NCR167 Annual Report from the University of Wisconsin

James G. Coors, Professor
Department of Agronomy

The corn breeding/genetics program at the University of Wisconsin involves research with both grain and silage germplasm. The more basic research focuses on selection methodology and genetic variation for grain yield and related agronomic traits. The more applied breeding work focuses on germplasm and technology development for improving yield and nutritional quality of silage corn. Current projects receiving the most attention in 2003-4 are listed below:

Selection Methodology and Genetic Variation:

Double cross improvement: Selection schemes designed to improve the cross between two populations are known as reciprocal recurrent selection (RRS). W577 was originally a double-cross hybrid [(W64A x A295)(Oh43 x W374R)] introduced by the Wisconsin corn-breeding program in 1963. Six cycles of full-sib RRS have now been completed using the F_2 of two parental single crosses as the initial A and B populations. Preliminary results show that the A x B population crosses have increased grain yield over cycles of RRS, but the per se performance of both the A or B populations have not improved. The objectives of the ongoing research are: 1) to compare genetic variation within and between the A and B parental populations at cycle 0 and cycle 6, 2) to determine direct and indirect responses to selection after six cycles, 3) to estimate inbreeding depression within the A and B parental populations, and 4) to compare estimates of genetic variation within and between the A and B parental populations using both phenotypic measures and molecular markers (SSRs). Phenotypic and genotypic data is being analyzed from a set of experiments conducted in two locations over three years (2001 - 2003).

Long-term selection for prolificacy: The Golden Glow maize population has been selected for 31 cycles for increased prolificacy at the University of Wisconsin. During selection for increased number of ears per plant, it was noticed that morphology of prolific plants from later generations seemed quite different from that of the typical plant of the original Golden Glow. The increase in number of ears per plant has been accompanied by a reactivation of axilary meristems at multiple nodes of the main stalk, as well as an increase in lateral branch length and an increase in number of tillers per plant. It appears that *tb1* (*teosinte branched1*) or similar genes influencing tillering in maize (e.g., *tillered1 - tlr1* and *tillered2 - tlr2*) are associated with prolificacy and associated morphological changes.

Germplasm and Technology Development for Improved Yield and Nutritional Value for Silage

Wisconsin Quality Synthetic: The UW corn breeding program has unique germplasm, the Wisconsin Quality Synthetic, specifically designed to produce high-quality inbreds for use as parents for silage hybrids. The WQS synthetic is continuously improved using a S_2-topcross recurrent selection breeding method, and inbreds derived from succeeding

cycles of improvement will be developed to the S_6 stage and released (See http://uwsilagebreeding.agronomy.wisc.edu). We finished several evaluations over the first two cycles of selection in WQS in 2003, and we completed the third cycle of selection. The nutritional improvements characteristic of WQS germplasm are low neutral detergent fiber (NDF), high in vitro true digestibility (IVTD), high NDF digestibility (NDFD), and low lignin concentration. We released four inbred lines, W601S-W604S from WQS. These are the first inbred lines for silage released in the U.S.

GEM Quality Synthetic: We developed 114 S_2 families from GEM population CUBA164:S1517 and 55 S_4 families from GEM population CUBA117:S1520, and in 2003 these were evaluated for silage potential as topcrosses to inbred LH279. Twenty superior families identified in the topcross evaluation will be recombined in summer of 2004 to form an improved breeding population designated the GEM Quality Synthetic (GQS) that will undergo S_2-topcross recurrent selection. Superior inbred families will also be further inbred and crossed to several non-Stiff Stalk tester inbreds to identify inbreds suitable for release. GQS will complement WQS, a non-Stiff Stalk population, that as undergone three cycles of S_2-topcross selection using B73-type tester inbreds. Since GQS will be approximately 75% Stiff Stalk, inbreds from the two sources will produce silage hybrids with high forage yield and superior nutritional quality.

Near-Infrared Spectroscopy (NIRS): We have developed and updated a useful set of broad-based NIRS prediction equations for predicting four measures of nutritive value of corn silage; NDF, IVTD, starch, and protein. IVNDFD can then obtained as a function of NDF and IVTD. These NIRS equations, which are based on trials conducted throughout Wisconsin starting in 1991, are now routinely used by the UW corn breeding program as well as the corn hybrid evaluation program (conducted by Dr. J. Lauer, UW Agronomy - Corn Extension).

Digestion Kinetics of Silage Germplasm: Digestion kinetics are assessed in time-course digestion studies where rate and extent of digestion can be estimated. We have not seen much genetic variation for digestion kinetics components among conventional hybrids, however the breeding population WQS has desirable properties that appear to affect extent of digestion. At this point we are still evaluating whether there is a possibility of increasing rate of fiber digestion in WQS.

Starch Utilization by Ruminants: The primary aim of this research is to improve the utilization of corn grain and silage by dairy cattle through evaluation of starch and endosperm characteristics that influence ruminal starch degradation and the development of corn hybrids with increased starch digestibility. We are using near-isogenic lines for *fl2*, *ae1*, *o2*, *wx1*, *h1*, and *su2* genes in the Oh43 and W64A inbred backgrounds. These genes may produce a less dense endosperm than normal, which may influence starch degradability. We are also evaluating topcrosses involving 75+ inbreds from the GEM project and WQS for kernel hardness and vitreousness. A subset of these topcrosses are being evaluated for in vivo starch degradability.

Current Personnel:

James G. Coors	Project Leader
Dustin T. Eilert	Senior Research Specialist
Patrick J. Flannery	Research Program Manager
Eduardo Graterol	Ph.D. student (double-cross improvement)
Ben Justen	M.S. student (digestion kinetics)
Diana Ngonyamo-Majee	Ph.D. student (starch degradability, co-supervised with R.D. Shaver)

Collaborators:

Randy Shaver, Dept. of Dairy Science, UW
Joe Lauer, Dept. of Agronomy, UW
Mike Blanco, USDA-ARS, ISU
Linda Pollak, USDA-ARS, ISU

Publications:

Allen, M.S., J.G. Coors, and G.W. Roth. Corn Silage. 2003. In D.R. Buxton, J.H. Harrison, and R.E. Muck (eds.) Silage Science and Technology. ASA, CSSA, and SSSA. Madison, WI.

Schwab, E.C., R.D. Shaver, J.G. Lauer, and J.G. Coors. 2003. Estimating silage energy value and milk yield to rank corn hybrids. J. Anim. Feed Sci. & Technol. 109:1-18.

Nass, L.L., and J.G. Coors. 2003. Potential of exotic x adapted maize germplasm for silage. Maydica 48:197-206.

Germplasm Releases and Technology Development:

Coors, J.G., D.T Eilert, and P.J. Flannery. 2003. Release of inbred lines W601S, W602S, W603S, W604S for developing silage hybrids. Wisconsin Alumni Research Foundation (WARF, P03302US).