A Comparison of Five Types of Testers in Evaluating the Relationship of Stalk Rot Resistance in Corn Inbred Lines and Stalk Strength of the Lines in Hybrid Combinations

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CORNSTALK rot is one of the most important diseases of corn in Iowa and Diplodia zeae (Schw.) Lev. is usually the most common causal organism. Inbred lines developed in the Iowa Station breeding program in recent years have been selected for resistance to stalk rots. Plants that have been self pollinated are inoculated with a D. zeae spore suspension, and ears are saved usually from only those plants displaying a satisfactory degree of resistance to the development and spread of the rot. The assumption is that, in general, those lines that exhibit superior resistance to Diplodia stalk rot and stalk breakage in hybrid combinations. However, when new inbred lines are evaluated for combining ability in extensive yield trials, it is found that many of them must be discarded due primarily to weak stalks even though they may have been selected through several generations for resistance to stalk rot.

This study was designed to obtain information on the relationship between inbred lines and their testcrosses for stalk rot resistance, the relationship between resistance to stalk rot and resistance to stalk breakage, and the type of tester that will best evaluate the resistance of a line to stalk rot and stalk breakage in hybrid combinations.

REVIEW OF LITERATURE

There may be some question whether stalk rots produced by artificial inoculations are really of much value in breeding for resistance. The fungus normally enters the plant through a root or at a node through a bud, leaf, or shank. However, as has been pointed out by Koehler (4) and Sprague (7), this is really of little importance when corn borers can provide an avenue of entrance. Smith, Holbert and Hobbert (6) found high correlations for rot ratings obtained under artificial and natural infections.

Little data are available on the relationship between stalk rot resistance and stalk strength. Zubet et al. (8) did not find significant correlations between field stalk lodging and ratings for Diplodia zeae and Gibberella zeae (Schw.) Petch when these fungi were introduced artificially into the plants. Foley (1) reported that the artificial introduction of either D. zeae or G. zeae into corn stalks has little influence on the phases of stalk rot responsible for stalk weakness. Sprague (7) has stated that there is a general relation between Diplodia stalk rot rating and incidence of stalk breakage. However, the ability of an inbred to contribute stalk strength to hybrids can be measured satisfactorily only by testing in hybrid combinations.

Relatively little data have been reported on the problem of selecting the most suitable tester to determine the ability of inbred lines to transmit stalk strength to hybrid combinations. Green (2) reported the relative value of a lodging resistant and a lodging susceptible tester for estimating stalk strength contributed by 249 F2 plants. The susceptible tester afforded a greater opportunity for selection among the top crosses although correlations indicated that the testers in general ranked the plants crossed with them in the same order. Keller (3) obtained counts of broken stalks for 33 F2 lines crossed to each of 4 testers and tested in 1 year. Among the 6 correlation coefficients, 2 were positive and significant but neither was large enough to be of predictive value.

MATERIALS AND METHODS

A group of 35 inbred lines ranging from resistant to susceptible to Diplodia stalk rot was chosen for this study. All of these lines had been inbred for 6 or more generations. Some were considered as early, others as late, in the Ames area, but the majority of them would be mid-season type. Five types of testers were chosen: (1) inbred B14, highly resistant to Diplodia stalk rot and stalk lodging; (2) inbred Os420, susceptible to Diplodia stalk rot and stalk lodging; (3) single cross WF9XBR14, resistant to Diplodia stalk rot and stalk lodging; (4) single cross C.187X2 Os420 susceptible to Diplodia stalk rot and stalk lodging; (5) double-double cross 4570XHb180, intermediate in stalk rot resistance and stalk strength. The double-double cross is the tester parent used by the Iowa Station to evaluate new inbred lines in North Central Iowa. It contains 8 different inbred lines; WF9, B14, C.187-2, M14, Os420, Oh15, W22, and Hy, so is related to all of the other testers. Testcrosses were made for each inbred line with each of the testers.

Three field experiments were set up: (1) a test of the inbred lines to obtain ratings for incidence of Diplodia stalk rot; (2) a test for the testcrosses to obtain ratings for Diplodia stalk rot; (3) a second test of the testcrosses to obtain counts for broken plants below the ear node at harvest time. The inbred line experiment was a randomized block with 3 replications and 25 plants per plot. The testcross experiments were in simple split-plot designs with tester type being the whole plot and lines within testers being the subplots. The first testcross experiment had single row plots of 13 plants and 6 replications. The second testcross experiment had 2X5 hill plots with 40 plants per plot and 4 replications, the same as is used in regular yield trials. All tests were heavily planted and thinned to the stands indicated.

The inoculations with a Diplodia zeae spore suspension were made approximately one week after silking. This involved 2 dates for the inbred line experiments since dates of silking showed a spread of about 2 weeks. The inoculations were made in the first elongated internode above ground level. The stalks were split for stalk rot ratings 30 to 35 days after inoculation. A scale of 1 to 6 was used, wherein 1=0-25% spread within the inoculated internode, 2=26-50% spread, 3=51-75% spread, 4=76-100% spread, 5=infection spreading into adjacent internodes, and 6=plant killed. Usually 20 plants per plot in the inbreds and 10 plants per plot in the testcrosses were rated and the individual plant ratings were averaged to obtain a mean plot rating. The second experiment of testcrosses for counts of broken stalks was not inoculated. The count of plants broken below the ear node was made on November 26. This was about 2 weeks after a strong windstorm and 10 days after an 8-inch snowfall both of which caused much stalk breakage. This test gave more information on stalk lodging than is obtained in most years.


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