United States Department of Agriculture
Natural Resources Conservation Service

Plant Guide

SORGHUM

Sorghum bicolor *(L.) Moench*

Plant Symbol = SOBI2

Contributed by: USDA NRCS Tucson Plant Materials Center

Flowering sorghum seed head and vegetation in Tucson, Arizona. (Photo by Jonathan Walther, USDA-NRCS, Tucson Plant Materials Center)

Alternate Names

Alternate Common Names: sweet sorghum, sorgo forrajero (Spanish), durra (Africa), guinea corn, black amber, chicken corn, shattercane, wild cane, broomcorn, grain sorghum, forage sorghum, Sudangrass

Alternate Scientific Names:
Sorghum vulgare Pers.,
Andropogon sorghum (L.). Brot.,
Sorghum bicolor (L.) Moench ssp. *arundinaceum* (Desv.) de Wet & Harlan,
Sorghum bicolor (L.) Moench ssp. *bicolor*,
Sorghum bicolor (L.) Moench ssp. *drummondii* (Nees ex Steud.) de Wet & Harlan

Uses

Cover Crop: Sorghum is used as a drought tolerant, summer annual rotational cover crop either alone or seeded in a warm season cover crop mixture. There are multiple cultivars of sorghum available for use as a cover crop including sorghum-Sudangrass hybrids (*Sorghum bicolor* x *Sorghum bicolor var. sudanense*). However, all sorghum and Sudangrass-related species have the potential to smother weeds, suppress nematode species, and penetrate compacted subsoil (Clark, 2007). Sorghum cover crops can also be used as livestock forage in a cropping system (Magdoff and Van Es, 2009). Sorghum-Sudangrass hybrids can produce up to 4,000-5,000 pounds of dry matter per acre (Clark, 2007).

Soil Compaction: Sorghums and sorghum-Sudangrass hybrids have extensive root systems that can penetrate up to 8 feet into the soil and extend more than 3 feet away from the stem (Shoemaker and Bransby, 2010). These aggressive root systems alleviate subsoil compaction. To encourage more significant root growth, sorghum stalks should be cut at least once during the growing season when they reach 3–4 feet tall (Clark, 2007).

Weed Management: Sorghums are quick growing grasses that have the potential to shade out and/or smother weed populations when planted at a high density. In addition, root exudates of sorghum have been shown to reduce the growth of weeds such as velvet leaf, thorn apple, redroot pigweed, crabgrass, yellow foxtail and barnyardgrass (Stapleton et al., 2010). Sorghum is also recommended for control of nutsedge infestations (Clark, 2007).

One of the most studied root exudates of sorghum is the compound sorgoleone. Sorgoleone is produced exclusively by sorghum species and suppresses the growth of many plant species, but it is most active on small seeded species (Dayan et al., 2010). Sorgoleone activity in the soil is similar to the activity of a pre-plant incorporated herbicide. Detectable levels of sorgoleone have been measured up to seven weeks after incorporation (Dayan et al., 2010).

Root exudates also have the potential to harm annual and perennial crop species such as tomato, lettuce, and broccoli. However, researchers in California found that the harmful effects of sorghum root exudates are less persistent when sorghum residues are shredded and/or incorporated into the soil (Stapleton, 2010).

Pest Management: Sorghum-Sudangrass hybrids have been reported to inhibit some species of nematodes in subsequent crops. The suppressive activity of the hybrids

is due to their production of natural nematicidal compounds (Clark, 2007), their poor host status, general stimulation of microbial antagonists, and the release of toxic products during decomposition (Magdoff and Van Es, 2009). For maximum suppression of soilborne diseases, cut or chopped Sudangrass must be immediately well incorporated (Clark, 2007).

Some cultivars of sorghum harbor beneficial insects such as seven-spot lady beetles and lacewings (Clark, 2007). Encouraging beneficial insects is an important part of an integrated pest management plan.

