3-39 Ion Beam Irradiation on Rice Seeds for the Mutation Breeding Project of the Forum for Nuclear Cooperation in Asia (FNCA)

A. Tanaka [a)], S. Nozawa [a)], Y. Hase [a)], I. Narumi [a)], H. Ishikawa [b)] and A. Koike [b)]

[a)] Life Science and Biotechnology Division, QuBS, JAEA,
[b)] Nuclear Safety Research Association

1. Introduction

For the spread of radiation application and development of ion beam breeding technique, ion beams have been utilized under the Mutation Breeding Project of the Forum for Nuclear Cooperation in Asia (FNCA) of MEXT (Ministry of Education, Culture, Sports, Science and Technology). This project contributes to increase food production and to improve food quality in Asia, by developing new mutant varieties with resistant to disease, insects, and environment, or higher yields and quality of important crops such as soybean, sorghum, orchid and banana, and so on. As the Sub-Project on Composition or Quality in Rice, utilization of ion beam has been started in 2009. Eight participant countries, i.e., Bangladesh, China, Indonesia, Korea, Malaysia, The Philippines, Thailand and Vietnam joined the ion beam irradiation with rice seeds.

2. Materials and Methods

In general, hulled dry seeds of a rice cultivar (cv.) of participant countries were irradiated with 320 MeV carbon ion beam in TIARA [1)]. After irradiation, seeds were rightly sent back to the participant countries and grown to obtain the offspring.

At the FNCA workshop on Mutation Breeding held in Philippines in November 2010, we have deeply discussed the appropriate population size for irradiation treatment and suggested that the minimal number of initial cells to be irradiated is at least 5,000 in order to obtain enough mutants. The protocol for selection of seeds after irradiation was also discussed and it was suggested to harvest 5 seeds from 5 panicles from each M_1 plant as shown in Fig. 1.

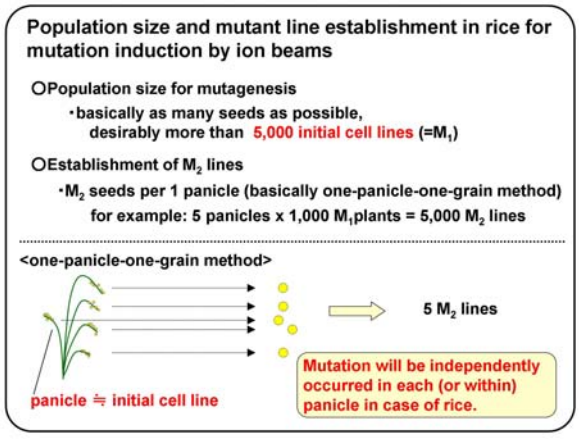

Fig. 1 Protocol for mutation line establishment in rice.

3. Results and Discussion

In 2010, most of participant countries were able to decide the best doses for mutation induction and some countries have also carried out harvesting of M_2-M_3 plants and their screening. For example, in the Philippines, initial result showed that the best dose was found to be 20 Gy and the lethal doses were 160 and 200 Gy. In the M_1 generation, plant height, days to heading, number of productive tillers, number of seeds per panicle, and sterility were affected by the irradiation. However, no differences were obtained on the panicle length and 100 seed-weight. In Vietnam, mutation has been observed in plant height, grain weight, maturity or sterility in the M_2 generation of both Khang dan and Bac thom varieties. In the M_3 generation, some interesting characteristics related to yield were shown and chosen as for grain weight, short grow duration, tolerant to disease, and semi-dwarf plant (Fig. 2). In Bangladesh, the M_3 progenies derived from irradiated seeds of a local salt tolerant cultivar-Ashfal were evaluated. The M_3 progenies derived from either 40 Gy or 200 Gy included photoinsensitive mutation. This progenies also included early mature and high yield characters (Fig. 3).

Fig. 2 Khang dan variety (*left*), and its semi-dwarf mutant that is tolerant against lodging (*right*).

Fig. 3 BRRI dhan-29 variety (*right*), and its mutant line with early mature and high yield (*left*).

Reference

1) A. Tanaka et al., JAEA Takasaki Ann. Rep. 2009 (2011) 61.