Progress Report:

This report serves to document research conducted under specific cooperative agreements between ARS and the North Carolina State University. Additional details of research can be found in the report of the parent project 3625-21000-036-00D-Germplasm Enhancement of Maize Project (GEM). Further information will be available in handouts at the December, 2007, cooperators meeting and the December, 2007, TSG meeting. This subproject relates to the primary objectives of the parent project, which includes coordination and conducting the GEM Project for the southern region and development of germplasm focused on 50% tropical derivation. This report summarizes the research conducted under specific cooperative agreements between the ARS and N.C. State University.

This subproject is concerned with nine 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 13 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) Sampling allelic diversity from representative races not encompassed by GEM yield-trial efforts.

49 entries (out of almost 500 tested) have been advanced from first year to second year trials in 2007, and 20 entries (out of 90 tested) were advanced from second year to third year testing. In 2007, 16,300 yield and disease plots (Tables 1 and 2) were coordinated through Raleigh (8,700 planted at NC State locations). This includes 400+ plots that were grown solely for GLS evaluations at three NC State locations.

Approximately, 1250 nursery rows and over 800 isolation block rows were planted in 2007 at Raleigh. Nursery work involves 12 new breeding crosses. In 2006, 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 those studies continued to reveal a great spread in yield potential, and those results heavily influenced our choices for 2007 nursery work. Disease evaluation continues in 2007 for GLS, where advanced materials are evaluated. In 2007, 11 GEM families were recommended to GEM Cooperators and provided from stocks furnished to Ames. Finally, 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 the most recent work in that area has been tentatively accepted for publication in Crop Science. The two most important tables are included as an Appendix to this report. Summaries of ongoing work are presented in Tables 3, 4, and 5. CML lines 10, 108, 157Q, 274, 341, 343, and 373; 89291 from IITA and NC296A perform well, with CML341 and 343 having the most promise.

Over 300 nursery rows were devoted to the Allelic Diversity study, which involves accessions that are outside the core plant breeding materials utilized by GEM and most plant breeding organizations. These represent new F1 hybrids from about 75 accessions. The F1s were produced last winter by Jim Deutsch of Syngenta and Randy Holley of Pioneer, using PHB47 and PHZ51 as ex-PVP parents. Backcrosses to the ex-PVP lines were made this summer; some of the F1 hybrids involving PHB47 were notably earlier than PHB47 itself. About 100 new accessions were sent to Deutsch and Holley this fall to make new F1 crosses.

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. The four new recommended lines with adequate seed availability are from DK888 N11.

Two new lines of investigation are in progress; eight new testers are being evaluated (three from Holdens and five from Pioneer; first year results are shown in Tables 7 to 9), and inbred GEM lines that have been developed at NC State will be tested for the first time in 2007 - these have been previously tested in NC-only trials. They will be compared head-to-head with some of the best GEM families that have been tested for two years.

Tables 10 and 11 report the LS Means summaries of 2nd and 3rd year data for families tested in a third year, while Tables 12 to 14 report the 2nd year summaries for families tested for a second year. Tables 15 to 20 present summaries of inbred trials based upon elite GEM families across NC environments.

Collaborative work with other USDA-ARS scientists and other public researchers includes fusarium molecular marker work with Drs. Holland (USDA-ARS, Raleigh) and Payne (NC State); racial classification using molecular markers with Drs. Buckler (USDA-ARS, Cornell) and Doebley (U. WI); and southern corn leaf blight resistance using molecular markers with Dr. Peter Balint-Kurti (USDA-ARS, Raleigh).

The most important events in the program at Raleigh involve new research personnel. Matt Krakowsky has joined us from Tifton, GA; he will be leading the GEM efforts in Raleigh. In addition, we have been able to hire a highly competent M.S. plant pathologist, Dale Dowden, who has had 30 years experience working with corn in the Southeast, mostly with DeKalb in North Carolina and Georgia. Both these ARS scientists are well qualified and promise to bring better coordination to an effort that has been more than a bit overextended at times.

Appendix Table 1. Yields for 88 experimental entries and 13 commercial checks. Standard errors (SE) of yield estimates are included because data are from a different number of environments.

