

Crop Profile for Sorghum in Kansas

Prepared January 2000

General Production Information



Sorghum is planted under dryland and irrigation conditions. In 1998, total acreage harvested under dryland and irrigation conditions was 3.152 million and 148,000 acres, respectively. Dryland areas produced 250.07 million bushels, while 13.930 million bushels of grain sorghum were produced from the irrigated areas.

Commodity Information in 1998:

- **State Rank:** 1, both in grain and silage productions.
- **Production:** 264 million bushels for grain and 1.2 million tons for silage.
- **% U.S. Production:** 50% and 38% for grain and silage, respectively.
- **Acres Planted:** 3.5 million.
- **Acres Harvested:** 3.3 million for grain and 80,000 for silage.
- **Yield per Acre:** a record high for grain (80 bushels) and 15 tons for silage.
- **Cash Value:** \$466.8 million.
- **Yearly Production Costs per Acre:** \$124 (average production cost in central, western, eastern and irrigated areas).
- **Leading production counties:** Marshall (in the northeastern) produced 8.16 million, Washington and Mitchell (in north central) produced 7.66 and 6.17 million bushels, respectively (Figure 1).

Figure 1. Top three Kansas counties sorghum production in 1998.

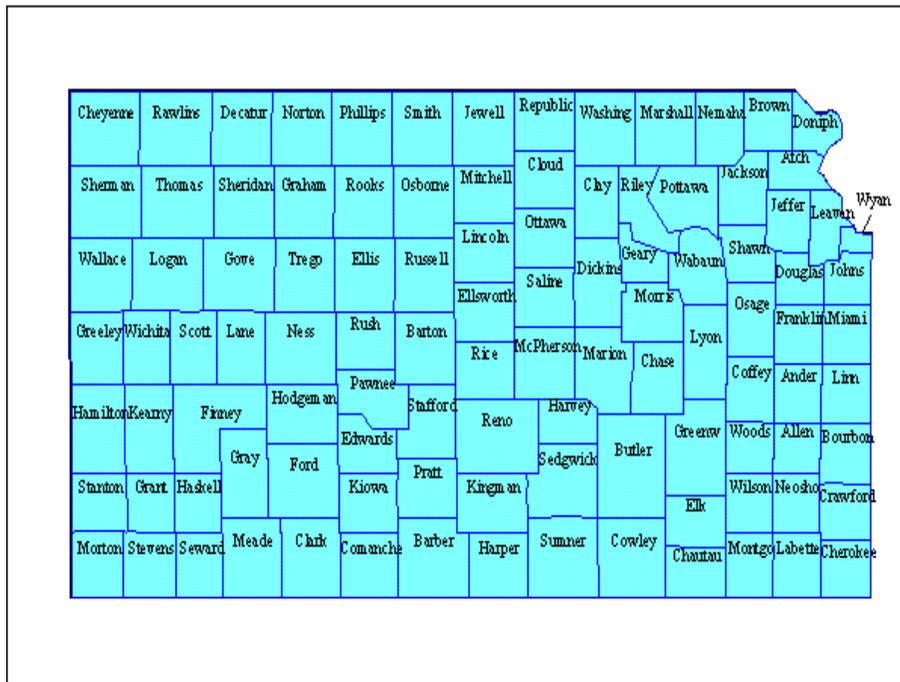


Figure 2. Production Regions



The state of Kansas is divided into nine districts (figure 2). Soil types vary within a district. In general, northwestern and most of the west is deep, dark gray-brown silt loams, except the southwest counties are silt and sandy loams, and brown loamy fine sands. A moderately deep, dark gray-brown silt loams, and gray clays dominate the central and north central districts of Kansas. Northeastern Kansas has very dark brown silt, clay and silty clay loams soils whereas, the southeastern part has shallow, very dark gray-brown silt, clay, and silty clay loam soils. Average rainfall in Kansas ranges from about 16 inches in the west central to over 38 inches in the southeast.

Most of the sorghum produced for grain was grown in the central districts. In 1998, Sumner was the leading county planted sorghum for grain, followed by Reno, Washington, then Marion. The average acreage ranged between 83,000 to 96,000. The leading counties in acres harvested for silage were Rooks in the north central district with 4,100 acres, followed by Hamilton with 3,900 acres and Morton with 3,100 acres in the southwestern district.

Cultural Practices

A number of different tillage and planting systems are used in sorghum production, include primary or secondary tillage, or no tillage operations prior to planting. Conservation tillage includes reduced till, mulch-till, ecofallow, strip-till, ridge-till, zero-till, and no-till. Primary emphasis in conversation tillage is erosion protection.

Sorghum is planted on 30-inch rows or drilled in narrow rows of 15 inches rows. Planting dates vary from mid-May until early July. Sorghum is germinated when soil temperature reaches 70 °F at 2-inch depth. Seeding rate ranges from 24,000 to 100,000 seeds/acre depending on water availability, soil type of a region, natural rainfall and/or irrigation.

Insect Pests

Insect problems in sorghum vary in different areas of the state, from season to season, and from field to field. The green bug is generally of primary concern since it occurs statewide and is capable of inflicting serious damage almost any time during the growing season. Chinch bug is important in central and eastern Kansas, especially during dry seasons. In addition, there is a relatively large group of insects that may, at times, be of local importance, these include false wireworms, seed corn beetles, kafir ants, and wireworms that attack seeds at planting time. Early season insects include wireworms, white grubs, and billbugs. Insects that attack seedlings to 6" plants are flea beetles, thrips, cutworms, corn leaf aphids, chinch bugs, and corn stalk borer. At whorl stage, corn leaf aphids, greenbugs, and fall armyworms are of concern. Later in the season, chinch bugs, false chinch bugs, spider mites, corn earworm, grasshoppers, and sorghum mites may attack sorghum plants.

