Registration of Two Tetraploid Rice Genetic Stocks

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The USDA-ARS developed two tetraploid (4X = 2n = 48) rice (Oryza sativa L.) pools that subsequently were reselected as genetic stocks, TG1 (Reg. No. GS-7, PI 644028) and TG2 (Reg. No. GS-8, PI 644029). TG1 and TG2 were produced by intercrossing a colchicine-induced 4X with two spontaneous 4X lines. These 4X genetic stocks have higher seed set than their 4X parents, although not as high as their corresponding diploid (2X) parents. These 4X stocks may have value for breeding 4X rice for novelty and/or production uses.

The parents of the germplasms were 4X SY, developed by colchicine-induction of 2X SY, an advanced-generation line that came from the cross of indica cultivar Shuang 13/japonica cultivar Ying-tou-jing in Guangzhou, China; 4X L202, a spontaneous 4X line selected in California in a farm field of the cultivar L-202 (L202) (Tseng et al., 1984); and 4X JKSN, a spontaneous 4X line selected in Arkansas in a farm field of the cultivar Jackson (JKSN) (Bollich et al., 1996).

Line 4X SY was induced by soaking 2X SY seeds in water for 2 d to initiate germination. Seeds with 2- to 4-mm shoots were then placed in 0.02% colchicine solution for 2 d. By this time noticeably inhibited roots and shoots appeared, and seeds were washed thoroughly and placed in petri dishes with wet filter paper for 3 or 4 d. Seedlings with adventitious roots were transplanted to pots. Of 598 treated seeds, 355 survived to grow into plants, of which 5 were 4X. Tetraploids also were produced by taking seedlings at the 5- to 6-leaf stage, cutting the base of the seedlings transversely at root crowns, then soaking in 0.05% colchicine solution for 10 d. The washed seedlings were then transplanted in the field. Of the 316 soaked seedlings, 183 survived to produce plants, of which 10 were 4X. Tetraploid C1 plants usually had only one to three tillers, which produced 50 to 60% 4X spikelets within a panicle. Tetraploid grains were much larger and had a longer awn than 2X grains. Only 10 to 20% of the C2 plants from C1, 4X seeds were 4X, with others reverting to 2X, indicating that the 4X condition had become stabilized, although not as high as their corresponding diploid (2X) parents. When examined with the technique of Beachell and Jones (1945) and Yan and Pao (1960), root tips from the larger 4X grains were found to have 48 chromosomes, compared with 24 chromosomes in the small 2X grains. Similar distinguishing characteristics of 4Xs had been noted by previous authors, including Beachell and Jones (1945) and Yan and Pao (1960).

The spontaneous 4Xs were found by searching farm fields for early maturity, when 2X panicles had turned down while 4X panicles with large florets, remained erect due to greatly reduced seed set. Chromosome numbers were not checked in the 4X lines, as these were true-breeding in previous generations.

The F1s of 4X SY/4X L202 and 4X SY/4X JKSN were planted in the field in 1997. The 4X F1s had seed set of 72 and 86% which exceeded that of their 2X parents, indicating that the 4X condition had become stabilized, although not as high as their corresponding diploid (2X) parents (Table 1). The F2 plants, along with 4X parents and ratooned 4X F1 plants, were grown in 1998. Seed sets of the F1s and F2s ranged from <10 to 90%, with 70% or higher seed set being selected, out of a total of approximately 1100 plants, a selection intensity of 3.0%. Visual selection for high seed set continued, albeit less intensely, on a panicle-to-panicle basis in subsequent generations. Selection also was practiced for disease resistance, with 4X SY/4X L202 selected fpr the recessive glabrous leaf and hull characteristic, derived from C1 4X seeds were 4X, with others reverting to 2X. In the C2 line, the number from 4X SY/4X L202 was narrowed down to one glabrous line (TG1), and the number from 4X SY/4X JKSN was narrowed down to one glabrous line (TG2).

As expected, grain size of the 4X lines was considerably larger than that of their 2X parents (Table 1). The F2 generations of both crosses, along with 4X parents and ratooned 4X F1 plants, were grown in 1998. Seed sets of the F1s and F2s ranged from <10 to 90%, with 70% or higher seed set being selected, out of a total of approximately 1100 plants, a selection intensity of 3.0%. Visual selection for high seed set continued, albeit less intensely, on a panicle-to-panicle basis in subsequent generations. Selection also was practiced for disease resistance, with 4X SY/4X L202 selected for the recessive glabrous leaf and hull characteristic, derived from C1 4X seeds were 4X, with others reverting to 2X. In the C2 line, the number from 4X SY/4X L202 was narrowed down to one glabrous line (TG1), and the number from 4X SY/4X JKSN was narrowed down to one glabrous line (TG2).