2006 Annual Report
United States Germplasm Enhancement of Maize Project

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Project Title: Anthracnose Stalk Rot Resistance from Exotic Maize Germplasm

Justification:
Anthracnose stalk rot (ASR), caused by *Colletotrichum graminicola* (Ces.) G.W. Wils., causes stalk rot problems and contributes to increased lodging in New York and throughout many U.S. maize-producing areas. The only economically feasible control of ASR is through resistant varieties and cultural practices that reduce disease incidence. Recent research has focused on exotic sources for improved ASR resistance, given the limited resistance available in temperate maize germplasm. This project aims to develop new maize inbreds with excellent resistance to ASR (derived from the tropical germplasm sources used) and good agronomic quality, yield potential, and temperate adaptation (derived from the proprietary temperate inbreds crossed to the exotic populations).

General Objective:
To develop temperate-adapted inbreds with both anthracnose stalk rot resistance and good yield potential from GEM germplasm.

Specific Objectives for Current Project Year:
1) Increase seed of superior GEM-derived inbreds and develop descriptive materials for release.
2) Generate families for future stalk rot and yield selection from a new population formed from the best non-stiff stalk inbreds derived from GEM work to date.
3) Initiate stalk rot resistance and yield selection in two 75% temperate:25% tropical GEM populations that have good stalk rot resistance and have shown desirable traits in other GEM projects..

Materials and Methods:
Objective 1: The results described herein represent the latest year of a multi-year inbred development effort. Results of 1995 per se evaluations were used to select five 75% temperate : 25% exotic populations with potential for anthracnose stalk rot resistance. Results of 1996 testcross yield evaluations of these populations were used to select the four with the best yield potential. For each of these four populations, 50 S1 ears were grown out ear-to-row in summer 1997. Eight plants per family were self-pollinated, injected with approximately 500,000 conidia/plant of *Colletotrichum graminicola*, and selected for anthracnose stalk rot resistance by splitting and rating the lowermost eight stalk internodes at harvest. In 1998, selected S2 ears were grown out ear-to-row for another cycle of inbreeding and selection for resistance, and were testcrossed. For the S3 to the S5 generations (1999 through 2001), selected ears were grown out ear-to-row for inbreeding and selection for ASR resistance, and testcrosses from the families that gave rise to these selections were evaluated in yield trials in three New York locations. Yield and resistance data were used for selection. In summer 2002, S5 and S6 progenies were planted out ear-to-row for sib increase and testcrossing. Twenty-seven lines and testcrosses of each to two testers (one public line cross and one Holden's tester) were planted in two replications at Aurora NY in summer 2003 for stalk rot evaluation as described above. Most of these

testcrosses also had sufficient seed for yield evaluation at three New York locations. These same studies were repeated in summer 2004 and 2005 for all the progenies where seed supply was adequate. Yield trial results and both per se and testcross ASR resistance ratings were used to select four inbreds for seed increase in 2006 in preparation for their release.

Objective 2: Population development was initiated from the best new non-stiff stalk inbreds developed through Objective 1 by making all possible F1 crosses among seven GEM-derived inbreds from three different GEM populations (three from FS8B(T):N1802 and two each from AR01150:N0406 and GOQUEEN:N1603). The resulting F1s were sent to a winter nursery in Florida where they were random mated for a first generation and a second generation of random mating was performed in summer 2006.

Objective 3: Seed was requested for two 75% temperate : 25% tropical GEM populations (CH05015:N1204 and UR10001:N1702) that performed well in our original ASR evaluations in 1995 and have proven useful for other traits (CH05015 has shown promise for yield potential and aflatoxin resistance and UR10001 has shown promise for yield potential and corn borer resistance). From each population, 150 seeds were sown at high density (about 40,000 plants/acre) in 2005 and individual plants with good nick and reasonable flowering date were self pollinated to generate S1 families. In 2006, 44 S1 families from CH05015:N1204 and 60 from UR10001:N1702 were grown in two separate blocks. In one block, per se ASR rating and selfing were done on families with reasonable agronomic performance. In the second block, testcrosses were made to an ASR-susceptible tester (B37) for use in 2007 ASR evaluations and to an elite tester (LH198) for use in 2007 yield trials.

Progress to Date:

Objective 1:
Populations selected based on per se anthracnose stalk rot resistance (evaluated in 1995) and testcross yield potential (evaluated in 1996) were FS8B(T):N1802, CH04030:S0906, AR01150:N0406, and GOQUEEN:N1603. From these populations, a total of 27 lines were selected based on per se anthracnose stalk rot resistance and testcross yield potential. Of these, 18 remained in testing through 2004 and 14 looked promising enough to include in seed increases in the 2005 nursery while they were being tested for a final year. Four were ultimately chosen, based on resistance and yield potential, for seed increase and release: CH04030:S0906-195, AR01150:N0406-266, FS8B(T):N1802-212, and FS8B(T):N1802-215.

Table 1 shows inbred ASR ratings averaged over four years (2002 through 2005) with two replications per year in inoculated trials, hybrid ASR ratings averaged over three years (2003 through 2005) with two replications per year in inoculated trials, and hybrid yield data averaged over up to eight New York environments (maximum of 18 replications) in on-farm (non-inoculated) trials. Inbred checks include DE811ASR and RD6501(LB31)-1-2 (resistant checks), B37(RD6501)-1-474 and LB31 (intermediate resistance), and B37 (susceptible check). Four commercial hybrids were used as hybrid checks.

