

The Association of Cercospora Resistance and Yield in Commercial Hybrids

L. G. Campbell and G. A. Smith

USDA, Agricultural Research Service, Northern Crop Science Laboratory, Fargo, North Dakota 58105-5677

Host plant resistance is an efficient method of controlling many crop diseases. Incorporating disease resistance while maintaining or increasing yield and quality is a constant challenge for commercial plant breeders. The task is especially difficult if the desired resistance is not simply inherited, as is the case with most sugarbeet (*Beta vulgaris* L.) diseases, including Cercospora (*Cercospora beticola* Sacc.) leaf spot. Cercospora resistant parental lines are available and many commercial sugarbeet hybrids have at least some resistance to Cercospora. Commercial yield trials often are planted at sites that avoid Cercospora infestation or it is controlled with chemicals. Under these conditions neither the value of resistance nor the inherent yield reduction, if any, associated with breeding for resistance is apparent. This study examines the trade-off between Cercospora resistance and performance and provides insight for choosing hybrids for specific environmental and management situations.

Forty commercial hybrids, all recommended for growing in Cercospora-threat areas, were grown at Fargo, North Dakota (no Cercospora) and at Fort Collins, Colorado in 1991 and 1992. The field at Fort Collins was inoculated with Cercospora to produce an epidemic. Disease severity was recorded (0 = no symptoms to 9 = complete defoliation). Root yield was measured at both locations.

In both years, root yields at Fargo were directly related to disease severity at Ft. Collins. Regression of root yields on damage ratings indicated a 1.0 ton/acre increase for each increment (increased susceptibility) on the damage scale in 1991 and a 1.1 ton/acre increase in 1992. The spread of the points about the regression lines indicated varying degrees of success in overcoming the negative association between

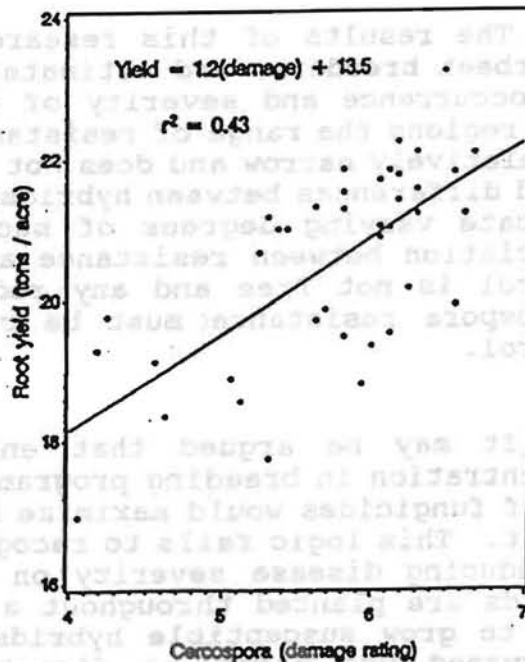


Fig. 1. Relationship between root yield at Fargo, North Dakota and Cercospora resistance rating for 40 commercial hybrids, 2-year means (1991-92).

resistance and root yield (Fig. 1). The Cercospora epidemic in the Ft. Collins nursery was less severe in 1992 than in 1991. Regression analysis indicated no relationship between yield and disease severity under the milder Cercospora epidemic in 1992 but did indicate a 1.3 ton/acre decrease for each increment in susceptibility in 1992. The lack of association between yield and resistance at Ft. Collins in 1992 suggests that under less severe disease conditions the benefits of resistance are similar to the yield potential sacrificed to obtain the resistance. Under severe disease conditions there was a small reduction in sugar content associated with increased susceptibility. There was no obvious relationship between sugar concentration and disease resistance in the absence of the disease (at Fargo).

While differences between Fort Collins and Fargo involve more than the presence or absence of Cercospora, the patterns associated with locations and the consistency of trends over years clearly suggest that Cercospora resistance had a major influence on relative productivity. The number of hybrids and breeding programs represented strengthen the validity of these conclusions. The results demonstrated that resistance is essential if Cercospora is present and not controlled with fungicides.

The results of this research quantify the dilemma faced by sugarbeet breeders, and ultimately by producers, in regions where the occurrence and severity of Cercospora is unpredictable. In many regions the range of resistance currently available to growers is relatively narrow and does not include highly resistant hybrids. Yield differences between hybrids with similar levels of resistance indicate varying degrees of success in overcoming the negative association between resistance and yield. Furthermore, chemical control is not free and any reduction of yield associated with Cercospora resistance must be compared to the cost of chemical control.

It may be argued that enhancing root yield and sucrose concentration in breeding programs and recommending the occasional use of fungicides would maximize breeders' efficiency and growers' profit. This logic fails to recognize the importance of resistance in reducing disease severity on a regional basis. If resistant hybrids are planted throughout a region a few individuals may be able to grow susceptible hybrids successfully even though their widespread use might be disastrous. Also, not breeding for resistance assumes that other control measures will always be effective and available. Experience has shown that Cercospora may develop resistance to widely used fungicides.