Studies on the Inheritance of Resistance in Corn to Helminthosporium maydis Leaf Spot

J. B. Pate and P. H. Harvey

RECENTLY the increasing seriousness of the Helminthosporium diseases of corn has emphasized the need for determining sources of resistance and investigations on the inheritance of resistance. Leaf blight caused by Helminthosporium turcicum Pass. and the leaf spot diseases caused by H. maydis Nisikado and Miyake and H. carbonum Ullstrup races 1 and 2 occur in North Carolina. The leaf spot caused by H. maydis has been prevalent over a period of several years and very severe in 1945 and 1949.

Elliot and Jenkins (2) have carried out tests to locate sources of resistance to H. turcicum leaf blight. Studies on the inheritance of its resistance have been reported by Jenkins and Roberit (3) and Genter (1). Ullstrup (4) has reported on the inheritance of resistance to H. carbonum race 1. There are no reports of similar studies with H. maydis leaf spot. The investigations reported here were initiated to ascertain the differential resistance to H. maydis leaf spot of various inbred lines of corn and to study the inheritance of resistance to the disease.

MATERIALS AND METHODS

One hundred and thirteen inbred lines were tested for resistance to H. maydis leaf spot in 1947, and four of the most resistant lines (NC18, NC61, NC87 and Tenn. J526-2), four of the most susceptible lines (NC52, NC52(10), NC65 and N. C. J315) and two intermediate lines (NC45 and C.I.21) were crossed in all possible combinations. The resulting single crosses and parent lines were evaluated for resistance for 3 years. Plants in four one-time backcrosses were self-pollinated and the progenies grown from them were used in studying the segregation of genes governing resistance. Populations of several of the single crosses were also observed.

The inbred lines tested in 1947 were divided into early, medium, and late maturing lines and S1 and S2 second cycle lines, i.e., lines derived from a cross of two lines with one backcross and selected for H. maydis reaction in 1945. Each of these five groups was tested in a separate experiment. The single crosses and their parents as well as the parental inbreds of the backcross progenies were placed in the same experiment each year. Each of the four groups of backcross progenies was either tested in a separate experiment each year or in instances where the number of progenies was small, two groups were placed together. Randomized block, simple lattice and simple rectangular lattice designs were used. F1 populations were not tested in a definite experimental design. Plot size for the inbred lines tested in 1947 was 15 plants long. In the remaining experiments a single row of 15 plants was used.

The culture of H. maydis used in the preparation of the inoculum was obtained in 1947 by a tissue transplant from a leaf spot lesion on a corn leaf and was maintained on agar by mass transfer.

Each year before using the isolate in field inoculations, its virulence was tested in greenhouse inoculations on inbred lines of known leaf-spot reaction. Inoculum was prepared by macerating petri plate cultures of the organism in a Waring Blender, adding 100 cc. of water per culture. Before application, this stock inoculum was diluted by adding 10 parts water to 1 part inoculum. During the first 3 years of the tests, the inoculum was applied with a glass tube siphon from a 4-liter bottle. In 1950 a small pressure sprayer was used in the application. In both instances approximately 10 cc. of the inoculum were directed into the whorl of plants being inoculated.

In 1947 each plant in all plots was inoculated twice; first at a height of 6 to 8 inches and again 1 week later. A hill of the susceptible line, NC52, was placed at the ends of each plot in 1948 and 1949, and these were inoculated several times until secondary spread of the disease began. All plants were inoculated in 1950.

The continuous nature of the variation from very resistant to very susceptible necessitated the use of a rating scale. The scale used consisted of six classes, 0, 1, 2, 3, 4, and 5 with 0 for immunity and 5 for very heavy infection. Ratings were made once each year when it appeared that the epidemic had reached its most severe stage. All plants in a plot were carefully examined for plant to plant variation in making the ratings. Each plant was scored in the F1 populations. However, the plant-to-plant variation in the materials in the other experiments was slight, therefore the plot as a unit was scored.

EXPERIMENTAL RESULTS

The epidemics which developed varied somewhat from year to year, but were especially severe in 1947 and 1949. The inoculation of border plants at the ends of the plots appeared to be as effective in initiating an epidemic as when all plants were inoculated.

The reaction of the 113 inbred lines varied from very resistant to very susceptible. The reaction of the lines did not appear to be related in any way to earliness, as all classes of resistance were found in each of the three maturity groups. Even though the selected second cycle lines were only in the S1 and S2 generations, plant-to-plant variation for resistance was insufficient to permit classification on a per-plant basis. However, there were wide differences among lines derived from the same parentage. Generally the ratings of these second cycle lines were within the range of the ratings of the two original parental lines, but there were instances where recovered lines were either more resistant or more susceptible than either of the original parent lines.

Statistical analyses of the ratings of the single crosses and parents showed highly significant differences each year. The mean ratings of the parents and three representative single crosses of each class (susceptible X susceptible, etc.) are given in table 1. The combined analyses over years for the 11 inbreds and 37 single crosses tested each year showed significant variation in the disease ratings between inbreds and single crosses and also between years. No significant interaction was found between years versus hybrids and inbreds.

The grand mean ratings of all of the parent lines except NC65 conform with their selection in 1947 as resistant, intermediate and susceptible. NC52, NC32(16), and N. C. J315 were similar in reaction. NC65 was consistently more...