Sorghum producers applied insecticides to eleven percent of the planted acres during 1998. Aerial broadcasting after planting was the major method of application. Chlorpyrifos was the most commonly applied insecticide. Five percent of Kansas sorghum acres were treated with one time chlorpyrifos at a rate of 0.44 Ib a.i./A for the season, totaling 79,000 pounds.

Insecticide and miticide classes are indicated as follows:

1. **Organophosphates**
2. **Biologicals**
3. **Carbamates**
4. **Organochlorines**
5. **Pyrethroids**
6. **Other**

The following are the classified insecticides applied on Kansas sorghum during 1998. Data are reported from the Kansas Agricultural Chemical Usage, 1998 Wheat and Sorghum Pesticide Summary publication (MF-2437), in response to a survey provided by the Kansas Agricultural Statistics (KAS) and the National Agricultural Statistics Service (NASS) to Kansas producers:

Chlorpyrifos

- **Trade name and formulation:** (1) Lorsban® * 4E
- **Average use rate:** 0.44 Ib a.i./A
- **Number of application:** 1.0
- **Percent acres treated:** 5%
- **Amount applied per year:** 79,000 Ib
- **Target pests:** greenbugs.

Methomyl

- **Trade name and formulation:** (3) Lannate® *
- **Average use rate:** 0.25 Ib a.i./A
- **Number of application:** 1.0
- **Percent acres treated:** 3%
- **Amount applied per year:** 23,000 Ib
- **Target pests:** not reported.

Major insects and the recommended classes of insecticides for sorghum in Kansas:

Seed Attacking Insects:

False Wireworms are yellowish to brown, relatively long-legged hard shelled larvae up to 1 ½ inches or more in length and about the diameter of a large match stick; **Kafir Ant** are tiny (1/6 inch) and orange color; and **Seed Corn Beetle** (*Agonoderus lecontei*) are ¼ inch in length, medium to dark brown with light colored margin around the wing covers.

- **Distribution:** Statewide
- **Damage:** feed and destroy the planted seed before germination
- **Infestation time:** at planting
- **Timing of control:** before planting
- **Cultural Control Practices:** none
- **Biological Control Practices:** none
- **Insecticide treatments:**
Lindane or Lindane/diazinon is used as seed treatment. Label directions on rate and method of application should be followed.

Wireworms(*Elateridae*) are the immature stages of click beetles. They are generally shiny, slender, and hard bodied. Color range from yellow to brown.

- **Distribution:** statewide
- **Damage:** feed on seed or cause injury (stunted plants) or death to small plants by tunneling into the below-ground portion of plants
- **Infestation time:** early season
- **Timing of control:** early season
- **Cultural Control Practices:** none
- **Biological Control Practices:** none
- **Insecticide treatments:**

Seed treatments

-Lindane or Lindane/diazinon. Label directions on rate and method of application should be followed

-Imidacloprid (Gaucho 480) @ 8 oz/100 wt seed, applied as a slurry prior to planting.

Soil treatments

-(3) Carbofuran (Furadan®* 4F) @ 2.5 oz per 1,000 feet of row

-(1) Terbofos (Counter®* 15G or 20CR) @ 1 Ib a.i./A.

Cutworms cause less damage to sorghum than to corn. They are brownish to blackish worms and feed on small plants.

- **Distribution:** statewide
- **Damage:** plants partially or totally cut off just above or below the soil surface

- **Infestation time:** during the first two weeks following planting
- **Cultural Control Practices:** none
- **Biological Control Practices:** none
- **Insecticide treatments:**
 - (1) Chlorpyrifos (Lorsban®*4E) @ 1 Ib a.i./A
 - (5) Lambda-cyhalothrin (Warrior®*T) @ 0.015-0.02 Ib a.i./A
 - (5) Cyfluthrin (Baythroid®*2 EC) @ 0.005-0.02 Ib a.i./A.

Above the Ground Insects:

Chinch Bugs (*Blissus leucopterus*) migrate from small grain fields to nearby sorghum as immature wingless bugs. Adults fly into sorghum either directly from overwintering grasses or from either wheat or other sorghum. Damage generally appears at the margin of the field and progresses inward in May and June.

- **Distribution:** generally in the eastern half of the state, usually in sorghum fields adjacent to wheat
- **Damage:** stunting or dying of small plants with occasionally much reddish discoloration on the lower portions of plants
- **Infestation time:** from seedlings to 6-inch plants
- **Timing of control:** planting time soil treatments or seed treatments
- **Cultural Control Practices:**
 - Plant sorghum away from wheat, especially thin wheat
 - Plant a trap crop between sorghum field and wheat before the normal date of sorghum planting
 - Plant resistant sorghum hybrids
 - Encourage good early vegetative growth
 - Consider planting-time insecticide
 - Scout nearby wheat or small grains during May or June
 - Use a combination of the above ground practices as an integrated approach. The best combination is the use of resistant sorghum hybrids with an adequate chemical program (planting-time).
- **Biological Control Practices:** none
- **Insecticide treatments:**
 - Imidacloprid (Gaucho 480) used as seed treatment @ 8 oz/100 wt seed.

Planting-time treatment

- (3) Carbofuran (Furadan®*4F) @ 2.5 oz per 1,000 feet of row
- (6) Aldicarb (Temik®*15G) @ 1.0 Ib a.i./A, however research indicated promise of early season control @ 0.5-0.75 Ib a.i./A

Field sprays

- (3) Carbaryl (Sevin®) @ 1 ½ to 2 Ib a.i./A
- (3) Carbofuran (Furadan®*4F) @ ½ Ib a.i. in 20 to 30 gal of water/A
- (1) Chlorpyrifos (Lorsban®*4E) @ ½ to 1 Ib a.i./A
- (5) Lambda-cyhalothrin (Warrior®*T 1 Ib EC) @ 0.03 Ib a.i./A
- (5) Cyfluthrin (Baythroid®*2 EC) @ 0.02 to 0.044 Ib a.i./A.

