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Sorghum Varietal Improvement Needs for The South

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SORGHUM VARIETAL IMPROVEMENT NEEDS FOR THE SOUTH

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Sorghum is a crop of tropical origin. However, it is involved in the arid to semi-aid areas of the tropics, not the humid areas. My work has been to characterize some of the requirements for sorghum improvement in the humid Southeast or other subtropical high rainfall areas. I will present a sorghum breeders viewpoint.

Most of my comments will address yield constraints in grain sorghum production, however, make some comments about sorghum silage and sorghum-sudan hybrid quality, and conclude with a short discussion of a serious sorghum production constraints found in many of the tropical areas of the world and to a lesser degree here in the Southeastern U.S. - aluminum (Al) and manganese (Mn) toxicities.

A breeding program must evaluate germplasm in the environment where the farmers will be growing the hybrids. In the past, many of the grain sorghum hybrids sold and grown in the Southeast were developed in the drier regions of West Texas.

If water is eliminated as a variable, yields of grain sorghum are almost always lower in the Southeast than on the high plains of Texas. This is attributed to the higher elevation in West Texas and associated with the lower elevation in the Southeast,and higher night temperatures. We know little about the genetic variability of sorghums to elevated night temperatures. We do know that higher night temperatures do hasten anthesis, reducing the number of days from planting to the period of grain-fill, and this results in lower yields. It has been estimated that for every one day reduction in the number of days to bloom for the same hybrid results in about 300 lbs/A less grain produced. Perhaps we need more tropically adapted hybrids in the southeast region.

Some of the so-called cultural constraints can be better reduced through breeding and others through management. Late planting due to cold wet soils, applying nitrogen too late to increase yields, weeds and insects are some problems that frequently reduce yields in the Southeast.

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There is a large amount of genetic variability in sorghum. Seed color, head shape and size, plant height, length of maturity, seed size and other seed or grain characteristics are just a few of the different phenotypic characteristics in which we can measure variability. There are many more heritable characters that we cannot see, but that can be measured under the right conditions.

In humid areas, diseases of sorghum are the most serious factors limiting yield. Charcoal rot, Fusarium stalk rot and Anthracnose can damage stalks causing lodging, low test weight, and low yields.

Anthracnose is also a serious leaf and panicle disease. However, there is good genetic resistance to this disease (Figure 1). There is evidence that a different biotype of Anthracnose has been found in Georgia. Grey leaf spot, zonate, rough spot and a variety or other minor diseases take their toll when sorghum is grown in humid areas. Sometimes the only affect of these diseases is small seed or reduced test weight, but this translates into reduced yield.

Year in and year out, one disease in its many forms and symptoms probably causes more poor yields or reduced grain quality than any other disease in humid areas of the world. It is Fusarium moniliforme. The disease caused by this agent can affect the whole plant as Pokka Bong, or just result in the leaves sticking together as they emerge from the whorl to form a whip, or as a red stalk rot, or as a disease of the panicle. One of its most severe forms is Fusarium head mold (Figure 2). The farmer can literally lose his crop at maturity by a week or rain and high humidity.

Fusarium and other grain molds can cause nearly total loss by the combine grinding of grains to dust. If the grain does make it into the combine hopper, it is severely docked when sold. Sprouting in the head is another hazard of rains at harvest time.

Diseases are not the only problems in the Southeast. The sorghum midge can also reduce yields or destroy nearly the whole crop. Some hybrids on the market now have genetic resistance to the sorghum midge. The fall armyworm is a frequent pest in this area of the country. We have found some genetic tolerance to the fall armyworm, but the level of resistance is not high and the farmer needs to control this pest with insecticides.

I now want to make a few remarks about forage quality. With silage sorghums the breeder needs to consider three biological systems - the plant, the fermentation system in the silo, and the digestion by the ruminant. One of the genetic factors which increases sorghum forage digestibility the most is the brown midrib factor which causes a reduction in the amount of lignin. I recently released eleven male sterile (A-lines) and maintainer (B-lines) with brown midrib genes.

Figure 1. Antracnose resistant hybrid (right) compared to a susceptible hybrid (left).