Forage: Sorghum and sorghum-Sudangrass hybrids are all very palatable and are highly valued as forage crops. They can be used as silage, hay, green chop, or in pastures. Sorghum and Sudangrass plants contain a compound called dhurrin, which can break down to release prussic acid (hydrogen cyanide, HCN) (Undersander, 2003). Prussic acid is released from the sugars within the plant during frosts, decomposition, drought stress, and mechanical damage (Dover, 2004). Livestock may show symptoms of prussic acid poisoning within 5 minutes of ingestion and may die within 15 minutes (Stichler and Reagor, 2001).

Biofuel Production: Sorghum cultivars are studied intensively as potential biofuel sources due to their high biomass yield and sugar production. The sugars sorghums produce give it an economical advantage over starch based crops for biofuel use. Other desirable characteristics of sorghum that make it an attractive biofuel crop for use on marginal lands include its wide range of adaptation, drought resistance, and salinity tolerance (Shoemaker and Bransby, 2010).

Ethnobotany: Sorghum bicolor was domesticated in Africa 3000 years ago (Barkworth, 2003). The first recorded appearance of sorghum in Europe was in the first century A.D. and it was introduced to the United States in the 1850's for syrup production (Winberry, 1983). It is still one of the most important grain crops grown for human consumption and animal feeding throughout the world.

Sorghum grain is gluten free and is a good substitute for cereal grains such as wheat, barley, and rye for individuals with celiac disease. Other uses for sorghum worldwide include beer production (Africa), distilled alcoholic beverages (China), wall boards, and packaging materials (Delserone, 2008).

Status

Sorghum bicolor is a state listed noxious weed in Indiana, Maryland, Nevada, and Pennsylvania. It is listed as a secondary noxious weed in Iowa when not cultivated, and a prohibited noxious weed in Ohio. Please consult the PLANTS Web site and your State Department of Natural Resources for this plant's current status (e.g., threatened or endangered species, state noxious status, and wetland indicator values).

Description

General: Sorghum is an upright, short-day, summer annual that is a member of the Poaceae family. The grass blades are flat, stems are rigid, and there are no creeping rhizomes. Sorghum has a loose, open panicle of short, few-flowered racemes. As seed matures, the panicle may droop. Glumes vary in color from red or reddish brown to yellowish and are at least three quarters as long as the elliptical grain. The grain is predominately red or reddish brown (Kearney and Peebles, 1969; Barkworth, 2003).

Sorghums exhibit different heights and maturity dates depending on whether they are grain sorghums (*Sorghum bicolor* ssp. *bicolor*), forage sorghums *(Sorghum bicolor)*, Sudangrass *(Sorghum bicolor* ssp. *drummondii*), or sorghum-Sudangrass hybrids *(Sorghum bicolor* x *Sorghum bicolor var. sudanense)*. Growth characteristics also vary depending on the location grown, inputs, and agronomic practices. In general, forage sorghums are taller plants with later maturity dates and more vegetative growth than grain sorghums. Sudangrass and sorghum-Sudangrass hybrids fall in between grain sorghums and forage sorghums in height (Undersander, 2003).

Distribution:

Sorghums are of tropical origin (Barkworth, 2003), but have spread all over the world, with current production in many countries including Africa, China, Central and South America, India, and the United States. For current distribution, please consult the Plant Profile page for this species on the PLANTS website.

Adaptation

Sorghum will grow in low fertility, moderately acidic and highly alkaline soils, but it is best adapted to fertile, well drained soils at a pH between 6.0–6.5. Sorghum is not tolerant of frost, shade, or sustained flooding (Clark, 2007; FAO, 2012; Undersander, 2003).

Establishment

Sorghum can be established in conventional, reduced tillage, or no till cropping systems with drill seeding or broadcasting. Soil temperatures should be between 60–70°F before planting sorghum. The recommended seeding depth for all sorghums is ¾–1 ¼ inches in heavy soils and up to 2 inches in sandy soils (Undersander, 2003).

