Isolation of early-heading mutants induced by heavy-ion radiation in an Indonesian native rice cultivar

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Rice is cultivated as far as 50º N in China and 40° S in Argentina. [1] The period from seeding to heading is important for cultivation over a wide latitude. The heading time can be determined by the period of vegetative growth phase, from seedling to panicle primordium initiation, and reproductive phase, from panicle initiation to heading.[2] The vegetative growth phase consists of the basic vegetative phase (BVP) and photoperiod sensitive phase (PSP). Cultivated rice is classified as a short-day plant, and it exhibits a wide genetic diversity with respect to sensitivity to photoperiod [3]. Tanisaka et al. isolated a longer BVP mutant line induced by γ-irradiation of seeds of the Japanese lowland rice cultivar 'Ginbozu' with a longer PSP and shorter BVP.[3] Indonesian rice cultivars belonging to the ecotype bulu have a shorter PSP and longer BVP.[4] The aim for this study was to isolate a shorter BVP mutant line induced by heavy-ion radiation.

Dry seeds of an Indonesian native rice cultivar (*Oryza sativa* L. 'Gemdjah Beton' belonging to the ecotype bulu) were irradiated with C-ions accelerated to 135 MeV/nucleon by (RRC) at a dose of 125 Gy in April 2011. LET values of the C-ions corresponded to 22.5 keV/μm.

In 2011, the M_1 seeds were sown in seedling trays at the end of April and grown in a greenhouse for 4 weeks. Field experiments were conducted in the paddy fields of the Experimental Farm Station, Graduate School of Life Sciences, Tohoku University, in Kashimadai, Osaki, Miyagi, Japan (37º28', 141º06'). A fertilizer was applied to the paddy fields at rates of 30 kg of N, P, and K/ha. We transplanted 3,000 seedlings (age, four weeks) into a single lot at the end of May. Plants were grown at a density of a plant per hill, with 30-cm spacing between hills. In the middle of September, more than 15 M_1 plants flowered one week earlier than the other M_1 plants and the wild-type 'Gemdjah Beton'. We sampled the M_2 seeds of these M_1 plants in the beginning of November.

In 2012, we planted the M_2 seeds of these selected lines at the end of April and then transplanted 50 seedlings per each line in a paddy field at the end of May. One mutant line flowered over about ten days earlier than the other M_2 lines and the wild-type in the middle of September. At the end of October, M_3 seeds of 26 plants were sampled in the M_2 line.

In 2013, we randomly selected 10 M_3 lines from 26 M_3 lines and grew 50 plants of each M_3 line. The period from transplanting to the heading of wild-type was 17 weeks. Six M_3 lines exhibited the segregation from 15 to 17 weeks. The heading day of two M_3 lines was the same as that of the wild-type. All plants of another two M_3 lines showed heading two weeks earlier than the wild-type. Therefore, we succeeded in isolating early-heading mutant lines induced by heavy-ion radiation.

Seven loci that control the period of BVP were detected in cultivated rice.[5] We are currently attempting to determine the locus of the mutant gene that shortens the period of BVP in the mutant lines isolated in this study.

Fig. Early-heading M_3 mutant line (left) and wild-type (right) grown in a paddy field on October 18, 2013

References

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