Evaluation of Anthracnose on Grain Sorghum

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The discovery of cytoplasmic male sterility (8) in grain sorghum (Sorghum vulgare Pers.) and the subsequent increase in grain yield of F_1 hybrids have stimulated new interest in this crop. As hybrids increased the yield potential, grain sorghum production spread in all directions from the Southern Great Plains Region of the United States. As the crop moved into new environments, new problems developed which threatened its progress. One of the main problems to limit the production of grain sorghum in the humid environment of Georgia and other southeastern states was the build-up of anthracnose (Colletotrichum graminicola (Ces.) G. W. Wils.).

Anthracnose on sorghum was first reported in the United States in 1912 (2) from Texas. Although the disease commonly occurs on grain sorghum (6, 7), it has been considered of importance mainly on sorgo (sweet sorghum) and broomcorn (6). Only leaf symptoms of the disease were recognized until 1943 when serious outbreaks of a stalk-rot on broomcorn were reported in Illinois (3), and the causal organism was listed as C. graminicola. A year later LeBeau, Stokes, and Coleman (4) described a similar disease (red-rot) on sorgo and presented evidence to indicate that leaf-spot and stalk-rot were distinct phases of the disease caused by the same organism. Coleman and Stokes (1) later reported that resistance to anthracnose leaf-spot and stalk-rot was inherited independently, although the genes were closely linked (9.57% crossing over).

The collection of accurate data on the losses caused by anthracnose has been difficult because of the problem of maintaining disease-free controls. Anthracnose leaf-spot has contributed to significant reductions in Brix hydrometer readings, sucrose content, and purity of sorgo juice (4) which has resulted in a reduction in yield and quality of syrup. Where defoliation of the sorgo occurred at least one month prior to harvest, maximum reduction occurred; losses caused by later defoliation were less severe.

Luttrell (7) reported heavy infection of anthracnose leaftop and stalk-rot of grain sorghum in the Georgia variety trials in 1949. He expressed doubt that serious yield losses resulted from anthracnose leaf-spot since the symptoms appeared after the plants were mature. Lodging caused by stalk-rot, however, would have contributed to serious losses in yield in fields harvested with a combine. Losses from anthracnose stalk-rot have generally been associated with lodging (3) and these losses have been reported as high as 100% of total yield. Leukel and Martin (6) reported that diseased but unbroken stalks often bear abnormally small seed.

The present study evolved from the grain sorghum breeding and variety testing program conducted at the Georgia Experiment Station. Since grain yield losses due to anthracnose were important on susceptible hybrids, an attempt was made to measure the extent of these losses by associating varietal yield with anthracnose severity. The results of these studies and a description of new disease symptoms are reported in this paper.

MATeRIALS AND METHODS

The grain sorghum variety trials included 49 commercial and experimental hybrids and varieties representing most of the hybrids offered for sale in Georgia and many of the elite experimental hybrids from commercial and institutional breeding programs. A 7 x 7 triple lattice experimental design was used in the planting. Pits consisted of a single row 16 feet long spaced 36 inches apart.

Although variety trials were conducted annually at several locations, the only tests from which data were reported were those in which infection by C. graminicola was severe. During 1961, severe infection occurred in the Regional Grain Sorghum Hybrid test and the Georgia Grain Sorghum Hybrid test (hereafter called the Regional and Georgia tests, respectively). In the Experimental Georgia test at Experiment was used in 1962 and only the Georgia test at Blairsville in 1963.

Periodically during the growing seasons, the hybrids in each experiment were examined for anthracnose development, and new symptoms were noted. At maturity, anthracnose severity ratings were recorded for each hybrid in all replications. The rating was based on a scale from 0 to 5 where 0 represented no visible symptoms and 5 represented complete susceptibility. During 1961, separate anthracnose ratings were made on the leaves and heads. The rating in 1962 included a composite of leaf, stalk, and head infection. Since early stalk infection occurred in the Georgia test at Blairsville in 1963, separate ratings were recorded for leaf, stalk, and head infection in an attempt to determine whether head infection was associated with either the leaf or stalk phases of the disease.

Yields in pounds per acre and test weights were determined for the entries in the Georgia and Regional tests in 1961. The correlation of grain yield on anthracnose rating and the regression of test weight (where applicable) on anthracnose rating were computed to measure the effect of the disease on these characters. Correlation coefficients between grain yield and anthracnose rating and test weight and anthracnose rating were also computed as a further evaluation of the severity of the disease. The relationship of test weight to anthracnose severity was not studied in 1962 and 1963. The assumption was made that variety yield expression in the absence of the disease was not associated with either anthracnose resistance or susceptibility. Losses in grain yield occurred on a few hybrids as a result of bird depredation, and these hybrids were eliminated from the regression and correlation computations.

RESULTS AND DISCUSSION

Symptoms. During 1961 severe head infection (Figures 1 and 2) occurred on susceptible hybrids in the Regional and Georgia tests at Experiment and the Georgia test at Blairsville in 1963. By the time the grain reached the dough stage of maturity, diseased tissue was evident on the central rachis and primary, secondary, and tertiary branches of the panicle (head). The diseased tissue occurred as red or purplish red lesions which extended throughout the central section of the infected branch. In later stages of the disease, profuse sporulation occurred on these areas and was also evident on the glumes and seed. The seeds of susceptible hybrids failed to develop normally, and when severe infection...