

NCR-167 2003 Missouri Station Report, January-December 2003

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- **Annual progress report:**

The corn stalk rind penetrometer has been shown to be an effective tool for measuring stalk strength, however, it was not known whether selection for a stronger rind would have a correlated effect on stalk feeding by the second-generation European corn borer. The corn breeding project evaluated 12 cycles of selection for high and low rind penetrometer resistance in Missouri Second Cycle Stiff Stalk Synthetic for stalk strength, feeding damage by the European corn borer, and several other agronomic traits. We showed that selection for high rind penetrometer resistance was effective at increasing resistance to second-generation European corn borer damage as well as resistance to stalk lodging. By using selection for rind penetrometer resistance to reduce stalk lodging, corn breeders may also anticipate a no cost, favorable, indirect selection response for reduced feeding damage by second-generation European corn borer.

The Germplasm Enhancement in Maize project strives to improve corn through the introgression of selected exotic accessions, but it had not been known what proportion of exotic alleles remained in the lines after crossing to domestic, proprietary inbreds and selection. In collaboration with Linda Pollak, ARS, Ames, Iowa, we devised a novel scheme to statistically contrast the parental contribution of molecular marker alleles. Results showed that a substantial proportion of the new inbreds is indeed exotic and that certain chromosomal regions tend to favor the domestic or exotic alleles, even across pedigrees. This information will guide breeders and molecular geneticists in designing future marker-assisted selection studies. It points toward chromosomal regions of corn belt inbreds that may be improved through exotic introgression.

- **Major accomplishments over the life of the project:**

Corn rind penetrometer resistance has been used to measure stalk strength and improve stalk lodging resistance, and quantitative trait loci (QTLs) have been identified for both rind penetrometer resistance and second-generation European corn borer resistance. Phenotypic recurrent selection increases the frequency of favorable alleles over cycles of selection. Several studies have indicated that marker-assisted selection is also a potentially valuable selection tool. We compared the efficiency of phenotypic selection vs. marker-assisted selection for rind penetrometer resistance and second-generation European corn borer resistance. Marker-assisted selection for high and low rind penetrometer resistance was effective in the three populations studied. Phenotypic selection for both high and low rind penetrometer resistance was more effective than marker-assisted selection in two of the populations. However, in a third population, marker-assisted selection for high rind penetrometer resistance using QTL effects from the same population was more effective than phenotypic selection, and using QTL effects from an independent population was just as effective as phenotypic selection. Marker-assisted selection for resistance and susceptibility to second-generation European corn borer using QTL effects from the same population was effective in increasing susceptibility, but not in increasing resistance. Marker-assisted selection using QTL effects from an independent population was effective in both directions of selection. Thus, marker-assisted selection was effective in selecting for both resistance and susceptibility to second-generation European corn borer. These results demonstrated that marker assisted selection can be an effective selection tool for both rind penetrometer resistance and second-generation European corn borer resistance. These results also validate the locations and effects of QTL for rind

penetrometer resistance and second-generation European corn borer resistance identified in earlier studies.

White food-grade corn is used mainly for dry corn meal and grits products. Seed producers, corn millers, and farmers use agronomic performance data to select hybrids adapted for growing in specific regions of the U.S. Smaller seed companies have benefitted by having their products tested in a much wider area than could be accomplished by the company itself. Late maturity, white food-grade corn performance and grain quality testing was conducted from 1977 to 2002. During 26 years of testing, 715 hybrids from public and private sources were evaluated. Early maturity, white food-grade corn performance and grain quality testing was done from 1984 to 2002. During 19 years of testing, 387 hybrids from public and private sources were evaluated. Testing was supported by the North American Millers' Association and participating seed companies. Because of an insufficient number of entries to justify growing the late and early maturity tests, they were discontinued in 2003.

- **Publications or manuscripts accepted for publication:**

Flint-Garcia, S. A., L. L. Darrah, M. D. McMullen, and B. E. Hibbard. 2003. Phenotypic versus marker-assisted selection for stalk strength and second-generation European corn borer resistance in maize. *Theor. Appl. Genet.* 107:1331-1336. (Graduate student thesis publication)

Martin, S. A., L. L. Darrah, and B. E. Hibbard. 2003. Divergent selection for rind penetrometer resistance and its effects on European corn borer damage and stalk traits in corn. *Crop Sci.* 43: In press. Accepted 28JUL03. (Graduate student thesis publication)

Barry, B. D., A. Q. Antonio, L. L. Darrah, B. E. Hibbard, J. M. Barry, T. W. Praiswater, C. L. Thiel, and D. B. Willmot. 2003. Release of maize germplasm lines Mo48 and Mo49 with resistance to European corn borer. USDA-ARS and Missouri Agricultural Experiment Station.

- **Manuscripts with ARS approval submitted for publication:**

Willmot, D.B., B.E. Hibbard, B.D. Barry, and L.L. Darrah. 2003. Registration of Mo48 and Mo49 maize germplasm lines with resistance to European corn borer. *Crop Sci.*

Hibbard, B.E., L.L. Darrah, and D.B. Willmot. 2003. Identification, development, and use of native sources of resistance to western corn rootworm larvae. *Proceedings of the International Symposium on the Ecology and Management of Western Corn Rootworm.* Jan. 19-23, 2003. Goettingen, Germany.

- **Theses:**

Glover, M.A. 2003. Diallel analysis of Chinese and U.S. maize germplasm. M.Sc. thesis, University of Missouri-Columbia.

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