MULTIPLE DISEASE RESISTANCE IN MAIZE

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In India maize *(Zea mays L.)* is subject to attack not only by downy mildew (DM) but also by leaf and sheath blights, stalk rots, rust, smuts and ear rots which altogether total about 35 individual diseases. Accordingly, in the All-India Maize Improvement Program consideration has to be given to eight to ten major diseases, including four DMs. Here the results of our work on the development of multiple disease resistant varieties out of *Sclerospora* induced DM resistant materials obtained through the courtesy of Dr. B.L. Renfro, Coordinator of the Inter-Asian Corn Program are presented. These, together with data on sorghum DM incidence from sick plots at Mysore, India, are listed in Table 1.

A composite of these 11 varieties was formed at Hyderabad in 1973-74 Rabi. Three seeds from each entry were bulked together to seed each of 40 rows. Plants in each row were subsequently sib-pollinated. Pollen was used only from plants which showed the least incidence of turcicum leaf blight *(Helminthosporium turcicum)*, common rust *(Puccinia sorghi)* and freedom from stalk rot. The same selection criteria were employed for the female plants. About one-half of the seed amount was kept in store while the remainder was planted at New Delhi during 1974 Kharif in 200 rows of 10 meter length and artificially inoculated with *Helminthosporium maydis*. From this, 120 full-sib families were developed. The selection criteria were low ratings to *H. maydis*, freedom from borer infestation and plants having medium, uniform height.

These 200 families were planted in 1974-75 Rabi at Hyderabad for assessing their reaction to turcicum leaf blight, common rust, late wilt *(Cephalosporium maydis)* and charcoal rot *(Macrophomina phaseolina)*. One-hundred eleven full-sib and 79 half-sib families were selected on the basis of resistance to all four diseases. During the 1975 crop season these families were

Table 1. Reaction of 11 maize entries and two susceptible check varieties to *S. sorghi* at Mysore (1973).

Pedigree		% DM
Phil. DMR 1 & 5 × (Cupurico × Flint Compuesto FC_3) F_4		6
Phil. DMR 1 & 5 × (Cupurico × Flint Compuesto FC_3) BC_2, F_2		0
Phil. DMR 1 & 5 × Thai Composite-# 1-(S) C_1 F_4		0
Phil. DMR 1 & 5 × Thai Composite-# 1- (S) BC_2, F_2		0
Phil. DMR 1 & 5 × Puerto Rico Gr. 1 (E) C_2 F_4		0
Phil. DMR 1 & 5 × Caribbean Composite (M) C_3 F_3-#		0
Phil. DMR 1 & 5 × (Cuba 40 × Cuba Gr. 1) (F) F_4		0
Phil. DMR 1 & 5 × Guatemala PB-5 F_4 F_3-#		0
Thai Opaque Composite #-1 × (Phil. DMR-1, 5 × Cupurico × Flint Compuesto) F_3		5
Phil. DMR-1		0
Phil. DMR-5		0
Susceptible checks	CM 500 (Maize)	50
	DMS 652 (Sorghum)	56

further evaluated for resistance to *H. maydis* and Pythium stalk rot at New Delhi, and bacterial stalk rot and brown stripe DM at Pantnagar. In all, 47 full-sib and 42 half-sib families were selected on the basis of resistance to these diseases, as well as, resistance to lodging. In 1975-76 Rabi 156 new full-sib families were generated at Hyderabad. In addition, 163 new half-sib families were also developed in isolation by using the balanced composite (mixture of equal amount of seed from each family) as the pollen parent.

In the 1976 crop season the families are under yield test in a replicated trial at Dharwar (16° latitude). Simultaneously, they are under evaluation to banded leaf and sheath blight *(Rhizoctonia solani)*, *H. maydis* and Pythium stalk rot at New Delhi and to Sorghum DM (maize race) at Udaipur.

Some noteworthy facts have emerged from this study. The base population originally possessed resistance to Philippine DM *(S. philippinensis)* in the Philippines, to sorghum DM *(S. sorghi)* in Thailand and sugarcane DM *(S. sacchari)* in Taiwan. These also showed resistance to the sorghum race of sorghum DM in Mysore (India) in sick plots.

Evaluations in the subsequent cycles have shown a high degree of resistance to *H. maydis* leaf blight under conditions of artificial inoculation. Among the full- and half-sib families, 95.5% and 89.9% of them were found to be resistant; i.e. they were rated 2.0 or less on a 1-5 scale of measurement.

A majority of both full- and half-sib families was also found to be highly resistant to brown stripe DM in the 1975 crop season; the proportion was 94.2% in full-sib and 88.4% in half-sib families. Resistance in the field was expressed in the form of chlorotic, non-sporulating, small broken flecks or stripes. This is interesting in the sense that the materials, originally resistant to *Sclerospora*-induced DMs, have also turned out to be resistant to *Sclerophthora*-induced DMs. Furthermore, they have been observed to possess resistance to the two Helminthosporium leaf blights and to common rust. Thus, this work shows that multiple disease resistant varieties can be developed from one or more base populations provided rigorous testing is carried out under conditions of artificial disease epiphytotics.

Development of Multiple Disease Resistant (MDR) Varieties

1973	Eleven Downy Mildew Resistant (DMR) varieties Rated as resistant to Sorghum DM at Mysore.
1973-74	Equal quantity of seed bulked and bulk-sibbed. *Selection criteria:* Freedom from *Helminthosporium turcicum*, common rust and stalk and ear rot infection.
1974	Generated 120 full-sib and 80 half-sib families. *Selection criteria:* Least rating of *H. maydis*, freedom from borer infestation and medium height.
1974-75	Tested to turcicum leaf blight, common rust, late wilt and charcoal rot. Selected 111 full-sib and 70 half-sib families.
1975	Tested to bacterial and Pythium stalk rots, brown stripe DM and *H. maydis* leaf blight. Selected 47 full-sib and 42 half-sib families resistant to all the diseases as also to lodging.
1975-76	Generated 156 full-sib and 163 half-sib families.
1976	Yield test at Dharwar; evaluation to Sorghum DM at Udaipur and banded leaf and sheath blight, *H. maydis* and Pythium stalk rot at New Delhi.
1976-77	Development of experimental varieties.
1977	Testing in All-India Coordinated trials for yield and other traits.