Corn Earworms (*Heliothis zea*) are greenish, pinkish, to almost blackish color. Larvae are ¼ to 1 ½ inches in length and possess a series of stripes on the body.

- **Distribution:** more common in southern half of Kansas
- **Damage:** feed on and destroy grain in the developing head
- **Infestation time:** during the bloom and through the milk stages
- **Timing of control:** August and September
- **Cultural Control Practices:** tillage and early planting
- **Biological Control Practices:** none
- **Insecticide treatments:**
 - (3) Methomyl (Lannate®*) @ 0.45 Ib a.i./A
 - (5) Cyfluthrin (Baythroid®*2 EC) @ 0.02 to 0.044 Ib a.i./A
 - (5) Lambda-cyhalothrin (Warrior®*T) @ 0.02-0.03 Ib a.i./A
 - (1) Chlorpyrifos (Lorsban®*4E) @ 1 Ib a.i./A.

Corn Leaf Aphids (*Rhopalosiphum maidis*) are medium to dark green aphids found in the whorls.

- **Distribution:** Statewide
- **Damage:** leaves become shiny, syrupy, and excessive honeydew present. Some leaves turn yellow with reddish blotches. Generally, no visible injury associated with these insects even though they may be quite numerous
- **Infestation time:** anytime during growing season
- **Timing of control:** June-August, or during whorl stage
- **Cultural Control Practices:** none
- **Biological Control Practices:** parasitic wasps and lady beetles
- **Insecticide treatments:**
 - (1) Chlorpyrifos (Lorsban®* 4E) @ ½ to 1 Ib a.i./A
 - (1) Parathion* @ ½ Ib a.i./A
 - (1) Disulfoton (Di-Syston®*8) @ ¼ to ½ Ib a.i./A.

Fall Armyworm (*Spodoptera frugiperda*)

- **Distribution:** statewide
- **Damage:** feeds on and leaves holes in the leaves. Whorl feeding is most common resulting in a "ragworm" type of injury. Damage more severe on late-planted fields.

- **Infestation time:** whorl stage
- **Timing of control:** June-August
- **Cultural Control Practices:** avoid late planting dates
- **Biological Control Practices:** none
- **Insecticide treatments:** is generally discouraged unless more than 75% of plants show fresh injury. Insecticides recommended to control fall armyworms are:
 - (1) Chlorpyrifos (Lorsban®*4E) @ ½ to 1 Ib a.i./A
 - (3) Methomyl (Lannate®*) @ 0.45 Ib a.i./A
 - (5) Lambda-cyhalothrin (Warrior®*T) @ 0.02-0.03 Ib a.i./A
 - (5) Cyfluthrin (Baythroid®*2 EC) @ 0.02 to 0.044 Ib a.i./A.

False Chinch Bugs are small grayish insects, similar in size and shape to chinchbugs, but color is different. These bugs develop on mustard weeds.

- **Distribution:** statewide
- **Damage:** occasionally occurs, bugs feed in the heads of developing sorghum
- **Infestation time:** July-September
- **Timing of control:** July-September
- **Cultural Control Practices:** none
- **Biological Control Practices:** none
- **Insecticide treatments:**
 - (5) Cyfluthrin (Baythroid®*2 EC) @ 0.02 to 0.044 Ib a.i./A.

Grasshopper (*Acrididae*)

- **Distribution:** statewide
- **Damage Caused:** feeds on leaves, particularly around sorghum field margins. Occasional signs of feeding are observed on the developing seeds in the head
- **Infestation time:** July-August
- **Timing of control:** early in the summer and before infestations move into adjoining sorghum
- **Cultural Control Practices:** none
- **Biological Control Practices:** none
- **Insecticide treatments:**
 - (5) Esfenvalerate (Asana®*2>*) is labeled for non-crop border use, follow label directions for rates
 - (1) Dimethoate (Cygon) @ ½ Ib a.i./A
 - (1) Chlorpyrifos (Lorsban®*4E) @ ¼ to ½ Ib a.i./A
 - (5) Lambda-cyhalothrin (Warrior®*T) @ 0.02-0.03 Ib a.i./A
 - (1) Parathion* @ ½ Ib a.i./A
 - (5) Cyfluthrin (Baythroid®*2 EC) @ 0.02 to 0.044 Ib a.i./A.

Sorghum Greenbugs are tiny light yellowish-green soft-bodied insects that concentrate primarily on the

undersides of lower leaves.

- **Distribution:** statewide but more in central and eastern areas
- **Damage:** seedlings show signs of reddening and sometimes plants dying
- **Infestation time:** anytime during the growing season from seedling through soft dough stages
- **Timing of control:** May-June on seedling plants
- **Cultural Control Practices:** plant resistant hybrids, use reduced-till or no-till planting to discourage infestations, or use a combination of reduced-till with resistant hybrids
- **Biological Control Practices:** lady beetles are effective on light or beginning of infestations. Parasitic wasps are usually extremely effective later in the season, or a combination of beneficial insects with host plant resistance reduces the risk of greenbug damage
- **Insecticide treatments:**
 - Imidacloprid (Gaucho 480) as seed treatment @ 8 oz/100 wt seed

Planting time treatment:

- (1) Terbofos (Counter®*15G) @ 8.7 Ib a.i./A or Counter 20CR @ 6.5 Ib a.i./A
- (3) Carbofuran (Furadan®*4F) @ 2 2/3 pt/A
- (6) Aldicarb (Temik®*15G) @ 1.0 Ib a.i./A

Foliar sprays:

- (1) Disulfoton (Di-Syston®*8) @ ½ Ib a.i./A
- (3) Carbofuran (Furadan®*4F) @ ½ Ib a.i./A
- (1) Parathion* @ ½ Ib a.i./A
- (1) Chlorpyrifos (Lorsban®*4E) @ ¼ to ½ Ib a.i./A
- (1) Dimethoate @ 0.33 Ib a.i./A
- (1) Malathion* @ 1 Ib a.i./A.

