Registration of Maize Germplasm Line GEMS-0067

M.R. Campbell,* Jay-lin Jane, Linda Pollak, Mike Blanco, and Anna O’Brien

GEMS-0067 (Reg. no GP-550, PI 643420) is a partially inbred germplasm line released by Truman State University (TSU) in accordance with the Germplasm Enhancement of Maize Project (GEM) protocol (Pollak, 2003). This line is being released for use in the development of genetically diverse, elite, Amylomaize Class VII (starch amylose > 70%) parental lines. These lines possess modifier genes that, together with the recessive amylose-extender (ae) allele, elevate starch amylose content to at least 70%. The development of high-amylose maize varieties was described by Fergason (1994) where difficulties encountered during development were likely due to the lack of modifier genes needed to reach required amylose percentages in most breeding sources. To our knowledge GEMS-0067 represents the only public source of Amylomaize VII germplasm to date. Development of GEMS-0067 was achieved utilizing exotic tropical germplasm as a source of these modifiers from the cooperative USDA-ARS GEM project and is here described.

Selection for high amylose modifier genes began in 1997 at Truman State when a sister-line hybrid H99ae × OH43 ae (provided by Dr. David Glover, Purdue University) was used as a male in crosses with many sources of exotic maize germplasm. These included several hundred plant introductions and 70 breeding crosses from GEM. Our results revealed that two plant introductions Zia Pueblo NRC 5357 (PI 218131) and Cochiti Pueblo NRC 5298 (PI 218131) and one GEM breeding cross (GUAT209:S13) contributed high amylose modifi ers raising amylose levels to at least 70% in the F1 kernels as described previously by Campbell et al. (2003). Only lines from GUAT209:S13 × (H99ae × OH43ae) were found to survive inbreeding and therefore used in subsequent breeding studies while the others were dropped.

GUAT209:S13 is a 50% tropical exotic breeding cross, classified by GEM as stiff-stalk. It was derived from crossing Guatemalan 209 (PI 498583), a yellow flint population of the tropical race, Tusón, to a proprietary stiff-stalk inbred from a private GEM cooperator designated as company 13. Fifty kernels of the original GUAT209:S13 × (H99ae × OH43ae) F1 seed (from the bulk of approximately five ears using GUAT209:S13 as a female) was planted in a winter nursery in Puerto Rico. Resulting plants were self-pollinated and ears with segregating kernels (3 normal:1 ae-type) were harvested from ten of these plants. Mutant ae F2 kernels were visually selected from each ear, bulked, and planted to establish 50 F3 plants which, on selfing, produced ears having only ae-type kernels (F3 seed, F4) in the summer of 1998 near Kirkville, MO. For each (H99ae × OH43ae) × exotic cross, grain samples from at least three F3 ears were analyzed for starch amylose using a colorimetric iodine affinity (IA) procedure (Williams et al., 1958) following starch extraction and purification. Remainnt grain samples were used for inbreeding ear-to-row to the F1, generations and selections made to fix modifiers based on laboratory IA data obtained following each generation.

GEMS-0067 is currently maintained by sib-mating within the F1 derived line from the pedigree GUAT209:S13 × (H99ae × OH43ae). Evaluations made in Kirkville from 2002 to 2003 indicate that GEMS-0067 is a vigorous line with pollen shed occurring approximately four days before B73. Its average plant height is approximately 20 cm less than B73, with an upright leaf structure, yellow kernels and a red cob. Since the ae donor was from the non-stiff stalk source H99ae × OH43ae, GEMS-0067 is of mixed heterotic derivation, composed of 50% non-stiff stalk (NS) and 50% stiff stalk (SS). Subsequent crosses made with GEMS-0067 to both NS and SS testers have shown good yield in preliminary data over two years. Data regarding amylose content, plant characteristics, and yield are available on the GEM web site (www.public.iastate.edu/~usda-gem; verified 27 March 2007), under Public Cooperator Reports-Campbell, for 2004 and 2005.

Selection for high amylose was initially made solely on the colorimetric IA method which measures only “apparent amylose.” Additional analytical techniques used to characterize the starch are shown in Table 1. GEMS-0067, having modifiers from GUAT209:S13, was compared to several public inbreds possessing the ae gene but without high amylose modifier genes. Starch was isolated from duplicate 100-gram bulk samples obtained from each genotype. Samples 1 and 2 were starches purified.