Entry	Yield t/ha	SE	No. Env.†	Entry	Yield t/ha	SE	No. Env.†
Experimental Entries							
A214N x LH132.LH51	5.1	0.44	04	CML270 x LH132.LH51	5.2	0.52	02
BO46W x LH132.LH51	7.1	0.37	10	CML273 x LH132.LH51	6.9	0.44	04
C70 x LH132.LH51	7.0	0.43	04	CML274 x LH132.LH51	7.3‡	0.36	14
CML5 x LH132.LH51	5.7	0.44	04	CML285 x LH132.LH51	6.8	0.44	04
CML9 x LH132.LH51	5.7	0.44	04	CML288 x LH132.LH51	5.5	0.52	02
CML10 x LH132.LH51	6.8	0.35	18	CML295 x LH132.LH51	5.9	0.44	04
CML14 x LH132.LH51	5.6	0.44	04	CML304 x LH132.LH51	6.0	0.52	02
CML16 x LH132.LH51	7.1	0.36	14	CML311 x LH132.LH51	6.3	0.44	04
CML38 x LH132.LH51	6.9	0.35	18	CML314 x LH132.LH51	6.2	0.44	04
CML40 x LH132.LH51	6.3	0.44	04	CML319 x LH132.LH51	6.2	0.44	04
CML45 x LH132.LH51	5.1	0.44	04	CML321 x LH132.LH51	5.7	0.44	04
CML48 x LH132.LH51	5.0	0.44	04	CML322 x LH132.LH51	5.8	0.44	04
CML52 x LH132.LH51	6.8	0.38	08	CML323 x LH132.LH51	5.8	0.44	04
CML56 x LH132.LH51	5.4	0.44	04	CML325 x LH132.LH51	6.0	0.52	02
CML61 x LH132.LH51	5.9	0.44	04	CML327 x LH132.LH51	6.9	0.37	10
CML69 x LH132.LH51	6.7	0.35	18	CML329 x LH132.LH51	6.8	0.44	04
CML91 x LH132.LH51	6.8	0.35	18	CML331 x LH132.LH51	5.6	0.44	04
CML92 x LH132.LH51	6.7	0.35	18	CML332 x LH132.LH51	6.5	0.44	04
CML103 x LH132.LH51	7.1	0.35	18	CML333 x LH132.LH51	6.8	0.35	18
CML108 x LH132.LH51	7.2‡	0.35	18	CML341 x LH132.LH51	7.3‡	0.35	18
CML116 x LH132.LH51	6.4	0.38	08	CML343 x LH132.LH51	7.7‡	0.37	10
CML142 x LH132.LH51	6.9	0.44	04	CML373 x LH132.LH51	7.2‡	0.37	10
CML144 x LH132.LH51	6.8	0.44	04	CML374 x LH132.LH51	7.1	0.37	10
CML145 x LH132.LH51	5.5	0.44	04	CML384 x LH132.LH51	4.9	0.52	02
CML150 x LH132.LH51	6.3	0.44	04	DO940Y x LH132.LH51	6.6	0.37	10
CML154Q x LH132.LH51	6.8	0.35	18	87036 x LH132.LH51	5.5	0.66	04
CML157Q x LH132.LH51	7.2‡	0.35	18	89199 x LH132.LH51	7.0	0.66	04
CML158Q x LH132.LH51	6.4	0.44	04	89291 x LH132.LH51	7.7‡	0.43	04
CML159 x LH132.LH51	6.6	0.44	04	89302 x LH132.LH51	6.5	0.43	04
CML161 x LH132.LH51	6.3	0.44	04	90156 x LH132.LH51	5.7	0.43	04
CML173 x LH132.LH51	6.7	0.44	04	90301 x LH132.LH51	6.6	0.43	04
CML176 x LH132.LH51	7.0	0.36	14	NC296A x LH132.LH51	7.4‡	0.38	08
CML184 x LH132.LH51	6.9	0.44	04	Tzi3 x LH132.LH51	6.4	0.43	04
CML186 x LH132.LH51	6.6	0.44	04	Tzi17 x LH132.LH51	6.4	0.43	04
CML193 x LH132.LH51	6.2	0.44	04	Tzi18 x LH132.LH51	6.2	0.44	04
CML216 x LH132.LH51	7.0	0.36	14	VO613Y x LH132.LH51	6.6	0.37	10
CML218 x LH132.LH51	6.0	0.44	04	314190w x LH132.LH51	4.3	0.52	02
CML220 x LH132.LH51	6.2	0.44	04	316096A x LH132.LH51	6.0	0.52	02
CML223 x LH132.LH51	6.6	0.44	04	317027A x LH132.LH51	5.7	0.52	02
CML228 x LH132.LH51	6.2	0.44	04	318056A x LH132.LH51	5.6	0.52	02
CML238 x LH132.LH51	5.9	0.44	04	326172w x FR615.FR697	6.6	0.40	06
CML255 x LH132.LH51	6.6	0.44	04	326633A x FR615.FR697	6.4	0.52	02
CML261 x LH132.LH51	6.0	0.44	04	327609A x FR615.FR697	6.4	0.52	02
CML269 x LH132.LH51	7.1	0.36	14	796 NS x LH132.LH51	4.9	0.52	02
Commercial Checks							
DeKalb 687	7.6	0.44	04	Pioneer 3165	6.9	0.44	04
DeKalb 697	8.2	0.36	14	Pioneer 32D99	9.0	0.43	04
Garst 8288	7.8	0.36	10	Pioneer 32K61	7.0	0.37	10
HC33 x TR7322	6.9	0.43	04	Pioneer 32R25	8.4	0.40	06
LH132 x LH51	6.7	0.36	14	Pioneer 32W86	8.4	0.43	04
LH195 x LH256	6.7	0.52	06	Pioneer 31G98	8.3	0.36	14
LH200 x LH262	7.5	0.36	14				
Mean of Exp. Entries	6.4						
Mean of Checks	7.6						

† Number of environments represented by the data.