If planting sorghum for cover crop, pest management, and/or weed control, some general recommendations are to broadcast seed at 40–50 lb per acre or drill seed at 35–40 lb per acre (Clark, 2007). Lower seeding rates are typically used if planting sorghum for other purposes or with other species. Seeding rates will vary widely depending upon the method of planting, the type of sorghum planted, and the goals of the planting. For the

best seeding rates, methods, and practices for your area contact your local NRCS office or Extension service.

Management

Fertilization: Fertilizer application frequency and amounts will vary with the type of sorghum planted and the goals of the planting. Soils should be tested prior to planting to determine fertilizer requirements. Sorghum biomass will increase with the amount of nitrogen applied. Standard biomass production (4,000-5,000 pounds of dry matter per acre) will require applications of 75–100 lb of nitrogen/acre (Clark, 2007).

Forage/grazing management: All sorghums grow tall and develop thick stalks if left unmanaged. Timely mowing/grazing is important because tall, fibrous plants are difficult to mow or otherwise incorporate into soils. Mowing or grazing when stalks are 3–4 feet tall encourages tillering and deeper root growth and keeps regrowth vegetative and less fibrous (Clark, 2007).

General recommendations to avoid prussic acid poisoning when using sorghums for forage include waiting until plants are 18–30 inches tall before grazing and not grazing closer than 5–7 inches if regrowth is desired. In addition, do not graze immediately after a killing frost (Teutsch, 2009; Undersander, 1990; Undersander, 2003).

Cover crop termination: Sorghum can be killed with herbicide, tillage, and flail chopping. The large quantity of biomass sorghum can produce has the ability to tie up nitrogen and other nutrients. Sicklebar mowing, disking, or flailchopping before tillage will shred biomass into smaller pieces, accelerate residue decomposition, and decrease the likelihood of nitrogen being unavailable to the subsequent crop (Dover, 2004). In no till cropping systems, flail chopping after frost, or using herbicide to kill sorghum is recommended (Clark, 2007).

If using sorghum for weed control, a California study has shown that weeds were suppressed for longer periods of time when sorghum residues were left on the soil surface versus soil incorporation (Stapleton, 2010).

Pests and Potential Problems

There are a multitude of bacterial, fungal, and viral diseases of sorghum (Kucharek, 1992; Toler, 1985). Common fungal diseases include anthracnose, leaf blight, sorghum downy mildew, zonate leaf spot, rough spot, sorghum rust, charcoal rot, and stalk rot/grain mold. Grain can also be affected by fungal smut. Most viral diseases of sorghum are mosaics with the most important being maize dwarf mosaic (Toler, 1985). One of the most common bacterial diseases of sorghum is bacterial leaf stripe (Kucharek, 1992).

Insect pests of sorghum can be split into groups including soil and seedling (wireworms, white grubs, beetle larvae, rootworms, cornstalk borers, cutworms, and chinch bugs), leaf and stalk boring (aphids, greenbugs, whorl-worms, budworms, fall armyworms, grasshoppers, mites, stalk boring moth caterpillars), and panicle and seed pests (sorghum midge, corn earworms, fall armyworms, sorghum webworms, stink bugs, false chinch bugs) (Teetes and Pendelton, 1999; Buntin, 2012).

General guidelines for the control of disease and insect pests are the selection of resistant hybrids, planting disease-free seed at the appropriate soil temperatures, avoiding field operations when foliage is wet, proper crop rotation, control of weeds, and removing or burying crop debris (Kucharek, 1992; Teetes and Pendelton, 1999; Buntin, 2012). Identification of individual diseases and insects is paramount when choosing control methods. Please contact your local agricultural extension specialist for assistance in proper identification of diseases and/or insect pests in your fields.

Environmental Concerns

A subspecies of sorghum, shattercane (*Sorghum bicolor* ssp. *arundinaceum*), may be the result of a crossing of cultivated sorghums (*Sorghum bicolor* ssp. *bicolor*) and Johnsongrass (*Sorghum halepense*), an invasive, noxious weed in many parts of the U.S. (Hill, 1983). To prevent crossing of cultivated sorghums with Johnsongrass use sterile sorghum cultivars and control Johnsongrass infestations.