Table 1. ASR ratings (average percentage rotted tissue for the 2nd through 8th internodes on eight inoculated plants per replication) for inbreds (2002 to 2005, two replications per year) and hybrids (2003 to 2005, two replications per year) and hybrid yield data (up to eight on-farm environments, 2003 to 2005, non-inoculated, total of 18 replications) for new GEM inbreds and check inbreds and hybrids.

Inbred	Inbred ASR (%)	Tester	ASR (%)	Yield (bu/A)	Grain Moist. (%)	Yield: Moist. Ratio	Lodging (%) Stalk	Lodging (%) Root
		Testcross to LH Tester						
CH04030:S0906-195	16.2	LH176/LH177	28.4	129	22.4	6.4	22	3
AR01150:N0406-266	18.2	LH198	11.1	165	25.9	6.5	12	1
FS8B(T):N1802-212	9.7	LH198	11.2	154	26.1	6.2	7	7
FS8B(T):N1802-215	9.3	LH198	20.0	198	27.6	7.6	18	2
RD6501(LB31)-1-2	6.4							
B37(RD6501)-1-474	11.3	LH176/LH177	39.2	139	24.9	6.1	20	5
B37	55.2	LH176/LH177	54.5	129	25.2	5.2	24	3
DE811ASR	5.0							
LB31	19.3							
		Testcross to Public Tester						
CH04030:S0906-195		RD6501/RD6502	21.7	145	25.7	6.2	27	5
AR01150:N0406-266		B73/CD1	17.4	160	25.7	6.7	31	5
FS8B(T):N1802-212		B73/CD1	21.2	150	26.9	6.0	21	6
FS8B(T):N1802-215		B73/CD1	34.2	162	27.3	6.3	28	3
RD6501(LB31)-1-2		B73/CD1	19.2	134	26.9	4.8	23	1
B37(RD6501)-1-474		RD6501/RD6502	19.4	141	26.0	5.6	30	14
B37		B73/CD1	49.9	139	26.4	5.3	30	9
B37		RD6501/RD6502	35.5	148	25.9	5.9	25	16
			Commercial Checks					
FS5206			42.0	147	25.4	6.6	22	2
FS5519			27.4	183	26.5	7.8	21	3
Pioneer Brand 34B23			18.7	196	26.1	8.1	25	2
GH8906			23.3	197	27.0	8.0	22	5

The FS8B(T)-derived inbreds were the most resistant per se, and were comparable in anthracnose response to the resistant inbred checks. The CH04030- and AR011050-derived inbreds were comparable to the intermediately resistant check LB31. In hybrid combination, AR011050:N0406-266 and FS8B(T):N1802-212 crossed with LH198 resulted in the most resistant hybrids in the test. Both of these hybrids were comparable in yield to the lowest yielding of the commercial checks, and the FS8B(T):N1603-212 hybrid had the least stalk lodging of all the hybrids tested. FS8B(T):N1802-215 crossed with LH198 had the best yield among the new lines, and was comparable in yield and better in standability than the three best commercial check hybrids. However, one should note that this hybrid was missing from a number of the on-farm environments due to lack of seed, so this comparison is based on fewer reps than most others and should be interpreted with caution. Crosses to public testers revealed marked improvement in resistance ratings for all new GEM inbreds, resistant check inbreds, and intermediately resistant check inbreds compared to B37 (susceptible inbred check) in the same combinations. Yields tended to be a bit lower and standability not quite as good with the public testers as compared to the LH testers, as might be expected. However, all the new GEM inbred testcrosses to public testers compared favorably in yield to the lowest yielding of the four commercial hybrid checks. CH04030:S0906-195 had less ASR resistance and lower yield potential than the other new GEM inbreds, however it was the best of the stiff stalk-derived inbreds developed through this project and as such, merits release.

Seed increases of all four of these new GEM inbreds were done in summer 2006 and the resulting ears are currently being processed and seed tested in preparation for the release of these new GEM lines.

<u>Objective 2</u>:
In 2005, all possible crosses were made among the lines chosen to contribute to the new non-stiff stalk GEM-related synthetic. The goal of this effort is to allow recombination among a diverse group of the most promising non-stiff stalk inbreds derived from our GEM work to date, and thus be able to extract a new set of inbreds with excellent stalk rot resistance and improved yield potential and standability. The lines included in this new synthetic are FS8B(T):N1802 derived inbreds 212, 215, 222, 259, and 263; AR01150:N0406 derived lines 218 and 266; and GOQUEEN:N1603 lines 233 and 239. This year, we completed two generations of random mating in this material. The resulting population currently is planted in a winter nursery to generate S1 families with which to initiate inbreeding and selection for anthracnose stalk rot resistance and yield potential.

<u>Objective 3</u>:
We initiated inbreeding and selection for anthracnose stalk rot resistance and yield potential in two new GEM populations (CH05015:N1204 and UR10001:N1702). S1 families from each population were self-pollinated and inoculated to select ASR-resistant families and the most resistant plants within families. Stalk splitting and ASR ratings are being done at present. In the second block, crosses to B37 (highly ASR susceptible) were made for stalk rot screening and crosses to LH198 for yield testing in 2007. Seed of these testcrosses is being harvested.

Summary of Accomplishments:
The major accomplishment for this project to date is the development of four new GEM-derived inbreds with good ASR resistance, both per se and in testcross combinations. Resistance in the best of these materials is comparable to that available in currently released U.S. inbreds. These inbreds also have reasonable yield potential, maturity, and standability in testcross combinations. All four will be released in the next few months. In addition, selection has been initiated in one new GEM-derived synthetic population and two new GEM populations to begin producing new ASR resistant inbreds from this project.