Sorghum Midge, a tiny orange or red maggot occasionally presents, but generally not visible except under microscope.

- **Distribution:** eastern areas, usually more common in southeast Kansas
- **Infestation time:** during bloom stage
- **Damage:** seeds fail to develop on part or most of the head
- **Cultural control practices:** establish more uniform, earlier dates of planting to avoid having sorghums blooming during mid- to late August
- **Biological Control Practices:** none
- **Insecticide treatments:** none recommended.

Sorghum Webworm is small, light brown, fuzzy stripped worm about ½ inch long when full grown.

- **Distribution:** eastern areas, usually more common in southeast Kansas
- **Damage:** feed on the developing seed

- **Infestation time:** during bloom stage
- **Timing of control:** August, September
- **Cultural Control Practices:** mowing Johnsongrass and planting early reduce infestation
- **Biological Control Practices:** none
- **Chemical Controls:**
 - (1) Chlorpyrifos (Lorsban®*4E) @ ½ to 1 Ib a.i./A
 - (1) Parathion* @ ¾ Ib a.i./A
 - (3) Methomyl (Lannate®* @ 0.45 Ib a.i./A
 - (3) Carbaryl (Sevin*) @ 1 to 2 Ib a.i./A
 - (5) Lambda-cyhalothrin (Warrior®*T) @ 0.02-0.03 Ib a.i./A
 - (5) Cyfluthrin (Baythroid®*2 EC) @ 0.02 to 0.044 Ib a.i./A.

Spider Mites (*tetranychidae*) are tiny "crawling specks" on the underside of lower leaves and migrate up the plant.

- **Distribution:** western areas, usually more common in extreme southwestern Kansas
- **Damage:** discoloration, browning and yellowing of the lower leaves with signs of light webbing on underside of infested leaves
- **Infestation time:** July-August
- **Timing of control:** July-August
- **Cultural Control Practices:** none
- **Biological Control Practices:** none
- **Chemical Controls:**
 - (1) Dimethoate (Cygon)@ ½ Ib a.i./A
 - (6) Propargite (Comite® II) @ 1.64 Ib a.i./A.

In 1998, Kansas Department of Agriculture authorized a Section 18 for the use of bifenthrin (Capture® 2EL) to control Bank grass mites in grain sorghum production for seed only.

Diseases

Only a few diseases cause economical losses in Kansas sorghum. Total eradication of disease in sorghum is not economically feasible. Estimated of annual sorghum yield losses in Kansas average about 8 percent. Growers try to minimize their damage from disease through the following integrated pest-management practices:

- Rotate crops

- Remove infested debris
- Plant disease-free seed
- Prepare proper seedbeds
- Plant resistant hybrids
- Provide adequate fertility based on soil tests and yield goals
- Accurate pesticide application
- Control insects

Sorghum diseases can be grouped by either pathogen type or the part of the plant they attack. A description of the most common diseases in Kansas follows. Keep in mind that only a few actually cause measurable yield loss.

Seed and seedling rot:

Seed rot and Seedling blight can be caused by several seed- or soil-borne fungi including *Fusarium*, *Rhizopus*, *Aspergillus*, *Penicillium*, and *Pythium*. Both diseases may occur during or following prolonged periods of cool, wet weather just after planting, especially in poorly drained soils. In addition, *Fusarium* seedling blight can occur during periods of hot weather following emergence. Seed rot diseases often attack the seed before it has a chance to germinate or before the plant emerges. Thus symptoms are often thin uneven stands or stands with yellow, weak plants. With seedling blights, plants usually emerge well, but then begin to decline. Plants may turn red, purple or yellow. Small purplish-black spots may form on the lowest leaves. If the subcrown internode is attacked before the secondary roots begin to develop, the plant usually dies.

Management of seed and seedling rot:

- Use seed treated with captan or fludioxonil
- Use metalaxyl for *Pythium* control

Management of seedling blight:

- Avoid planting in low pH soils that favor *Fusarium* development
- Certain herbicides including alachlor, metolachlor and atrazine may increase seedling blight severity especially in low pH soils.

Root and stalk rots:

Root rots are caused by several soilborne fungi, most notably the *Fusariums*. They occur to some extent every year, especially under adverse growing conditions. Symptoms consist of plants that can be easily uprooted. The outer portions of roots are red, gray or black in color and can be easily stripped off. The

top growth is stunted.

Management:

- Plant resistant hybrids
- Avoid soil compaction and make sure soil drainage is adequate
- Avoid continuous cropping, high nitrogen levels, and high plant populations.

Fusarium stalk rot is caused by several species of *Fusarium*. Some species can attack both corn and sorghum. Annual losses are estimated at 4 percent, although it may reach 50 percent in some areas. High nitrogen levels or high nitrogen to potassium ratios combined with high moisture levels following head initiation favor this disease. The most distinctive symptom of stalk rot is the shredding of the internal part of the stalk in the lower internode. The deteriorated inner stalk tissue can range in color from tan to salmon to dark red. Lodging of the stalk can be severe.