‡ Experimental entries in the top 10% for yield.

Appendix Table 2. 25% and 50%-exotic entry means from 10 environments. Data are given for yield, grain moisture, ear height, plant height, percent erect plants at harvest, and days to anthesis.

Entry	Yield t/ha	Mois. %	Ear Ht (cm)	Plant Ht (cm)	EP† %	Anth.‡ Days
BO46W x LH132.LH51	7.1	18.7	113	289	79§	70
CML10 x LH132.LH51	6.8	19.1	124	299	68§	71
CML10.NC414 x FR992.FR1064	7.5§	17.6	105§	280§	74§	68§
CML10.NC374 x FR615.FR697	7.5§	17.6	113	298	71§	69
CML16 x LH132.LH51	7.0	18.9	128	308	73§	69
CML38 x LH132.LH51	6.9	19.2	120	283§	69§	71
CML69 x LH132.LH51	6.7	19.1	115	281§	62	67§
CML69.NC414 x FR992.FR1064	6.7	17.7	103§	275§	70§	66§
CML69.NC374 x FR615.FR697	6.7	17.6	109	287	63	68
CML91 x LH132.LH51	6.8	17.2	107§	273§	76§	68
CML91.NC414 x FR992.FR1064	6.8	16.9§	94§	266§	78§	66§
CML91.NC374 x FR615.FR697	7.3	16.2§	105§	283§	71§	68§
CML92 x LH132.LH51	6.8	17.7	110	286	64	68
CML92.NC414 x FR992.FR1064	6.8	17.1	104§	274§	70§	66§
CML92.NC374 x FR615.FR697	6.9	16.4§	114	297	64	68§
CML103 x LH132.LH51	7.0	16.8§	115	276§	53	68
CML103.NC414 x FR992.FR1064	7.0	16.9§	103§	269§	68§	66§
CML103.NC374 x FR615.FR697	7.2	16.6§	112	287	63	67§
CML108 x LH132.LH51	7.2	17.1	100§	275§	71§	67§
CML108.NC414 x FR992.FR1064	6.8	16.8§	95§	265§	71§	65§
CML108.NC374 x FR615.FR697	7.2	22.0	102§	281§	71§	67§
CML154Q x LH132.LH51	7.0	18.5	106§	271§	53	67§
CML154Q.NC414 x FR992.FR1064	6.7	17.6	101§	273§	72§	66§
CML154Q.NC374 x FR615.FR697	7.2	16.6§	111	293	65	67§
CML157Q x LH132.LH51	7.3	17.9	121	292	74§	68
CML157Q.NC414 x FR992.FR1064	7.0	17.4	106§	277§	71§	66§
CML157Q.NC374 x FR615.FR697	7.2	16.9§	110	290	71§	68
CML176 x LH132.LH51	7.0	19.1	124	304	57	70
CML216 x LH132.LH51	7.0	18.9	128	309	56	71
CML269 x LH132.LH51	7.0	19.2	117	292	71§	70
CML274 x LH132.LH51	7.4§	17.7	124	301	73§	71
CML327 x LH132.LH51	6.9	17.6	120	296	76§	69
CML333 x LH132.LH51	6.8	18.6	115	284§	62	68
CML333.NC414 x FR992.FR1064	6.9	17.7	107§	278§	67§	67§
CML333.NC374 x FR615.FR697	7.3	16.9§	115	294	69§	68
CML341 x LH132.LH51	7.1	18.9	123	295	69§	71
CML341.NC414 x FR992.FR1064	7.5§	17.2	109	280§	75§	68§
CML341.NC374 x FR615.FR697	7.7§	16.7§	111	289	72§	69
CML343 x LH132.LH51	7.7§	18.7	110	285	76§	70
CML373 x LH132.LH51	7.2	19.1	110	280§	78§	69
CML374 x LH132.LH51	7.1	18.5	122	300	71§	69
DO940Y x LH132.LH51	6.7	18.1	113	277§	73§	69
VO613Y x LH132.LH51	6.6	18.8	117	275§	70§	70
Entry Mean	7.0	17.9	112	285	69	68
DeKalb 697	8.3	17.0	105	275	72	68
Garst 8288	7.9	17.2	97	281	82	66
LH132 x LH51	6.7	15.9	98	269	70	66
LH200 x LH262	7.6	16.6	111	282	70	68
Pioneer P31G98	8.3	15.9	107	283	75	68
Check Mean	7.7	16.5	103	278	74	67
LSD (W=.05); Entry v. Check Mean	0.4	0.5	4	6	7	1

†Percent erect plants at harvest.

‡Data collected at 3 environments only.

§ Within one LSD of the check mean.