

Sorghum



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Sorghum

The sorghums are annual or perennial plants belonging to the portion of the grass family in which species are canelike resembling corn. The flowers are wind-pollinated and eventually develop hard dry fruits (caryopses) enclosed within the persistent glossy glumes. There are approximately 25 species of *Sorghum*, none of which are native to the United States; however, *Sorghum bicolor* (L.) Moench and *Sorghum halepense* (L.) Pers. have been introduced (Barkworth, 2003). The cultivation of sorghum started in Africa between 3000 and 4000 B.C. in the Ethiopian highlands (Doggett, 1976). Sorghum was brought to the United States in the 1800s where it was first grown along the Atlantic coast and then moved westward into areas that were too dry for corn. Since its introduction the crop has greatly changed, the changes resulting from natural mutation and plant breeding. Sorghums grown in the United States are classified according to their use. Plants used for grain are classified as grain sorghums, plants with high saccharine content and used for silage or syrup are classified as sorgos, plants used for brushes and brooms are classified as broomcorns and plants used for hay and pasture are classified as grass sorghums (Poehlman, 1959). Figure 1 shows the dense inflorescence of grain sorghum, while figure 2 shows the contrast in growth habit between grain sorghum and sudangrass.



Figure 1.
Grain sorghum with dense inflorescence.



Figure 2.
Difference in growth habit of grain sorghum (foreground) and sudangrass (background).

The inflorescence in sorghum consists of a spikelet pair and a rame internode that extends from the sessile spikelet to the next most distal sessile spikelet (Barkworth, et al. 2003). The inflorescence branch (rame) usually disarticulates between sets of spikelet pairs at the rame nodes (figure 3). Within the spikelet pair the sessile spikelet contains one sterile or staminate and one bisexual floret, while the pedicellate spikelet consists of a pedicel and a rudimentary spikelet. The sessile spikelet is dorsally compressed and has two firm glumes, the lower is larger than the upper and together conceal the florets. Within the sessile spikelet the lemma of the sterile floret and the lemma and palea of the fertile floret are hyaline and the fertile lemma may be awned (figure 4).

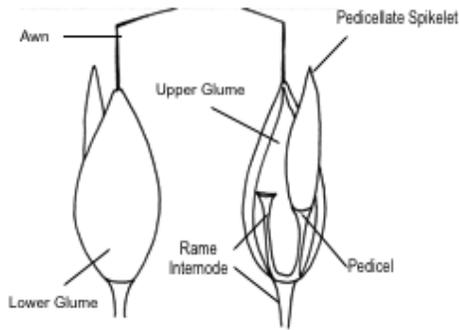


Figure 3.

External morphology of sorghum spikelet (Meyer, 1996).

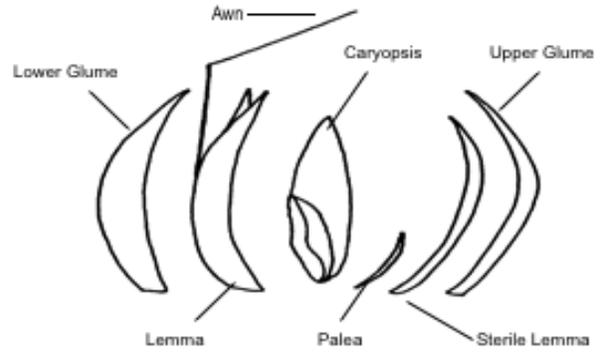


Figure 4.

Internal morphology of sorghum spikelet (Meyer, 1996).

Commonly there are three recognized subspecies of *S. bicolor* occurring in the United States, *Sorghum bicolor* (L.) Moench subsp. *bicolor*, grain sorghum, *Sorghum bicolor* (L.) Moench subsp. *verticilliflorum* (Steud.) de Wet ex Wiersema & J. Dahlb., common wild sorghum and *Sorghum bicolor* (L.) Moench nothosubsp. *drummondii* (Steud.) de Wet ex Davidse, sudangrass (DiTomaso, 2007). These three subspecies, as well as *S. halepense* and the uncultivated strains of *Sorghum bicolor*, along with their many derivations are all interfertile (Barkworth, 2003).

The cultivated strains of annual *S. bicolor* subsp. *bicolor* (grain sorghum, sorgo, and broomcorn) are extremely variable in their growth characteristics. One of the major objectives in the breeding of these sorghums was to develop resistance to shattering or disarticulation of the spikelets at maturity (Poehlman, 1959) (figure 5). Cultivated sorghums have inflorescence branches that remain intact at maturity, (they do not disarticulate) and their caryopses are exposed, extending beyond the glumes at maturity (Barkworth, 2003) (figure 6).

