Raleigh, NC, November 2006 Progress Report:

This report summarizes the research conducted under specific cooperative agreements between the ARS and N.C. State University. Additional details will be available in handouts at the December, 2006, cooperators meeting and the December, 2006, TSG meeting. This subproject is concerned with ten aspects of the overall GEM effort. (1) The development of GEM families from breeding crosses. (2) Making topcross seed of the families. (3) Setting up appropriate experiments to compare the topcross families with commercial and experimental checks. (4) Providing seed for these experiments to 14 additional GEM collaborators. (5) Growing the experiments ourselves at several locations. (6) Analyzing and summarizing our own and our collaborators data. (7) Selecting the better materials for subsequent-year trials. (8) Increasing seed of better families, providing it to Ames and other GEM cooperators and to the NCRPIS. (9) Deriving and testing inbred lines from the better GEM families. (10) Sampling allelic diversity from representative races not encompassed by GEM yield-trial efforts.

56 entries (out of 720 tested) have been advanced from first year to second year trials in 2006, and 58 entries (out of 134 tested) advanced from second year to third year testing. In 2006, 16,747 yield trial plots (Tables 1 and 2) were coordinated through Raleigh (9,309 planted at NC State locations). An additional 1,458 plots were grown solely for GLS evaluations at three NC State locations; thus a total of 18,205 evaluation plots were coordinated through Raleigh.

Over 1,500 nursery rows and 1,550 isolation block rows were planted in 2006 at Raleigh. Nursery work involves 4 new breeding crosses and 3 additional breeding crosses derived from tropical inbred lines. In 2006, 19 GEM families were recommended to GEM Cooperators and provided from stocks furnished to Ames; five additional families were recommended and provided directly from Raleigh.

We have continued routine screening of available tropical lines, as so little data are available to choose among them for use in GEM or other research. A summary of some of that work has been published in the Duvick issue of *Maydica*; a reprint is included as an Appendix to this report. Summaries of ongoing work are presented in Tables 3, 4, and 5.

In 2005, the effort to evaluate GEM breeding crosses for yield *per se* was continued as part of an overall effort to evaluate new material. Data from that study revealed a great spread in yield potential and heavily influenced our choices for 2006 nursery work. While substantial variation occurs in GEM F2 populations, it unlikely to be sufficient to alleviate a difference of several standard deviations between Breeding Cross F1s and the mean of the lowest yielding adapted check. Direct tests of Breeding Cross F1s were continued in 2006, and useful data was obtained for 3 locations. The following crosses look reasonably promising:

PEDIGREE	Bu/A.	H2O	%E.P.	PEDIGREE	Bu/A.	H2O	%E.P.
FS8B(T):N11a	132	19.4	91	BR106:T33a20	116	17.0	92
BR106:T33axLH132	125	19.1	95	BR105:N16	115	19.5	87
CHIS775:S19	123	19.5	85	PE11(51501):S11a	115	18.4	89
FS8B(T):N18	118	18.8	90	BG70404:D27xLH51	115	18.1	89
BR106:G39	117	19.2	93	FS8A(T):N18	113	19.0	89
BR106:LH132	117	19.7	99	SE32(52051):N11c	113	18.2	95
PE27(51675):D27	116	21.0	91	BVIR155:S18	112	19.7	88
FS8B(S):S03	116	17.7	94	DKB830:S19	112	19.3	90

While BG070404:D27 with corresponding values of 114, 21.1, and 75 looks reasonable except for lodging.

In contrast, the following Breeding Cross F1s look as though they should be avoided:

PEDIGREE	Bu/A.	H2O	%E.P.
DK888:S08a	91	21.0	94
CUBA164:T26aS41	86	18.1	94
MDI022:LH132	69	20.1	88

Check performance and CVs are listed below:

PEDIGREE	Bu/A.	H2O	%E.P.
Pioneer 32D99	148	18.7	97
Pioneer 31G98	145	16.8	98
Pioneer 32K22	144	17.8	98
DeKalb 697	139	19.0	97
LH200 x LH262	139	17.0	98
Garst 8288	136	17.6	99
LH132 x LH51	117	16.8	99
LSD .05	16	1.1	11
C.V. %	9	3	7

In addition, a group of Breeding Cross F2s were tested. While testing F2s is a more questionable endeavor, nevertheless,

PEDIGREE	Bu/A.	H2O	%E.P.
ANTIG01:N16F2	111	19.0	78
DREP269:S06F2	102	17.0	96*
DKXL380:N11aF2	94	18.8	90
DKB844:S16F2	89	19.0	83*
CML287:S18F2	86	19.4	94*

* Also good in 2005.

look like keepers (although two do lodge), while

PEDIGREE	Bu/A.	H2O	%E.P.
SANM126:LH132F2	71	19.8	88
CHIS462:N08aF2	52	20.3	86

do not look very promising.

Table 6 presents summary data for the better GEM families that have been tested for more than one year and the status of seed availability. Most of these families are from DK888 N11; one each is from DK212T N11 and Chis 740 S14. One (from SCR Gp3

N14) is recommended on the basis of its performance on a second tester (LH132.LH195; it was originally recommended on the basis of crosses with FR992.FR1064).

Tables 7 through 12 report the ANOVAs and LS Means summaries of 2nd and 3rd year data for families tested in a third year, while Tables 13 to 16 report the 2nd year summaries for families tested for a second year.

Table 17 presents the summary for the breeding cross trial. Tables 18 to 21 present summaries of inbred trials based upon elite GEM families across NC environments.

After working with 50%-tropical GEM allelic diversity lines a second summer, it was apparent that survival to homozygosity of such materials was problematic in North Carolina. The likelihood of any surviving lines being used for phenotyping in the Midwest would clearly be very low. In addition, two of the PVP lines used initially, LH39 and MBNA, were not very widely adapted. A third, LH132, would probably do well in crosses to early and medium maturity accessions, but it is now considered a fairly late line in the Midwest. As a result, we recommended the use of a single, earlier-maturing PVP line, PHB47, but others felt that two PVPs were needed. At this point, the best reasonably-early non-SS PVP that appears to have wide adaptation is PHZ51, so we recommended that. Two other PVPs merit mention: HBA1 appears to be one of the best non-SSs in Raleigh, but, like LH132, it is late. MDF-13D would be the second choice for a non-SS. Both it and PHB47 did well in hurricane-battered Florida in 2005.