Resistance in Commercial Sunflower Hybrids to Races of Downy Mildew *(Plasmopara halstedii)*

T. J. GULYA
USDA Northern Crop Science Lab, Fargo ND 58105
e-mail : gulyat@fargo.ars.usda.gov

Downy mildew (DM) of sunflower is predominantly controlled through the use of genetic resistance, except in countries like the United States where a great diversity of fungal races has prompted seed companies to rely on fungicidal seed treatment. Other researchers at this symposium have observed that the distribution and diversity of downy mildew races is not simple. In nearly all cases where adequate surveys have been made, researchers have identified several races occurring in all countries. This complicates the task of commercial breeders, for now hybrid evaluation needs to consider resistance to all the predominant DM races. The objective of this study was to evaluate a wide range of commercial hybrids, from several companies and many countries, for resistance to the now predominant DM races, and ultimately to find hybrids with multiple race immunity by testing with highly virulent DM isolates.

Materials and Methods

A total of 168 hybrids was chosen from commercial and public breeding programs in the United States, Argentina, Australia, France, Hungary, Romania, South Africa and Yugoslavia. Companies participating from the U.S. included Cargill, Dekalb, Eureka, Interstate and Pioneer. Additionally, the 29 entries from the 1996-7 FAO-sponsored hybrid trial were included. All entries were tested in greenhouse trials using our modification of the whole-seedling immersion technique (Gulya, 1996). Disease was evaluated 11-12 days after inoculation, with susceptibility categorized as the appearance of any sporulation on either cotyledons or true leaves.

When entries had fungicides (presumably metalaxyl) on the seeds, extra precautions were taken to remove the fungicides. All seeds were initially soaked in a 20 % sodium hypochlorite solution, with a small amount of added detergent, for 10 minutes, followed by a rinse under running tap water. Fungicide-treated seed was soaked in hypochlorite two additional times, each for 5-10 minutes and with a subsequent rinse under running tap water. The seeds were placed in a germinator for 24 hr, after which the seed coats (hulls) were removed, and the naked achenes then placed on fresh germinator paper for 48 hr prior to inoculation.

All 168 hybrids were evaluated for resistance to races 2 and 3 [virulence pattern 3000 and 7003, respectively, using a set of 12 differentials (Gulya, 1995)]. Twenty seedlings of each hybrid were tested with each race. In cases where there appeared to be segregation (due to genetic nonhomogeneity or to residual fungicide on the seeds), the tests were repeated. Those entries displaying resistance to race 3 were then tested for resistance to race 4 (virulence pattern 7303). Hybrids with resistance to races 2, 3 and 4 were

finally tested with the two most virulent races, namely race 5 (7703) and virulence pattern 7303. Due to lack of seed, only 11 hybrids could be tested with the most virulent DM races, namely race 5 (7703) and Race 4 7303. The combination of the latter two races, if used together, would produce a virulence pattern of 7733, which would infect ten differentials but not HA-335 or RHA-340. No downy mildew isolate has been found to date, from any country, which systemically infects these USDA lines.

Results and Discussion

Of the 168 hybrids tested, 82 % were resistant to race 2. While race 2 is a minor component of the downy mildew population in North America and other continents, the gene *Pl2* is commonly incorporated into many commercial parental lines, thus producing race 2 -resistant hybrids whether needed or not. Race 2-susceptible hybrids were identified from several U.S. companies, as well as from other countries. Hybrids from Australia, where DM does not exist, and from South Africa, where DM has only recently been observed, were more likely to be susceptible to race 2. When all 168 hybrids were tested for resistance to DM race 3 (7303), only 27 hybrids (16 %) showed resistance. When hybrids resistant to races 2 and 3 were inoculated with race 4, 20 out of 27 hybrids (12 % of the original 168 hybrids) were resistant. Due to lack of seed, only 11 hybrids could be tested further with the most virulent races, namely race 5 (7703) and 7303. Of these 11 hybrids six were resistant to both races. None of the 11 hybrids were resistant to one race and susceptible to the other. The six hybrids displaying resistance to all five races were NSH-444 (Yugoslavia), Bilto (a French entry f rom Verneuil), Mayo (a Hungarian hybrid from Szeged), two experimental hybrids from Pioneer-US (designated X-363 and X-364), and Melody (a French hybrid from Hillishog-NK).

Based on my experience with these DM races and other sunflower germplasm, it is highly likely that these six hybrids would be resistant to most, if not all other races that are now known to exist. While the sources of multiple race DM resistance in these hybrids is proprietary information, most breeders have acknowledged that the USDA lines HA-335 through HA-339 are the most widely used sources of multiple race resistance. In countries where metalaxyl is not registered for use as a sunflower seed treatment, such multiple race immunity would be as effective as any fungicide, and with the discovery of metalaxyl resistance in France, there will be more incentive to release DM-resistant hybrids. Additionally, in countries where multiple races are already known to exist, it would be easier and more effective for commercial breeders to incorporate such multiple race immunity rather than searching for individual genes to counter each race as new ones continue to be discovered.

In conclusion, commercial breeders have routinely incorporated resistance to race 2 in hybrids marketed around the world. Resistance to races 3 and 4 is much less common, but still appears in some hybrids. In this study, at least six hybrids (four of which are currently marketed) were resistant to a battery of five races, which represented the most common races around the world, plus two of the most virulent races.

References

1. Gulya, T. J. 1995 - Proposal for a revised system of classifying races of sunflower downy mildew. Pages 76-78 IN Proc. 17th Sunflower Research Workshop, Fargo ND. Jan 12-13, 1995.

2. Gulya, T. J. 1996 - Everything you should know about downy mildew testing but were afraid to ask. Pages 39-48 IN Proc. 18th Sunflower Research Workshop, Fargo ND. Jan 11-12, 1996.