Management:

- Plant resistant hybrids with good stay green characteristics
- Avoid continuous cropping, high nitrogen to potassium levels, and high plant populations
- Use potassium chloride where soil tests show a deficiency
- Control insects and diseases to prevent leaf area losses.

Charcoal rot, caused by the soilborne fungus *Macrophomina phaseolina*, usually occurs in light or shallow, drought-stressed soils. Symptoms are similar to that of Fusarium stalk rot except that numerous small, black fruiting structures called sclerotia can be found attached to the vascular strands giving the interior of the stalks a blackened appearance.

Management:

- Plant resistant hybrids with good stay green characteristics
- Avoid drought stress by reducing plant populations
- Plant late-maturing hybrids.

Viral Diseases:

Maize dwarf mosaic virus (MDMV-A) and Sugarcane mosaic virus (SCMV) (formerly MDMV-B) are transmitted primarily by the greenbug and corn leaf aphids. MDMV-A virus overwinters in Johnson grass. The overwintering host of SCMV is unknown. The initial symptoms consist of a yellowish-green mosaic pattern in the whorl leaves. Cool nights (below 60 or 70° F for MDMV-A and SCMV, respectively) may cause a reddening and necrosis of the leaves on susceptible hybrids. Stunting is

usually evident. Flowering may be delayed and seeds may be underdeveloped. Plants that express only the mosaic reaction show less yield reduction than do plants with red leaf symptoms.

Management:

- Plant hybrids resistant to the red leaf phase of the disease.

Small seed disease is associated with infection by MDMV-A or SCMV. Disease development is favored by cool, wet weather and is best observed from the soft dough stage through physiological maturity. Symptoms consist of panicle branches with red to black lesions. Often damage is limited to a black dot inside a floret at the area of seed attachment. As seed shrinks, the black dot turns to a dull color. Hybrids resistant to MDMV-A and SCMV are not immune to small seed disease and no control treatment is recommended at the present time.

Fungal diseases of the foliage and head:

There are several foliar and head diseases caused by fungi that can cause economic yield losses in Kansas. Since fungicides are not available except as seed treatments, management practices consist of planting resistant hybrids, crop rotation, and removal of residue where soil erosion is not a problem. Kansas department of Agriculture authorized a Section 18 for Propiconazole (Tilt) to control ergot.

Sooty stripe, caused by the fungus *Ramulispora sorghi*, is associated with fields that have residue from a previous sorghum crop on the soil surface. Initial infection occurs when the fungal spores are splashed onto the lowest leaves. Following the initial infection, the disease then spreads upwards. Moderate to high levels of disease on susceptible hybrids can cause 25% yield loss or more. Symptoms consist of leaves with elongated tan spots that may extend several inches with broad, yellow-to-orange margins. On the underside of the leaf, small, black, reproductive structures known as sclerotia form within the lesion.

Management:

- Crop rotation combined with tillage to eliminate surface residues
- Plant high yielding resistant hybrids, such as full season hybrids.

Northern corn leaf blight, caused by the fungus (*Exserohilum turcicum*), develops under conditions similar to those that favor sooty stripe. It occurs during prolonged periods of warm, humid weather. Symptoms include large elliptical spots with tan to gray centers and red-to-purple borders.

Management:

- Crop rotation combined with tillage to eliminate surface residues

- Plant high yielding resistant hybrids.

Zonate leaf spot, caused by the fungus *Gloeocercospora sorghi*, is favored by extended periods of high humidity. It appears on sorghum leaves as circular, reddish purple bands alternating with straw-colored or tan areas, which form a concentric, or zonate, pattern with irregular borders.

Management:

- Crop rotation combined with tillage to eliminate surface residues
- Plant high yielding resistant hybrids.

Rust, caused by the fungus *Puccinia purpurea*, usually appears late in the growing season because it does not overwinter in Kansas and must move in from southern growing regions. It is favored by warm, wet weather and occasionally can cause economic yield loss if infection occurs earlier in the growing season on susceptible hybrids. Symptoms consist of small brown blister-like pustules that can form on both the upper and lower leaf surfaces.

Management:

- Plant resistant hybrids
- Avoid late planting.

Gray leaf spot, caused by the fungus *Cercospora sorghi*, usually occurs late in the growing season as the crop matures. Yield losses in Kansas are rare. Leaf lesions consist of narrow, rectangular shaped lesions that are either tan or purple in color, depending on the genetics of the hybrid.

Management:

- Use crop rotation
- Plant resistant hybrids.

Sorghum downy mildew, caused by the fungus *Peronosclerospora sorghi*, is most common in eastern and south central Kansas. It is especially noticeable when sorghum is planted after sudan grass. Symptoms consist of leaves with bright green and white strips in late spring or early summer. Later in the season, leaves are shredded by wind until most of the veins are separated. Heads are partially or completely sterile.

Management:

- Avoid planting sorghum after sudan grass
- Use crop rotation

- Plant resistant hybrids
- Treat seed with metalaxyl.

Crazy top downy mildew, caused by *Sclerophthora macrospora*, occurs in heavy or poorly drained soils, and infects young seedlings during periods of flooding within two weeks of emergence. It has a wide host range of grasses including wheat and corn. Infected plants exhibit thick, stiff, twisted, yellow leaves. Diseased plants either do not produce heads or produce a leafy structure in place of the head.

Management:

- Plant resistant hybrids
- Use metalaxyl or mefenoxam treated seed
- Avoid wet areas of the field where the disease has been a problem in the past.

Sorghum ergot, caused by the fungus *Claviceps africana*, occurs worldwide. Male-sterile forage sorghums and hybrid seed production fields are most susceptible since the fungus can only attack an unpollinated floret. A mass of white fungal mycelia known as a sphacelium replaces the seed. A sweet, sticky discharge known as honeydew will drip from the head onto the leaves or soil and produces a white, powdery mass of conidia when moist conditions are present.

