THE USE OF EXOTIC AND DOMESTIC GERMPLASM FOR RESISTANCE TO THE SUGARBEET ROOT MAGGOT

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The sugarbeet root maggot (*Tetanops myopaeformis* von Röder) is a major insect pest of sugarbeet (*Beta vulgaris* L.) throughout two-thirds of the sugarbeet production areas of the U.S. Traditionally this pest has been controlled by insecticides applied at planting. Effective genetic resistance would reduce the need for insecticide applications and its associated costs. Genetic resistance would be essential if the commonly used insecticides lost their registration for use on sugarbeet.

Attempts to identify resistant genotypes have been marginally successful. For a number of years efforts to isolate resistance were centered in Utah - Idaho. Material from this program was transferred to North Dakota and has been evaluated and selected under natural maggot infestations near St. Thomas, North Dakota. The most resistant lines currently in the program were originally selected in a cooperative project between USDA and Amalgamated Sugar Co. This material had a 2-year average damage rating of 1.9, compared to 3.4 for commercial hybrids (0 = no damage to 5 = severely damaged). This level of control was similar to that obtained with insecticides at the same research site (Campbell et al., 1990). Progress from mass selection has been minimal with populations resulting from four selection cycles having damage ratings averaging 2.9.

While it seems apparent that one can develop lines with a moderate, and perhaps economically useful level of resistance, the difficulty of selection and the mode of inheritance (Theurer et al., 1982) make it difficult to incorporate maggot resistance into a commercial hybrid development program. These difficulties have prompted changes in the resistance breeding project at Fargo. The most resistant material presently in the program has been converted to a tetraploid line. Crossing a tetraploid pollinator with a diploid CMS line may produce a hybrid with a commercially useful level of resistance. Mass selection has been replaced with family selection. A genetically diverse population was subjected to three cycles of mass selection. Plants from that population

Table 1. Beta Accessions identified as sugarbeet root maggot resistant in CAC evaluations.

PI	Origin	PI	Origin
165485	India	293419	USSR
232887	Hungary	355962	USSR
266100	Poland	357357	Yugoslavia
266104	Poland	467869	China
274394	Poland	467870	China
285589	Poland	467871	China
285590	Poland	467874	China
285594	Poland	467875	China
286502	Poland		

were harvested individually and planted in a field test with two replicates. Ten beets from each plot were rated for maggot damage. A commercial hybrid was planted in every fifth plot. Selection was based upon the difference between the plot mean and the mean of the closest commercial hybrid check plot. The remaining roots from the selected families were then dug and selected for low maggot damage. Four to five roots from each of approximately 20 families were induced to flower, inter-mated, and provided approximately 100 families to evaluate in a second cycle. The second cycle was completed in 1992. The average damage rating for all families evaluated for the second selection cycle was 2.7, compared to 5.1 for the commercial hybrid (0 = no damage to 9 = severe damage). This process will continue as long as progress is apparent. This system quickly eliminates families derived from susceptible plants that escaped the maggot. It also provides a measure of field variability and emphasizes selection from areas of the field with more severe damage.

New and more effective resistance genes are welcomed in any resistance breeding program and are especially needed in the sugarbeet root maggot program. Two *Beta* accessions from the NC-7 collection (USDA/ARS, Ames, Iowa) that were identified as resistant in 1973 (Callenbach et al., 1974) have a level of resistance comparable to the best material presently in the program, but lack agronomic and quality characteristics needed for immediate use in a hybrid development program. PI179180 is a biennial with red globe-shaped roots that originated from Turkey. It also has resistance to Rhizomania and Erwinia (source - USDA/GRIN). PI181718 is predominately biennial with red globe-shaped roots and originated from Lebanon. The screening program under the direction of the Sugarbeet Crop Advisory Committee (CAC) has identified potential sources of resistance. Seventeen accessions identified in this effort are being increased for further evaluation (Table 1). All the accessions being examined are biennial *B. vulgaris* lines. Resistance from related species would require more effort to incorporate into useful germplasm and, in addition, the sprangeled roots of most wild accessions makes accurate damage assessment difficult.

Table 2. Sugarbeet root maggot damage rating scale used for breeding nurseries, Fargo, North Dakota.

Rating	Description
0	no scars
1	1-4 small (pin head size) scars
2	5-10 small scars
3	3 large scars or scattered small scars
4	Few large scars and/or numerous small scars
5	Several large scars and/or heavy feeding on laterals
6	up to 1/4 root scared
7	1/4 - 1/2 root blackened by scars
8	1/2 - 3/4 root blackened by scars
9	More than 3/4 of root area blackened

A 0 to 9 rating scale was utilized for evaluating damage in the breeding nursery in 1992 (Table 2). The 0 to 5 scale proposed by Blickenstaff et al. (1977) has been used extensively, and probably is adequate for insecticide trials and production field evaluations. However, it does not accurately measure the small differences observed in a screening and breeding program. It is especially inadequate for comparing differences among lines. With the 0 to 9 scale,

differences in ratings more closely reflect differences in damage. The scale presented in Table 2 is consistent with the general 0 to 9 scale recommended by the CAC for rating damage to numerous diseases and insects (Sugarbeet Crop Advisory Committee, First meeting report, 1983). The 0 to 9 scale can be easily remembered as ratings of 1 to 3 are indicative of light damage with little or no economic consequences; 4 to 6 represents moderate damage levels with detectable yield reductions likely; and ratings of 7 to 9 indicate severe damage with considerable yield reductions and possibly total loss.

References

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