Inheritance of Rust Resistance. VIII. Additional Studies on Kenya Varieties of Wheat

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In recent years Kenya varieties of wheat have been important sources of genes for rust resistance, particularly genes conditioning resistance to race 15B of stem rust. Earlier studies (4, 5, 6, 7) with races 15B and 56 have resulted in the identification of five genes, Sr6, Sr7, Sr9, Sr10, and Sr11, carried by Kenya wheats. Each of these genes has been transferred individually to the variety Marquis by backcrossing. Green et al. (3) tested the first four genes carried by the resistant parents.

The rapid changes in stem rust races that occur in Kenya have made necessary the production of many rust-resistant varieties. A considerable number of these varieties have been used in wheat breeding programs in North America. A study using races 15B and 56 was, therefore, undertaken to see whether the Kenya wheats carried genes other than those already identified.

MATERIALS AND METHODS

Thirty-eight varieties of Kenya wheat were obtained, 33 through A. B. Campbell of the Canada Department of Agriculture Research Station at Winnipeg and 5 from H. C. Thorpe, Njoro, Kenya. The large number of varieties to be studied made it nearly impossible to do a complete genetic analysis of each. It was decided, therefore, to cross each variety with the susceptible parent, Marquis, and then to test the F2 populations with races 15B and 56. By examining the F2 ratios and the types of resistance obtained it was hoped to determine with reasonable accuracy, the genes carried by the resistant parents.

Of the 6 genes that have been identified previously, Sr6 and Sr7 control reactions that are very distinctive. The gene Sr6 conditions a fleck reaction to races 15B and 56 but is dominant with 56 and recessive with 15B. The gene Sr7 confers resistance only to race 15B, the typical seedling reaction being a 1+ postule type with considerable yellowing particularly of the leaf tip. It seemed unlikely that other genes giving exactly the same reactions as Sr6 and Sr7 would be present in the Kenya varieties.

The reactions controlled by the genes Sr8, Sr9, Sr10, and Sr11 are less definitive and, consequently, these genes cannot be as easily identified. Gene Sr8 conditions a type 2 reaction to both race 15B and race 56. It had not been identified in the Kenya varieties studied earlier. Both Sr9 and Sr10 condition a type 2 reaction to race 56. Gene Sr9 confers a higher degree of resistance than Sr10 and is more nearly dominant. The gene Sr11 conditions a type 1+ reaction to race 56 and is dominant. Originally it was thought that the reaction conditioned by Sr11 resulted from the action of two, dominant, complementary genes Sr11 and Sr12. It has now been found that only one gene is involved (5, 8). Genes Sr9 and Sr10 have an additive effect and plants carrying both give a type 1 to 1+ reaction, similar to that conditioned by Sr11.

RESULTS AND DISCUSSION

The reactions obtained in the F2 populations could all be explained in terms of the five genes previously found in Kenya wheats. The genotypes postulated for the 38 Kenya varieties on the basis of the F2 results are given in Table 1. In the designation of the Kenya material, the first number (e.g. 184) indicates the cross, and the remaining symbols specify the particular line or selection from it. As might be expected different lines from one cross did not always carry the same genes. On several occasions two or more lines from a cross have been distributed to wheat growers as sister varieties.

The identification of genes Sr6 and Sr7 is almost certainly correct but the conclusions are less reliable for Sr9, Sr10, and Sr11. In most cases where Sr9 and Sr10 have been postulated as being present the combination could equally well be Sr10 and Sr11. However, Sr9 and Sr10 have been clearly identified in a number of Kenya varieties (4, 5, 7) whereas the presence of Sr11 has been established only in Kenya 338 (6).

Fortunately, some corroborating data are available. Dixon (2) has recently presented a paper giving pedigrees for many of the Kenya wheats. Figure 1 is a copy of Dixon's Fig. 1 modified in the following ways. First, the genotypes of Kenya varieties that have been fully analyzed genetically for resistance to races 15B and 56 (4, 5, 7) were added and underlined. Next, the postulated genotypes of the varieties in the present study were added but not underlined. Where the individual lines from one cross carried different genes, all of the genes were listed. Finally, the minimum number of genes for rust resistance carried by certain varieties in the pedigree was deduced either from their parentage or from the genotypes of their progeny. These genes were then listed in brackets. The important fact to be noted from the figure is that all of the genotypes postulated for the lines in the present study are feasible.

It seems reasonable to conclude that the resistance of most Kenya wheat varieties to races 15B and 56 is con-