Management:

- Avoid planting male-sterile forages or hybrids with cold sterility problems
- Avoid late planting

In 1998, Kansas department of Agriculture authorized a Section 18 for the use of propiconazole (Tilt®) to control sorghum ergot.

Head smut, caused by the fungus *Sporisorium reilianum*, is a rarely seen disease, but occurs most often in south central and southwest disease when it does occur. This disease attacks seedlings, but symptoms do not appear until boot or heading stage. Smut galls replace all or part of the entire head. No chemical controls are available.

Management:

- Rotate the crops
- Plant resistant hybrids.

Foliar diseases caused by bacteria:

While common, bacterial diseases cause no measurable losses under Kansas growing conditions. Their primary importance is in international trade because some countries prohibit the import of grain infested with these bacteria.

Bacterial stripe, caused by the bacterium *Pseudomonas andropogonis*, occurs during periods of cool, humid weather. Symptoms consist of leaves with long, narrow, reddish or tan stripes. Lesions are usually enclosed between veins. During periods of high humidity, a bacterial exudate forms over the lesion on the underside of the leaf. This exudate dries to form shiny, crusty spots. No control practices have been recommended.

Bacterial streak, caused by the bacterium (*Xanthomonas holcicola*, is very similar in appearance to bacterial stripe. It differs from bacterial stripe in that it prefers much warmer temperatures. Symptoms consist of narrow, watery, translucent streaks about 1/8 inch wide and 1 to 6 inches in length. After several days, lesion turns red. Like bacterial stripe, a bacterial exudate forms on the underside of leaves during periods of high humidity. No control practices have been recommended.

Weeds

Weed control in grain sorghum is best achieved with an integrated approach on crop rotations and herbicides or tillage, which enhances the ability of sorghum to compete with weeds. Integrated weed management program is based on field notes from previous years that show weed species present, their relative abundance, and locations of perennial-weed infestations. Successful control of annual weeds requires planting the crop into a weed-free environment and other management practices designed to get the crop up before the weeds. Perennial weeds can be suppressed, but are difficult to kill.

Cultural practices for weed control:

1. Crop rotation is the most effective method to control shattercane and Johnsongrass in sorghum.
2. Fallow periods and rotation with summer and winter crops like soybean and wheat, respectively.
3. Delay sorghum planting to promote faster germination in warmer soils, and to destroy early flushes of spring-germination weeds.
4. In tilled seedbeds, field cultivation prior to planting will control emerged weeds, reducing weed-seed in soil. However, this practice may not adequately protect soil from erosion by wind and water.
5. In no-till seedbeds, herbicides are used to control emerged weed seedlings.

Primary Weeds in Kansas Sorghum Fields

Common annual grasses:

- **Fall panicum** (*Panicum dichotomiflorum*) is a native weed. Seeds are the only source of reproduction. It flourishes in warm conditions. Common in cultivated fields, waste areas. Roadsides, abused pastures, and disturbed areas.
- **Witchgrass** (*Panicum capillare* L.) **or ticklegrass, panicgrass, tumbleweed grass** is a native weed. Seeds are the only source of reproduction. It flourishes in warm conditions. Common on cultivated land, roadsides, waste places, and rangeland in poor condition. It is abundant where the soil is somewhat sandy.
- **Foxtail includes giant** (*Setaria faberi*) (**giant bristlegrass, Chinese foxtail, Chinese millet, nodding foxtail**) native of Asia; **green** (*Setaria viridis* L.) (**green bristlegrass, pigeongrass, wild millet**) native of Eurasia; **and yellow** (*Setaria glauca* L.) (**yellow bristlegrass, pigeongrass, wild millet**) native of Europe. Seeds are the only source of reproduction. Common on cultivated soils, waste places, roadsides and degraded rangeland and pastures.
- **Crabgrass includes large** (*Digitaria sanguinalis* L.) (**hairy crabgrass, purple crabgrass**) native of Europe; **smooth** (*Digitaria ischaemum*) native of Europe. Seeds are the only source of reproduction. Both flourish in warm conditions. Both are common in lawns, cultivated fields, gardens, roadsides, pastures, and waste places.
- **Shattercane** (*Sorghum bicolor* L.) (**black amber, chicken corn, wild cane**) native of Africa. Seeds are the only source of reproduction. It is a major problem in sorghum fields because it is a wild sorghum and because seeds keep germinating throughout the summer. Flourish in warm conditions. Grown in cultivated fields of corn, grain sorghum, and soybeans. Usually requires postemergence herbicides for control.

Annual broadleaf weeds:

- **Kochia** (*Kochia scoparia* L.) (**summer cypress, fireweed, belvedere, mock cypress, Mexican firebush**) native of Eurasia. Flowering season is from July to October. Seeds are the only source of reproduction. Found on rangeland, pastures, fields and disturbed sites.
- **Common cocklebur** (*Xanthium strumarium* L.) is a native weed. Flowering season is from July to September. Seeds are the only source of reproduction. Found in open fields, gardens, pastures, and waste areas. Common cocklebur is especially abundant in areas where retreating water has exposed previously submerged land.
- **Common sunflower** (*Helianthus annuus* L.) (**annual sunflower**) is a native weed. Flowering season is from July to September. Seeds are the only source of reproduction. Found in cultivated fields, pastures, gardens, roadsides, waste ground, and disturbed sites.
- **Devil's claw** (*Proboscidea louisianica*) (**unicorn plant, aphid trap**) is a native weed. Flowering season is from June to October. Seeds are the only source of reproduction. Found in sandy and loamy soils. It is most common on waste ground, overgrazed pasture, fields, and roadsides.
- **Velvetleaf** (*Abutilon theophrasti*) (**Indian mallow, butter print, buttonweed**) originated from

India. Flowering season is from July to October. Seeds are the only source of reproduction. Found in summer crop fields such as sorghum, corn, and soybeans, in waste places, roadsides, and fence rows.

