Sorghum Improvement for Yield

Leo Hoffmann, Jr. and William L. Rooney*

A C₄ grass with center of origin in Africa, sorghum (Sorghum bicolor L. Moench) is adapted to a diverse set of environments ranging from arid and semiarid to tropical and temperate regions throughout the world. As a species, sorghum is classified into five distinct races; bicolor, caudatum, durra, guinea and kafir, and an array of intermediate classes (Harlan and de Wet, 1972). The genetic diversity and wide adaptation provide current sorghum improvement programs with a wide array of unique phenotypes and genotypes to use in future breeding efforts.

Sorghum ranks fifth among cereal grain crops in area planted and total production (FAOSTAT, 2014). This ranking is as a grain crop; however, it is equally important, if not more so, as a forage and fuel crop. Depending on the end use, yields of value can be either grain, or biomass, or a combination of the two.

Yields in sorghum are highly variable and influenced by environment, genotype and their interaction. According to FAOSTAT (2014), the worldwide sorghum grain yield average was 1457 kg ha⁻¹ in 2013. However, there was significant variation based on country of production. For example, the top producing countries were in excess of 3000 kg ha⁻¹. When compared to the documented yield potential of grain sorghum which is as high as 15,000 kg ha⁻¹ (Rooney, 2004), these averages indicate that actual yields are only 20% of the yield potential of the crop. Consequently, there are not only opportunities to improve the genetic yield potential of the crop, but to identify the environmental constraints that produce such a low actual to potential yield.

The purpose of this chapter is to discuss the challenges of breeding sorghum targeting yield improvement through both offensive and defensive breeding strategies. Within this context, offensive breeding refers to the genetic improvement of yield potential, while defensive breeding refers to the incorporation of traits designed to mitigate losses due to both abiotic and biotic stresses.

Historical Perspective: From Domestication to Hybrids

The center of origin for sorghum is Eastern Africa, and much of the diversity within the species still exists within this region (Dahlberg, 2000). By all accounts, sorghum was domesticated in the same area when humans identified and selected plants of value. As a self-pollinated species, these new variants likely arose from...