Allan County and as far north as Henderson County. In addition, several counties in southern Illinois at least as far north as the latitude of Henderson, Kentucky, were known to be infested.

There are still many unknowns about SCA as it is not well studied outside of Texas and Louisiana. Those interested in grain sorghum production are advised to consult *Kentucky Pest News* (<http://www2.ca.uky.edu/agcollege/plantpathology/extension/kpnindex.htm>) and the *Grain Crops Update Blog* (<http://graincrops.blogspot.com/>) often as information on incidence, scouting, thresholds, and pesticides are likely to change very quickly.

Chinch bugs, another piercing-sucking feeder, may also be found in Kentucky. Though this pest has been quite rare, it is very destructive when present. In Kentucky chinch bug is generally associated with late planting and drought conditions. They can infest at any plant stage during the season but have been important in Kentucky only in the seedling stages.

Insect pests that feed directly on the grain head are most likely to result in economically impor-

tant damage to grain sorghum. Sorghum midge and the “head worm complex” comprised of fall armyworm, corn earworm, and sorghum webworm feed directly on the grain. In addition, their excrement and moisture, as well as silk from the webworms, can reduce the grain quality and result in storage problems.

Sorghum midge, a very small fly, only attacks grain sorghum during the bloom phase. This fly lays its eggs in the open bloom and the resulting maggots feed on the developing grain from the inside. Protection from this insect can only be insured by killing the adult fly so that she cannot lay her eggs in the bloom. Insecticide application at any other time is of no use. Furthermore, caterpillars of the head worm complex feed on the developing grain after bloom. These insects can be seen and thus counted and recorded to determine if control is necessary. Early maturation of sorghum will help avoid problems with the sorghum midge and the head worm caterpillars.

Scouting and identification of grain sorghum insects, including economic thresholds for each insect pest, is discussed at length in *IPM-5: Kentucky Integrated Crop Management Manual for Field Crops—Grain Sorghum* (<http://www.uky.edu/Ag/IPM/manuals/ipm5s-org.pdf>).



Figure 7. Other aphid species pests of sorghum
Photo by Raul Villanueva

Insect control can be achieved through both cultural practices and chemicals. Planting date has a huge impact on potential damage by specific insects. Planting grain sorghum too early (before soil temperatures reach 65° to 70°F) can result in greenbug and chinch bug infestations while late plantings (June 1 and later) will increase problems with sorghum midge, the head worm complex, and likely SCA. In a given field a single planting date and uniform head emergence and head maturation are important in reducing the risk that insects will move from earlier to later developing plants. Effective johnsongrass control is also essential because it serves as an alternate host for all of the aphids and many of the other pests. Chemical control options may be necessary even with good cultural practices. For current recommendations for insecticides refer to ENT-24: *Insecticide Recommendations for Grain Sorghum (Milo)*. (<http://pest.ca.uky.edu/EXT/Recs/ENT24-Sorghum.pdf>).

Diseases

Seed and Seedling Diseases

Root Rot

Cause: *Periconia*, *Pythium*, *Rhizoctonia*, *Fusarium*

Symptoms: Stunted plants that are sometimes wilted and have pale green or yellow leaves. Roots can be soft and/or pink, reddish brown, or black instead of white and firm. Severely damaged plants will die. Surviving plants can be weak, unproductive, and more susceptible to other diseases and environmental stresses.

Key Features of Disease Cycle: The fungi that cause root rots are common in all soils and typically do not cause damage unless the plant is stressed. Common stresses include cool soils, poor drainage, or inadequate fertility. Healthy, vigorous plants can produce new roots to compensate for damaged roots. Stressed plants cannot easily produce new roots and are more likely to succumb to root rots.

Management: Plant high-quality seed of adapted hybrids. Plant seed into moist soils, which are preferably 70°F in the top 2 inches of soil. If seed is planted when soil is below 70°F consider using seed

that is treated with a broad-spectrum fungicide. Plant into fertile soils that have a pH of 6.0 to 6.5; *Fusarium* is more likely to infect plants when soil pH is low (around pH 5.0). Avoid stressful environments such as poorly drained fields and excessively high plant populations and ensure proper fertilization and pesticide applications to avoid stress and/or injury to seedlings. Fungicide seed treatments and in-furrow fungicide applications at planting may provide protection against root rot pathogens for a few weeks after planting but will not provide season-long control.