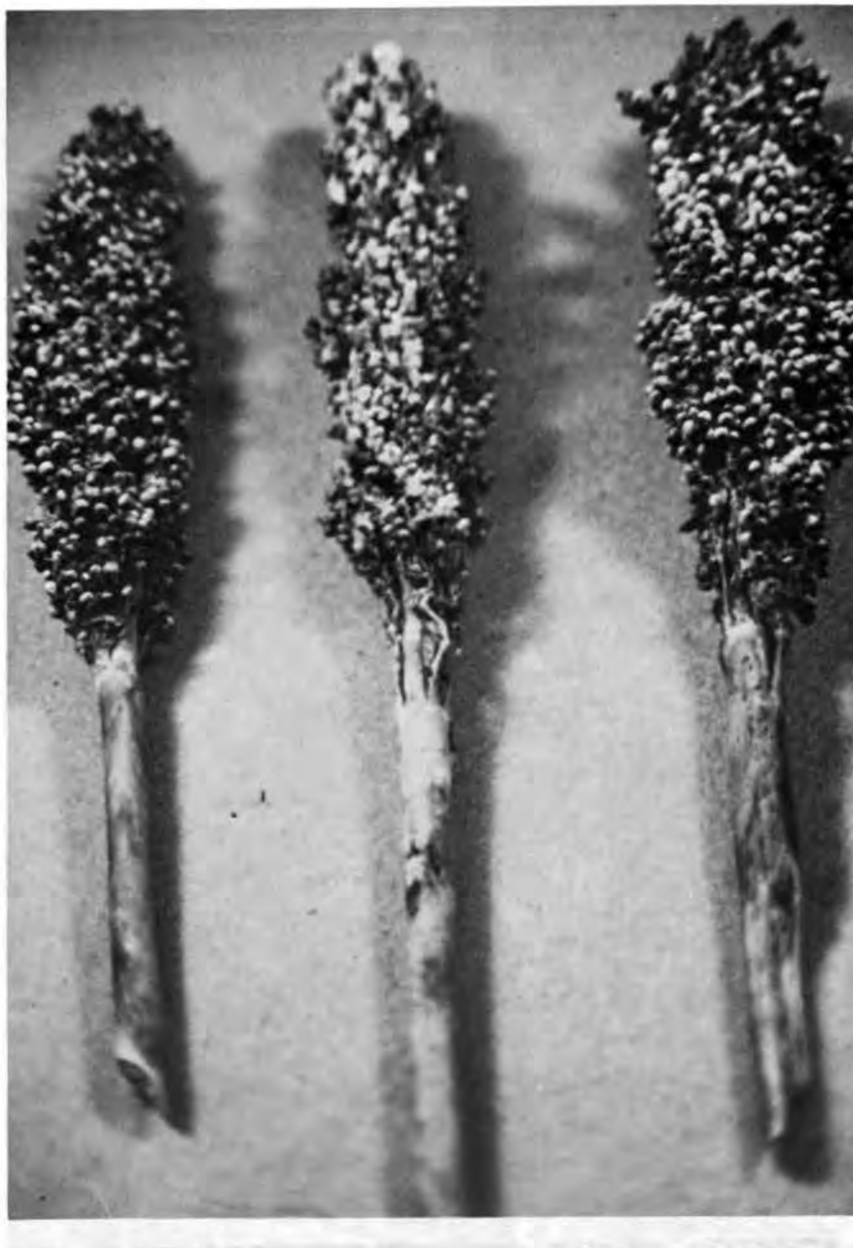

Figure 2. Grain sorghum heads showing varying degrees of head mold. Center most severe.

These genotypes have from 10 to 40% less lignin which makes them more digestible.

The last topic I want to address is the problem of sorghum toxicity to aluminum and/or manganese in acid soils. This is a serious constraint to sorghum production in many topical countries of the world, and to a lesser extent in the Southeast. In the Southeast it is mainly a subsoil problem. All U.S. sorghum hybrids are susceptible to high levels of aluminum saturation above 40%. Research in Colombia, South America has shown that some sorghum genotypes can produce high yields of grain at 65% aluminum saturation (Figure 3). When incorporated into U.S. hybrids, this germplasm should improve sorghum yields in the Southeast when soils have aluminum and manganese toxicity problems.

From this short discussion of problems and research needs to improve sorghum hybrids for some of the production constraints unique to the Southeast, we can see that commercial seed companies will need to address more of these problems in the future as sorghum acreage increases in the higher rainfall areas of the U.S.

Figure 3. Aluminum tolerant variety (right); susceptible variety (left).