

NCR167 2004-5 Annual Report from the University of Wisconsin

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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 2004-5 are listed below:

Selection Methodology and Genetic Variation:

Long-term selection for prolificacy: The Golden Glow maize population has been selected for 32 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 axillary 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 S₂-topcross recurrent selection breeding method, and inbreds derived from succeeding cycles of improvement will be developed to the S₆ stage and released (See <http://silagebreeding.agronomy.wisc.edu/>). 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 the third cycle of WQS in 2004.

GEM Quality Synthetic: We developed 114 S₂ families from GEM population CUBA164:S1517 and 55 S₄ 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 S₂-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 has undergone three cycles of S₂-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 be 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
Ntjapa Lebaka	Ph.D. student (starch degradability)
John Goeser	M.S. student (starch and fiber degradability)
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

Publications:

Coors, J.G. 2004. Breeding: Recurrent selection and gain from selection. The Encyclopedia of Plant and Crop Science, Marcel Dekker, Inc. (www.dekker.com).

Butruille, D.V., H.D. Silva, S.M. Kaeppler, J.G. Coors. 2004. Genetic structure and generation means analysis of three populations derived from the Golden Glow maize population. *Crop Sci.* 44:1527-1534.

Frey, T.J, J.G. Coors, R.D. Shaver, J.G. Lauer, P.J. Flannery, and D.T. Eilert. 2004. Selection for silage quality in the Wisconsin Quality Synthetic and related maize populations. *Crop Sci.* 44:1200-1208.

Germplasm Releases and Technology Development:

Coors, J.G., D.T Eilert, and P.J. Flannery. 2004. Release of inbred line W605S for developing silage hybrids. Wisconsin Alumni Research Foundation (WARF, P05228US).

Coors, J.G., D.T Eilert, and P.J. Flannery. 2004. Release of Wisconsin Quality Synthetic – Cycle 3 (WQS C3). Wisconsin Alumni Research Foundation (WARF, P05177US).

Coors, J.G., D.T Eilert, and P.J. Flannery. 2005. Release of Wisconsin Grazing Composite – Cycle 2 (WGRCOMP C2). Wisconsin Alumni Research Foundation (WARF, P05229US).

Coors, J.G., D.T Eilert, and P.J. Flannery. 2005. Release of W701BC – A multiple-eared inbred line of corn for production of “baby corn.” Wisconsin Alumni Research Foundation (WARF, P05295US).