Leaf Diseases

Maize Dwarf Mosaic

Cause: *Maize dwarf mosaic virus* (MDM)

Symptoms: The characteristic MDM symptom is leaf mottling where leaves turn yellow with light green islands. Mottling is more apparent on young leaves than older leaves. Leaves can also turn red followed by elongated tan stripes with red margins when growing temperatures fall below 55°F. Mottling is less visible at the boot growth stage. Most plants will survive infection but can be stunted and produce abnormal heads; severely infected plants may die.

Key Features of Disease Cycle: Some strains of the virus may overwinter in johnsongrass rhizomes. Aphids and greenbugs may acquire the virus by feeding on infected johnsongrass and then may transmit the virus when they feed on sorghum or other susceptible plants such as corn. Late-planted sorghum is at a greater risk of MDM because the insect vectors are in greater numbers later in the season.

Management: Insecticide treatments do not provide high levels of control of this disease. The best control of MDM is achieved when resistant hybrids are planted and when johnsongrass and other perennial grassy weeds are controlled.

Fungal Leaf Blights and Spots

Cause: *Exserohium*, *Bipolaris*, *Cercospora*, *Gloeocercospora*, *Ascochyta*, *Ramulispora*, *Puccinia*, *Helminthosporium*, *Colletotrichum*

Symptoms: Fungal leaf blight and spot diseases and their characteristic symptoms are presented in Table 2.

Key Features of Disease Cycle: With the exception of the sorghum leaf rust fungus (*Puccinia purpurea*), most fungi that cause leaf blights and spots survive in crop residue; spores are spread by wind and splashing rains. In severe cases where upper leaves are infected yield may be reduced, but in most cases these diseases cause minimal yield losses.

Management: Use resistant hybrids and rotate fields out of sorghum and corn for one to two years. Controlling grassy weeds can also eliminate potential inoculum sources. Foliar fungicides will provide some protection against most foliar diseases.

Bacterial Leaf Blights and Spots

Cause: *Burkholderia*, *Xanthomonas*, *Pseudomonas*

Symptoms: Bacterial leaf blight and spot diseases and their characteristic symptoms are presented in Table 2.

Key Features of Disease Cycle: Bacteria overwinter in infected plant debris and can be spread in seed. Spread of bacteria can occur by wind, splashing rain, and insects. Bacterial diseases are most severe when temperatures are warm (75° to 80°F) with high moisture. Bacterial diseases generally cause little economic damage.

Management: Purchase high quality, certified seed and use resistant hybrids. Limiting grain sorghum production in a field every third year and controlling weeds, especially shattercane (*Sorghum bicolor*), will reduce bacteria.

Stalk Rots

Charcoal Rot

Cause: *Macrophomina phaseolina*

Symptoms: The stalk feels spongy, and when stems are cut lengthwise the interior will be shredded and discolored because the fungus decomposes the pith tissue. Plants often lodge. Small, pin-sized black fungal structures (microsclerotia) may be observed in affected crown and stalk tissue.

Key Features of Disease Cycle: Charcoal rot is worsened by drought. Droughty conditions may weaken the plant's defenses, which can increase disease severity. High plant populations, high nitrogen

Table 2. Characteristic symptoms of grain sorghum foliar diseases

Disease	Pathogen	Lesion Shape	Lesion Size	Lesion Color	Other Characteristics
Leaf blight (northern leaf blight)	<i>Exserohilum turcicum</i>	Irregular, cigar-shaped	≥ 1"	Gray with tan-red borders	Very large elongated spots
Target spot	<i>Bipolaris sorghicola</i>	Round, elliptical	⅛ to 1"	Tan with red borders	
Gray leaf spot	<i>Cercospora sorghi</i>	Elongate to rounded	≥ ¼"	Dark purple	Lesions may become gray
Zonate leaf spot	<i>Gloeocercospora sorghi</i>	Irregular to semicircular	Lesions can combine to form large spots	Alternating dark purple and tan bands	Lesions resemble bull's-eye target; similar to red symptoms produced by maize dwarf mosaic virus
Rough spot	<i>Ascochyta sorghina</i>	Broad, elliptical	¼ to ½"	Grayish to yellow or purple	Center of lesion rough to touch; feels like fine sandpaper
Sooty stripe	<i>Ramulispora sorghi</i>	Elongate, elliptical	3 to 5" long, ¾" wide	Tan center, purple margins	Center of old lesions appear sooty
Rust	<i>Puccinia purpurea</i>	Round to elliptical raised pustules or blisters	⅙ to ⅛"	Light red-brown	Usually confined to older leaves
Southern leaf blight	<i>Bipolaris maydis</i>	Angular	Small flecks to 1 ½"	Tan	Minor significance
Anthraxnose	<i>Colletotrichum graminicola</i>	Elliptical	⅛ to ⅞"	Tan to red with distinct margins	Spore masses common in lesions; can develop on leaves and stems
Bacterial stripe	<i>Burkholderia andropogonis</i>	Rectangular	¼ to > 9"	Red stripes	Confined between leaf veins; appears in lower leaves first
Bacterial streak	<i>Xanthomonas campestris</i> pv. <i>holcicola</i>	Rectangular	1 to 6" long, ⅛" wide	Yellow stripes	Red-brown blotches appear in streaks; may broaden into oval spots with tan center and narrow, red margins
Bacterial spot	<i>Pseudomonas syringae</i>	Irregular	Small spots	Tan with dark margins	