Control

Please contact your local agricultural extension specialist or county weed specialist to learn what works best in your area and how to use it safely. Always read label safety instructions for each control method.

Seeds and Plant Production

When planting for seed production, a firm weed free seedbed is needed. Seeds can be planted up to 2 inches deep depending on soil textures. The seeding rate may vary widely depending on the variety being planted and row spacing. A general recommendation is to calculate seeding rates based on desired plant populations per acre rather than pounds of seed per acre due to the large variances in the seed sizes of sorghum varieties (Kansas State University, 1998). Sorghums cross pollinate, requiring seed production fields to be isolated by approximately 3,000 ft from other sorghum crops (FAO, 2012).

Fertilizer applications should be based upon soil tests. The nutrient requirements of sorghum seed production are similar to that of corn. Sorghum seed is sensitive to fertilizer burn. Fertilizer should be incorporated into the soil prior to planting or otherwise applied to avoid seedling damage (Undersander, 1990). Fertilizer should be applied so that nitrogen is available during the vigorous growth stages. By the boot stage of sorghums, 65–70% of the total nitrogen has been taken into the plant (Kansas State University, 1998).

Sorghum seed is harvested by combine when the seed moisture content is less than 30%. Sorghum seed is susceptible to damage during threshing and careful operation of the combine is necessary to minimize losses. Recommended cylinder speeds are 750-1300 R.P.M. Sorghum grain must be dried thoroughly and stored in clean containers to prevent mold development (Carter et al., 1990; Kansas State University, 1998).

Cultivars, Improved, and Selected Materials (and area of origin)

Cultivars of sorghum are readily available for different geographical regions, climates, soil types, disease resistance, and uses. To find the right variety or cultivar for use in your area contact your local NRCS office or Extension Service.

References

Barkworth, M. 2003. *Sorghum* Moench. In: Flora of North America Vol 25 Magnoliophyta: Commelinidae (in part): Poaceae, Part 2. Oxford Univ. Press, New York. p. 626–630.

Björkman, T., and J.W. Shail. 2010. Sudangrass and sorghum-Sudangrass. Cornell Univ. Cooperative Extension Fact Sheet 14, Ithaca. http://www.hort.cornell.edu/bjorkman/lab/covercrops/pdf/sudangrass.pdf (accessed 1 August 2012).

Buntin, D.G. 2012. Grain sorghum insect pests and their management. Univ. of Georgia Coop. Ext. Bull. 1283, Griffin. http://www.caes.uga.edu/publications/pubDetail.cfm?pk_id=7797 (accessed 1 August 2012).

Carter, P.R., D.R. Hicks, E.S. Oplinger, J.D. Doll, L.G. Bundy, R.T. Schuler and B.J. Holmes. 1990. Grain sorghum (milo). In: Alternative field crops manual. Wisconsin and Minnesota Cooperative Extension, Univ. of Wisconsin, Madison, and Univ. of Minnesota, St. Paul.

Clark, A. (ed.) 2007. Managing cover crops profitably, 3rd ed. National SARE Outreach Handbook Series Book 9. Natl. Agric. Lab., Beltsville, MD.

Delserone, L.M. 2007. Sorghum. J. of Agric. & Food Information 8:9–14.

Dayan, F.E., A.M. Rimando, Z. Pan, S.R. Baerson, A.L. Gimsing, and S.O. Duke. 2010. Sorgoleone. Phytochemistry 71:1032–1039.

Dover, K., K.H. Wang, and R. McSorley. 2004. Nemotode management using sorghum and its relatives. Florida Cooperative Extension ENY716, Gainesville.

Food and Agriculture Organization (FAO). 2012. *Sorghum bicolor* (L.) Moench. In: Grassland Species Profiles Database [online]. www.fao.org/ag/agp/agpc/doc/gbase/data/pf000319.htm (accessed 17 July 2012).