- **Venice mallow** (*Hibiscus trionum* L.) (**Flower-of-an-hour, brown-eyed Suzy**) originated from Europe. Flowering season is from June to September. Seeds are the only source of reproduction. Found in gardens, cultivated fields, pastures, roadsides, railroad rights-of-way, and waste places.

Common perennial weeds:

- **Johnsongrass** (*Sorghum halepense* L.) is a perennial grass originated from the Mediterranean region. Flourish in warm conditions. Rhizomes and seeds are the source of reproduction. Found in moist soil of waste places, cultivated fields, pastures, and roadsides.
- **Field bindweed** (*Convolvulus arvensis* L.) (**creeping Jenny**) is a native of Eurasia. Flowering season is from June to September. Seeds, spreading roots and rhizomes are the source of reproduction. Found on both cultivated and uncultivated land. It is most common in small grain and summer crop fields, in waste places, gardens, and roadsides.
- **Common milkweed** (*Asclepias syriaca* L.) is a native weed. Flowering season is from May-August. Rhizomes and seeds are the source of reproduction. Found in cultivated fields, floodplains, pastures roadsides, and waste places.
- **Hemp dogbane** (*Apocynum cannabinum* L.) (**Indian hemp**) is a native weed. Flowering season is from May-September. Rhizomes and seeds are the source of reproduction. Found in cultivated fields, pastured, rangeland, roadsides, and waste areas.
- **Woollyleaf bursage** (*Ambrosia grayi*) (**bur ragweed, woollyleaf povertyweed, woollyleaf franseria, lagoonweed**) is a native perennial weed. Flowering season is from August to October. Seeds and spreading roots and rhizomes are the sources of reproduction. Found in moist places in the fields, rangeland, and roadsides, and can grow in saline soils.

Chemical Treatments:

In 1998, ninety-one percent of sorghum acres were treated with some type of herbicide. An estimated 7.74 million pounds of herbicides were applied to Kansas sorghum fields. Broadcasting without incorporation after seeding was the most common method of application. Atrazine was the most frequently used herbicide, applied to eighty-two percent of Kansas sorghum fields. The average application rate of atrazine was 1.12 Ib. a.i./A per application. Forty-four percent of sorghum acres were treated with herbicides before planting, eight percent at planting, and fifty-one percent after planting.

The following are active ingredients of herbicides applied to Kansas sorghum during 1998. Data are reported from the Kansas Agricultural Chemical usage, 1998 Wheat and Sorghum Pesticide Summary

publication (MF-2437) in response to survey provided by the Kansas agricultural Statistics (KAS) and the National Agricultural Statistics Service (NASS) to Kansas producers. Herbicides are classified according to the primary mode of action:

Photosynthesis (D-1 quinone-binding protein) inhibitor:

Atrazine

- **Trade name and formulation:** AAtrex®*AAtrex Nine-O®*available in several trade names, commonly found in 4L and Nine-O DF formulations
- **Average use rate:** 1.12 Ib a.i./A
- **Number of application:** 1.1
- **Percent acres treated:** 82%
- **Amount applied per year:** 3.572 million Ib
- **Application time and target weed:** preplant; preplant incorporated; preemergence before grasses, broadleaf weeds, and sorghum emerge, to control the following: Annual morningglory, barnyard grass, cocklebur, giant foxtail, green foxtail, ground cheery, kochia, lambsquarters, hairy crabgrass, mustards, nightshade, pigweed, ragweed, velvetleaf, wild oats, witch grass, and yellow foxtail postemergence when sorghum is 6-12 inches high, or weeds are less than 6-inches tall to control the following: annual morningglory, cocklebur, lambsquarters, mustards, pigweed, ragweed, smartweed, wild buckwheat, and velvetleaf
- **Component of other products:** Guardsman®*Leadoff™, Laddok®*S-12, Marksman® *, Lariat® *, Bullet® *, Bicep II® *, Bicep II Magnum® *, Bicep Lite II® *, Bicep Lite II Magnum® *, Shotgun®*
- **Comments:** This product is restricted due to ground and surface water concerns. It is not used in well-drained soils, particularly in areas having high groundwater table. Not applied aerially or by ground within 66 feet of the points where field surface water runoff enters rivers or within 200 feet around lakes and reservoirs. This product should be used in combination with other herbicides to control weeds that can't be effectively controlled by this herbicide alone.

Bromoxynil

- **Trade name and formulation:** Buctril® , Moxy® , Broclean®
- **Average use rate:** 0.31 Ib a.i./A
- **Number of application:** 1.0
- **Percent acres treated:** 3%
- **Amount applied per year:** 31,000 Ib
- **Application time:** postemergence but before preboot stage of grain sorghum (growth stage 4)
- **Target plants:** broadleaf weeds in sorghum (grain and silage). Controls pigweeds, kochia, field bindweed, common cocklebur, common lambsquarters, sunflower, and velvetleaf
- **Component of other products:** Buctril + atrazine, Moxy + atrazine
- **Comment:** this herbicide is toxic to fish and wildlife. It is not applied directly to water, or when

weather conditions favor drift from target areas. Can be applied through sprinkler systems to grain sorghum.