Sources: Wrather, A. and L. Sweets. 2009. G4356, Management of grain sorghum diseases in Missouri. University of Missouri Cooperative Extension Service. <http://extension.missouri.edu/p/G4356>; Herbek, J., D.W. Johnson, J.R. Martin, J.D. Green, L. Murdock, and P. Vincelli. 1993. IPM-5: Kentucky Integrated Crop Management Manual for Field Crops-Grain Sorghum. University of Kentucky Cooperative Extension Service. <http://www.uky.edu/Ag/IPM/manuals/ipm5sorg.pdf>.

levels, and low potash levels can increase severity and incidence of this disease. The charcoal rot fungus survives the winter in soil and crop residue.

Management: Use resistant hybrids with good stalk strength, avoid excessive plant populations, maintain proper fertility, and reduce drought stress with irrigation where possible. The charcoal rot fungus has a wide host range; therefore, many rotational crops also could be susceptible, including soybeans and corn.

Fusarium Stalk Rot

Cause: *Fusarium thapsinum* and other *Fusarium* species

Symptoms: The pith of the lower stalk turns red. Plants can lodge or die prematurely. The pith of the stalks remains intact.

Key Features of Disease Cycle: *Fusarium* stalk rot is worsened during droughts.

Management: Use resistant hybrids with good stalk strength, avoid excessive plant populations, maintain proper fertility, and reduce drought stress with irrigation where possible.

Head Diseases

Smut

Cause: *Sporisorium* spp.

Symptoms: At heading masses of dark, powdery spores replace grain.

Key Features of Disease Cycle: Infection occurs in seedlings.

Management: Smuts are typically not serious problems because fungicide seed treatments control these diseases. Using

high-quality, certified seed of resistant hybrids is the most effective control of sorghum smuts.

Fusarium Head Blight

Cause: *Fusarium* species

Symptoms: Cream to pink fungal growth occurs on grain and can spread to infect the stalk at and immediately below the head.

Key Features of Disease Cycle: The fungus spreads through seed and on crop residue. Warm, moist conditions promote disease development.

Management: Timely harvest at proper grain moisture is important to limiting this disease. Hybrids with pigmented seed coats and open head types are more tolerant.

Harvesting

Grain sorghum does not reach moisture levels suitable for direct marketing (14.0%) or safe storage (13.5%) until after the application of a harvest aid or desiccant or a killing frost in Kentucky. Typically grain sorghum is harvested when seed moisture is between 18 and 22 percent after a harvest aid/desiccant application. In most fields, if harvest is delayed until after a killing frost significant pre-harvest loss can occur due to birds, insects, head molds, and unfavorable weather conditions. For full details on harvesting, drying, and storing grain sorghum refer to AEN-17: *Harvesting, Drying, and Storing Grain Sorghum* (<http://www2.ca.uky.edu/agc/pubs/aen/aen17/AEN17.PDF>).

Grain sorghum is typically harvested with a conventional sicklebar header. Stalks should be cut as high as possible to maximize grain heads harvested while minimizing the amount of plant tissue harvested. Grain sorghum stalks are usually much wetter than corn stalks, which allows them to be chopped and delivered to the grain tank, which can result in considerable foreign matter (in this case stalks) in the grain. If heads are drooping or stalks have lodged, pick-up type guards are recommended.

Summary

Diversifying grain crops production systems to include several crops can provide a means to mitigate losses due to uncontrollable environmental conditions. In Kentucky, grain sorghum is an excellent option because adapted hybrids with high yielding capabilities are available. Furthermore, grain sorghum tolerates droughty conditions and can

produce high yields with fewer inputs than corn. The main considerations for grain sorghum production are weed, insect, and disease management. With good agronomic management grain sorghum can be a very profitable crop in Kentucky.

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