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

E. Hanzawa,*1 Y. Kazama,*1 Y. Hayashi,*2 T. Abe,*2,*3 A. Higashitani*1 and T. Sato*1,*2

Rice is cultivated as far as 50° 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 photoperiod3). 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 M1 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 (37°28’, 141°06’). 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 M1 plants flowered one week earlier than the other M1 plants and the wild-type ‘Gemdjah Beton’. We sampled the M2 seeds of these M1 plants in the beginning of November.

In 2012, we planted the M2 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 M2 lines and the wild-type in the middle of September. At the end of October, M3 seeds of 26 plants were sampled in the M3 line.

In 2013, we randomly selected 10 M3 lines from 26 M3 lines and grew 50 plants of each M3 line. The period from transplanting to the heading of wild-type was 17 weeks. Six M3 lines exhibited the segregation from 15 to 17 weeks. The heading day of two M3 lines was the same as that of the wild-type. All plants of another two M3 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.

References