Registration of NPM-5 and NPM-6 Dwarf Grain Pearl Millet Restorer Germplasms

Pearl millet [Pennisetum glaucum (L.) R. Br.] NPM-5 (GP-39, PI 634546) and NPM-6 (GP-40, PI 634547), dwarf grain germplasms containing the A₄ cytoplasmic-nuclear male sterile (CMS) system with its respective nuclear restoration gene (R₄) were released by the Institute of Agriculture and Natural Resources, University of Nebraska-Lincoln, in November 2003. The A₄ CMS system uses Pennisetum glaucum spp. monodii cytoplasm and shows no reversion to male fertility, which typically occurs at a low frequency with the widely used A₁ CMS system. Since most germplasms completely maintain A₄ sterility (Hanna, 1989), male-fertility restorers (R₄) (Hanna, 1989) are rare and few have been made available in agronomically acceptable dwarf backgrounds. Developing A₄ restorers in lines carrying A₄ cytoplasm simplifies the selection of good restorer lines because the quality of the male fertility is self evident on the selected plants. Restorer lines developed this way are designated A₄R₄.

NPM-5 was developed by random mating 17 A₄R₄ parental breeding lines developed in the University of Nebraska-Lincoln (UNL) breeding program in 1999. These parent lines were developed from six selfed F₁ hybrids (Tift 23DA₄E × R₄ restorers) and two open-pollinated bulks of an early generation 91M54026A₄ line grown in the 1992 Puerto Vallarta, Mexico, winter nursery. The R₄ restorer gene source used in the F₁ hybrids and the open-pollinated A₄ lines was from the same parental lines used in the development of NPM-3 (Andrews and Rajewski, 1995). Seeds from these hybrids were grown at Mead in 1992, and 79 fertile selections with complete seed set were selfed and evaluated in 1993. The best 26 selections (dwarf, panicle exertion, complete seed set, early to medium maturity, and stiff stalk) were grown in a winter nursery in Puerto Vallarta and evaluated for seed set, dwarfness, panicle size, and earliness. Selfed seeds from 17 lines with complete fertility restoration were planted in isolation nurseries for random mating at the High Plains Agricultural Laboratory, Sidney, NE, in 1994. Ten of the open-pollinated families were similarly selected and random mated in 1995 and 1996. Bulk seed from this population was grown, selfed, and selected at Lincoln, NE, in 1997. The best 30 S₁ plants were random mated in isolation nurseries in 1998. Random mating and selection continued at Mead from 1999 to 2001. Harvested seed of the best 29 families was bulked for release in 2001. Experiments to evaluate fertility restoration at multiple planting dates were conducted at Mead in 2002. Pollen shed counts of NPM-5 indicated that 99 to 100% of the plants were male fertile. Topcrosses of NPM-5 on two A₄ testers showed averages of 61 to 93% fertility restoration.

NPM-6 was derived by intermating 37 A₄R₄ parental breeding lines developed in the UNL breeding program. Parental lines were chosen for their completeness of selfed seed set, diversity in genetic background (including both R₁ lines and R₄ lines) and their agronomic traits suitable for Nebraska conditions. The A₄ CMS system was intermated at Sidney in 1998 and at Mead in 1999. Thirty-six open-pollinated families were selected for pollen shed, pearl millet, and evaluated for seed set, complete seed set, dwarf height, panicle exertion, panicle size, and earliness. Selfed seeds from 17 lines with complete fertility restoration were planted in isolation nurseries for random mating at the High Plains Agricultural Laboratory, Sidney, NE, in 1994. Ten of the open-pollinated families were similarly selected and random mated in 1995 and 1996. Bulk seed from this population was grown, selfed, and selected at Lincoln, NE, in 1997. The best 30 S₁ plants were random mated in isolation nurseries in 1998. Random mating and selection continued at Mead from 1999 to 2001. Harvested seed of the best 29 families was bulked for release in 2001. Experiments to evaluate fertility restoration at multiple planting dates were conducted at Mead in 2002. Pollen shed counts of NPM-5 indicated that 99 to 100% of the plants were male fertile. Topcrosses of NPM-6 on two A₄ testers showed averages of 61 to 93% fertility restoration.

NPM-5 is a medium-early maturing, dwarf germplasm with good panicle exertion than 104 cm in height at maturity. It flowers between early June to early July plantings at the 4 to 9-d range between first plants flowering and the flowering date for the germplasm. Grain yields of 2870 kg ha⁻¹ have been recorded. Hybrid parents showed heterosis levels of 14 to 60% from planting dates, with the best hybrid yielding 1.25% Seed of NPM-5 is gray in color, variable in grain weight ranging from 5.9 to 13.9 g. Plants from 14 to 29 cm in length, with a mean of 25 cm, with a mean panicle size of 19.6, 18.7, and 5 cm NPM-2 (Andrews et al., 1995), and NPM-3, male NPM-5 is gray or white in color, variable in seed weight and peduncle diameter ranged from 2.2 to 3.7 cm, with exertion and segregation for bristled panicles. Grain yield of NPM-5 has not been determined.

NPM-6 is a medium-early maturing, dwarf germplasm with good panicle exertion than 100 cm in height at maturity. It flowers between early June to early July plantings at the 5 to 9-d range between first plants flowering and the flowering date for the germplasm. Grain yields of 2670 kg ha⁻¹ have been recorded. Hybrid parents showed heterosis levels of 0 to 51% from planting dates, with the best hybrid yielding 3526 kg ha⁻¹. Seed of NPM-6 is gray or white in color, variable in 1000-gain weight ranging from 5.9 to 13.9 g. Plants from 17 to 28 cm in length, with a mean of 22.5 cm, with a mean panicle size ranging from 2.1 to 3.3 cm with good interior disease reaction of NPM-6 has not been determined.

NPM-5 and NPM-6 provide more diverse sources of which dwarf A₄R₄ restorer lines can be derived from the A₄ CMS system for producing medium-early maturing dwarf grain hybrids. Male parental restorer on the A₄ system can be obtained from NPM-5 and NPM-6 through selection of desirable lines selfed seed set before testing for yield and fertility. Sources of identified dwarf R₄ restorers have been used in the A₄ system, which is considered to have seed including no male fertile reversions in males and generally better seed set in single cross hybrids compared with the currently used A₁ CMS system. Performance tests of NPM-5 and NPM-6 indicate the germplasms have fair to good combining ability diversity in genetic background (including both R₁ lines and R₄ lines) and their agronomic traits suitable for Nebraska conditions.