Han, L.P., Y. Steinberger, Y.L. Zhao, and G. H. Xie. 2011. Accumulation and partitioning of nitrogen, phosphorus and potassium in different varieties of sweet sorghum. Field Crops Res. 120:230–240.

Hill, R. 1983. Johnsongrass, *Sorghum halepense* (L.) Pers. and shattercane, *Sorghum bicolor* (L.) Moench ssp. *drummondii* (Steud.) de Wet. Regulatory Horticulture Weed Circular No. 4. Pennsylvania Dep. of Agric., Harrisburg. http://www.agriculture.state.pa.us/portal/server.pt/gateway/PTARGS_0_2_24476_10297_0_43/AgWebsite/Files/Publications/shattercane%20article.pdf (accessed 17 July 2012).

Kansas State University. 1998. Grain sorghum production handbook, C-687. Kansas State Univ. Agric. Experiment Stn. and Cooperative Extension Serv., Manhattan.

Kearney, T.H., and R.H. Peebles. 1969. Sorghum. In: Arizona flora. Univ. of California Press, Berkeley. p. 142–143.

Kucharek, T. 1992. Foliar and head diseases of sorghum in Florida. Circular 1073, Florida Coop. Ext. Serv., Gainesville.

Magdoff, F., and H. Van Es. 2009. Building soils for better crops, sustainable soil management. Sustainable Agric. Publ., Waldorf, MD.

Michaud, J.P., R.J. Whitworth, and H. Davis. 2012. Sorghum insect management. MF742. Kansas State Univ. Agric. Experiment Stn. and Cooperative Extension Serv., Manhattan. http://www.ksre.ksu.edu/bookstore/pubs/mf742.pdf (accessed 31 July 2012).

Shoemaker, C.E., and D.I. Bransby. 2010. The role of sorghum as a bioenergy feedstock. In: R. Braun, D. Karlen, and D. Johnson, editors, Sustainable alternative fuel feedstock opportunities, challenges and roadmaps for six U.S. regions, Proceeedings of the Sustainable Feedstocks for Advance Biofuels Workshop, Atlanta, GA. 28–30 September. Soil and Water Conserv. Soc., Ankeny, IA. p. 149–159.

Stapleton, J., C.G. Summers, J.P. Mitchell, and T.S. Prather. 2010. Deleterious activity of cultivated grasses (Poaceae) and residues on soilborne fungal, nematode and weed pests. Phytoparasitica 38:61–69.

Stichler, C., and J.C. Reagor. 2001. Nitrate and prussic acid poisoning. Texas Agric. Ext. Serv., College Station.

Teetes, G., and B.B. Pendelton. 1999. Insect pests of sorghum. Texas A&M Univ. http://sorghumipm.tamu.edu (accessed 31 July 2012).

Teutsch, C. 2009. Warm season annual grasses for summer forage. Virginia Cooperative Extension Publ. 418-004, Blackstone. http://pubs.ext.vt.edu/418/418-004/418-004.html (accessed 1 August 2012).

Toler, Robert. 1985. Maize dwarf mosaic, the most important virus disease of sorghum. Plant Dis. 69:1011–1015.

Undersander, D. 2003. Sorghums, Sudangrasses, and sorghum-Sudan hybrids. Univ. of Wisconsin Focus on Forage 5:5, Madison. http://www.uwex.edu/CES/crops/uwforage/SorghumsFOF.htm (accessed 1 July 2012).

Undersander, D.J, L.H. Smith, A.R. Kaminski, K.A. Kelling, and J.D. Doll. 1990. Sorghum-forage. In: Alternative field crops manual. Wisconsin and Minnesota Cooperative Extension, Univ. of Wisconsin, Madison, and Univ. of Minnesota, St. Paul. http://www.hort.purdue.edu/newcrop/afcm/forage.html (accessed 1 July 2012).

Winberry, J. 1980. The sorghum syrup industry: 1854-1975. Agric. Hist. 54:343–352.

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