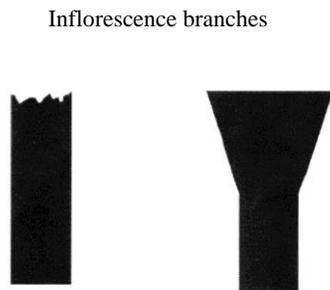


Figure 5.

Inflorescence branch on the left not disarticulating. Inflorescence branch on the right disarticulating. Disarticulation is to separate at a preexisting point (Little and Jones, 1980). Plants that disarticulate easily drop their seeds at maturity, a process called shattering.



Figure 6.

Grain sorghum spikelets in which the caryopses exceed the glumes and the spikelets do not disarticulate at maturity. Note the broken pedicel and rame segments at the base of the spikelet.

Shattercane, an uncultivated strain of *S. bicolor*, is listed as a noxious weed in some states (USDA, 2010). It is a highly variable plant with many biotypes (DiTomaso, 2007). Shattercane is an annual plant reproducing only by seed (Hinz, 2009) that “shatter” easily at maturity making it difficult to control. The plant often becomes a nuisance in cultivated fields reducing yields by competing for light and water with crop plants (Whitson, 1992). The spikelets of shattercane resemble those of grain sorghum but readily disarticulate at maturity (figures 7-8). The caryopses of grain sorghum and shattercane are indistinguishable.



Figure 7.
Spikelets of shattercane. Note the similarity in appearance to grain sorghum in figure 6.



Figure 8.
Shattercane spikelets disarticulate at maturity, as evidenced by the cup-shaped tip of the pedicel and rame segment.

Sudangrass, *S. bicolor* nothosubsp. *drummondii* is an annual plant used for hay. The plant and its spikelets are similar in appearance to johnsongrass and alnum grass but it does not produce rhizomes. The spikelets are 5-6 mm long and usually tardily disarticulate from the inflorescence branches. Unlike grain sorghum the caryopses are completely enclosed by the glumes at maturity (Barkworth, 2003) (figures 9-10).



Figure 9.
Sudangrass spikelets non-disarticulating inflorescence branches commonly observed in harvested product.



Figure 10.
Sudangrass spikelets after full maturity start disarticulating.

Johnsongrass, *S. halepense* is listed as a noxious weed in some states (USDA, 2010) and as a restricted noxious weed seed in the California Seed Law (CCR 3855). It is a perennial grass native to the Mediterranean area, purposefully introduced into the United States as a once desirable pasture and hay crop. The plant spreads by seeds (spikelets, caryopses) and creeping underground stems (rhizomes) (figures 11-12). The seeds can remain viable in the ground for over two years making eradication of the plants extremely difficult. The plant's rhizomes are thick and fleshy with many scars where the leaves would be attached (nodes). These rhizomes present a special problem in that routine cultivation practices chop up the rhizomes into many reproductive units each with the capability of producing a new plant. The spikelets are 3.8-6.5 mm long and 1.5-2.3 mm wide readily disarticulating usually below the sessile spikelets and sometimes below the pedicellate spikelets. Caryopses are not exposed at maturity (Barkworth, 2003).



Figure 11.

Johnsongrass spikelets with disarticulating inflorescence branches that have cup-shaped tips on their pedicel and rami segments.



Figure 12.

Johnsongrass rhizome with roots and culms.

Almum grass, *Sorghum ×almum* Parodi is listed as a noxious weed in several states (USDA, 2010) and as a restricted noxious weed seed in the California Seed Law (CCR 3855). Parodi first described the plant in 1936 as a hybrid between johnsongrass that has at least 55 morphologically distinct vegetative types in this country alone (Duke, 1998) and cultivated sorghum with its numerous cultivars. The hybrid produced is a perennial plant with short curving rhizomes and erect culms. In the 1950's this hybrid was grown as a forage crop in the Midwest (Eberlein, 1988). There are many derivatives produced from this hybridization and *S. ×almum* is just one (Barkworth 2003). In warmer areas of this country almum grass can be a short lived perennial with rhizomes that can create control problems, however, the main problem with controlling this grass is the shattering of its inflorescence at maturity. As shown in figure 13, the spikelets are slightly larger than johnsongrass (Duke, 1998) and readily disarticulate at maturity. The caryopses are not exposed as in grain sorghum (Barkworth, 2003).



Figure 13.

Almum grass spikelets with disarticulating inflorescence branches; note the cup-shaped tips of the pedicel and rami segments as in johnsongrass figure 11.

Figure 14 is a comparison of the spikelets of the different sorghum types discussed here. Note the variation of shape, exposure of the caryopsis and tips of the inflorescence branches



Figure 14. Size comparison of fertile spikelets of shattercane, grain sorghum, sudangrass, alnum grass, and johnsongrass.

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