Amino acid Synthesis (ALS synthase enzyme) inhibitor:

Prosulfuron

- **Trade name and formulation:** Peak ®
- **Average use rate:** 0.02 Ib a.i./A
- **Number of application:** 1.0
- **Percent acres treated:** 5%
- **Amount applied per year:** 5,000 Ib
- **Application time and target plants:** postemergence to control velvetleaf, common cocklebur, and morningglory. Also, it controls triazine-resistant biotypes. Does not control ALS-resistant pigweeds
- **Comments:** no grazing or feeding forage from Peak® -treated crops to livestock until 30 days after application.

It should be noted that Metsulfuron (Ally) was granted a Section 18 for sorghum in 1999, which is a year after the 1998 Pesticide Use Survey was conducted.

Seedling shoot inhibitors:

Alachlor

- **Trade name and formulation:** Lasso® *, Partner®*
- **Average use rate:** 1.93 Ib a.i./A
- **Number of application:** 1.0
- **Percent acres treated:** 10%
- **Amount applied per year:** 695,000 Ib
- **Application time:** preplant incorporated; preemergence surface
- **Target plants:** annual grasses and small-seeded broadleaf weeds like pigweeds
- **Component of other products:** Bullet® *, Lariat®*
- **Comments:** Lasso® is not applied when conditions favor drift, directly to water, or to area where surface water is present, especially where soils are coarse and ground water is near surface.

Metolachlor

- **Trade name and formulation:** Dual II Magnum®
- **Average use rate:** 1.55 Ib a.i./A
- **Number of application:** 1.0

- **Percent acres treated:** 40%
- **Amount applied per year:** 2.207 million Ib
- **Application time:** preplant surface or preplant incorporated into top 2 inches of soil; preemergence after planting but before sorghum or weeds emerge
- **Target plants:** annual grasses and small-seeded broadleaf weeds
- **Component of other products:** Bicep II® *, Bicep II Magnum® *, Bicep Lite II® *, Bicep Lite II Magnum®*
- **Comments:** to avoid spray drift, this product is not applied under windy conditions.

Propachlor

- **Trade name and formulation:** Ramrod® FL
- **Average use rate:** 2.44 Ib a.i./A
- **Number of application:** 1.0
- **Percent acres treated:** 3%
- **Amount applied per year:** 249,000 Ib
- **Application time:** preemergence surface applied before sorghum or weeds emerge
- **Target plants:** controls grasses more efficiently than broadleaf weeds in grain sorghum (milo) such as barnyardgrass, crabgrass, foxtail (yellow, giant, green), pigweed, and annual ryegrass
- **Comments:** Ramrod® is not applied when weather conditions are likely to cause drift from treated areas, directly to water, or to areas where surface water is present or to intertidal areas below the mean high water mark.

Dimethenamid

- **Trade name and formulation:** Frontier® 6
- **Average use rate:** 1.26 Ib a.i./A
- **Number of application:** 1.0
- **Percent acres treated:** 5%
- **Amount applied per year:** 215,000 Ib
- **Application time:** preplant and/or preemergence
- **Target plants:** annual grasses and small-seeded broadleaf weeds in grain sorghum
- **Component of other products:** Guardsman® *, Leadoff™
- **Comments:** This product is not applied where soils are permeable or coarse and ground water is near the surface, directly to water, or to areas where surface water is present.

Growth regulators:

2,4-D

- **Trade name and formulation:** available in several formulations or brand names
- **Average use rate:** 0.29 Ib a.i./A

- **Number of application:** 1.1
- **Percent of acres treated:** 18%
- **Amount applied per year:** 205,000 Ib
- **Application time:** preplant (burndown); postemergence when sorghum is 6 to 15 inches high
- **Target plants:** annual and perennial broadleaf weeds
- **Component of other products:** Landmaster®BW (preplant and burndown), Shotgun®*
- **Comments:** 2,4-D is toxic to aquatic invertebrates. It is not applied when weather conditions favor drift from target area, directly to water, or to areas where conditions favor drift from target area, directly to water, or to areas where surface water is present. Not used through any type of irrigation system.

It should be noted that 2,4-D was granted a Section 18 for sorghum in 1999, which is a year after the 1998 Pesticide Use Survey was conducted.

Dicamba

- **Trade name and formulation:** Banvel® , Clarity®
- **Average use rate:** 0.22 Ib a.i./A
- **Number of application:** 1.2
- **Percent of acres treated:** 10%
- **Amount applied per year:** 97,000 Ib
- **Application time:** postemergence; preharvest
- **Target plants:** many annual and some perennial broadleaf weeds in sorghum including triazine-resistant species
- **Component of other products:** Marksman®
- **Comments:** not applied directly to water or to areas where surface water is present. To avoid ground water contamination, not applied in areas where soils are permeable, particularly where water table is shallow.

Amino acid synthesis (EPSP synthase enzyme) inhibitor:

Glyphosate

- **Trade name and formulation:** Roundup™ , Roundup Ultra™
- **Average use rate:** 0.45 Ib a.i./A
- **Number of application:** 1.5
- **Percent acres treated:** 17%
- **Amount applied per year:** 414,000 Ib
- **Application time:** preplant burndown; spot treatments (direct postemergence); preharvest only for feed crop
- **Target plants:** annual weeds and volunteer grains
- **Component of other products:** Landmaster® BW

- **Comments:** not applied directly to water or to areas where water is present. Sorghum is not harvested or the treated vegetation is not fed to livestock for 8 weeks following application.

Reported data for the following herbicides used on sorghum were insufficient to publish:

- Halosulfuron (Permit®) and Bentazon (Basagran®) for postemergence broadleaf weed control.
- Paraquate (Cyclon® *, Gramoxone Extra® *) for preplant burndown or direct postemergence.
- Diuron (Karmex® DF, Direx® 4L or 80DF, Drexel Diuron 4L or 80DF) for perennial grasses.

® Registered name

Restricted-Use Pesticide (RUP)

™ Trade name

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