

South Dakota State University
2004 NCR-167 Report

Title: Corn Breeding, Genetics and Utilization

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Introduction:

South Dakota State University's corn breeding and genetics program primary foci are to conduct applied research in corn breeding and to train graduate students. Specific objectives that we would like to achieve are to: 1) develop and release inbred lines and improved populations that can be used to develop hybrids for livestock feed, grain production or other value added products. Emphasis will be placed on yield, adaptation, stress tolerance, and pest resistance, 2) evaluate and select corn adapted to South Dakota for phosphorous and nitrogen content to be used as a compliment/supplement to DDGs/co-product feed, 3) develop open-pollinated corn varieties, populations, and synthetics for sustainable agricultural operations (i.e. organic farmers) and conventional farming and, 4) continue to develop white corn as an alternative crop and breed other types of specialty corn.

Accomplishments:

The corn breeding program at South Dakota State University continues to make good progress in different areas of corn germplasm development. For yellow corn development, approximately 200 early generation lines and 300 advanced lines were planted in our 2004 breeding nursery. We also advanced approximately 150 white corn lines. Selected 2003 Inbred lines were evaluated this year for yield at our Brookings and Beresford locations.

Based on preliminary data, several yellow inbred testcrosses yielded superior at the Southeast Research (Beresford) station in terms of yield and lodging. Yields for the check hybrids ranged from 180.0 bushels/acre (bu/a) to 199.3 bu/a, while the yellow inbred testcrosses ranged from 57.6 bu/a to 248.7 bu/a. At our Brookings location, several yellow inbred testcrosses were also promising. The inbred testcrosses ranged from 26.9 bu/a to 214.5 bu/a and the check hybrids ranged from 109.3 bu/a to 163.5 bu/a.

The superior inbred lines will be advanced for testing to determine the relative merit of release to interested breeders. We also evaluated and selected all lines for stress tolerance, disease resistance, lodging, and overall plant health. Within the lines selected, plants will be advanced and crossed to testers for yield evaluation next year.

This year, at our NE (Watertown) Station, we evaluated three separate experiments from North Dakota State University. Several of the inbred testcrosses yielded superior to the hybrid checks. Based on these results, we will be able to use the promising open-pollinated materials as well as the promising inbreds for future SDSU germplasm enhancement.

We also extensively tested and evaluated white corn germplasm in terms of yield, disease resistance, stress tolerance, and lodging. White hybrid yield trials were conducted at our Brookings and Beresford locations. These trials, as well as the yellow hybrid yield trials, included lines that originated in the South Dakota State University (SDSU) corn breeding program, a few lines that were released from other public breeding programs, and lines from the private sector. While the inbred testcrosses did not yield superior to the check hybrids, several white inbred testcrosses yielded greater than the check average.

Increased ethanol production will mean increased distillers grain (DG), which is a feed source to livestock. Phosphorous (P) and nitrogen (N) content in DG is approximately three times greater than the content found in corn grain, resulting in losses to the environment. As a result, the phosphorous and nitrogen requirement must be balanced when feeding DGs to livestock. Our goal is to select adapted corn hybrids and to develop inbreds for low-phosphorous and low-nitrogen content for South Dakota producers. Three replications of 10 hybrids from various private companies were planted at three locations (Beresford, Watertown, Brookings) this spring. Each replicated entry was planted at two population densities; 29,700 plants/acre and 38,000 plants per acre. We hand-harvested 10 plants per plot and weighed them for a tonnage value. Each sample was then dried proceeded by a dry weight measurement. We are currently processing samples for P and N concentration analysis.

There is renewed interest, especially in low-yielding environments, in open-pollinated corn cultivars. We were awarded a grant through the North Central Regional SARE program to examine the economic and agronomic potential of open-pollinated corn varieties in 2002-3. This effort involved cooperation from producers, university extension personnel, and public corn breeders in South Dakota, North Dakota, Iowa, Minnesota, and Wisconsin. Based on preliminary 2002 and 2003 data, economic feasibility could be demonstrated. This data is being extensively evaluated and analyzed and will be published upon completion. A manual containing information for producers interested in growing and/or breeding open-pollinated corn will be made available early 2005. A short history of open-pollinated corn, breeding schematics, profitability equations, and our compiled SARE results are just a few of the items that will be featured.

Several small projects were also conducted. In 2003, we received materials from Cornell University, developed for (non-GMO) corn borer resistance. These lines were evaluated in 2003 and used to develop new populations in 2004. We plan to extensively evaluate these new populations next year. In addition, we planted advanced

generations of high oil corn, and developed red and blue corn populations for value-added/specialty markets.

In our efforts to achieve our primary goals, we currently have two graduate students. Pravin Gautam, our M.S. student, is researching commercial hybrids for P and N concentration (see above). Yusheng Wu, our PhD student, began to establish populations in our 2004 nursery with the intent of locating genes relevant to high amylose content via QTL analysis. He is currently utilizing the greenhouse to continue population development and generation advancement and is also performing lab functions involving DNA extractions to determine the polymorphisms between the high amylose inbred lines.

Projections:

As the South Dakota State University corn breeding program is ongoing, our objectives will not be met in one year. However, we are on course in achieving our goals.