Annex 4. Session Summary

Session Summary of FNCA JFY2012 Workshop on Mutation Breeding Project

Session 1 Final Report for Sub-Project on Composition or Quality in Rice

Ten Member Countries presented their final report for Sub-Project on Composition or Quality in Rice. The brief summaries are as follows:

Bangladesh (Dr. A.N.K. Mamun, BAEC)

We are going to release one variety very soon and the other one to two varieties with in two years. Other mutant lines are selected from carbon ion beam irradiated seeds. Mutant that is going to be released as variety soon produces higher yields than popular variety cultivated now. This variety will help to inter cropping and it would be possible to bring about 1,500,000 ha additional land under mustard/rapessed cultivation with a total additional production of 2,000,000 tons of mustard/rapessed, which will inturn produce 800,000 tons of edible oil after release of the mutant as variety.

China (Dr. Shu Qingyao, ZU)

To increase the nutritional value of rice grains, ten mutant lines with reduced phytate content were induced. To further understand the molecular genetic features of induced mutations, about ten mutated genes were identified and sequenced; results showed that most gamma rays induced mutations are short deletions (1-11 basebapirs), but nucleotide substitution and large deletion (up to 1.45kb) were also observed.

Indonesia (Dr. Sobrizal, BATAN)

To meet the Indonesian domestic demand for both rice grain quality and quantity, high variability of pure lines derived from a cross of Indica rice variety, IR36 and Japonica rice variety, Koshihikari have been constructed. Among these lines, KI 237 line was treated by gamma ray irradiation to remove its undesirable character. Ten high yielding and grain quality lines derived from these treated seeds were selected as promising lines. These lines are now under multi-location yield trials and other examinations such as grain quality and pests and diseases resistances as requirements of variety release in Indonesia.

Japan (Dr. Minoru Nishimura, IRB)

We completed amylose library consisted of Koshihikari and Hitomebore NILs with amylose-content gradients of about 2%. They will be used for the genetic analysis in the new MAFF project from 2013. We also analyzed the temperature response of low amylose mutant strains.

Korea (Dr. Si-Yong Kang, KAERI)

During the last research period of the project, we developed a rice mutant variety, cv. “Goldami-1” and then released from the KAERI. “Goldami-1” was developed by radiation fusion technology combining with plant tissue culture, and had a character of 70% increased amino acid compared with the original variety "Dongan" and check variety "Youngan", high lysine accumulating variety. A mutant line, T1001-1, was isolated from *in vitro* mutagenized population by ionizing radiation and shown to have increased VitE contents. To study the molecular mechanism of VitE biosynthesis, we identified rice genome encodes seven VitE biosynthetic enzymes and we analyzed their expression patterns. In addition, some of basic studies on rice have been conducted focusing on bio-effect and gene expression by ion-beam irradiation compared with gamma ray irradiation and space environment treatment.

Malaysia (Dr. Abdul Rahim Bin Harun, Nuclear Malaysia)

Malaysian Nuclear Agency has produced 2 mutant variety adaptable to water input requirement through gamma radiation. Under Sub-Project on Composition or Quality in Rice, Nuclear Malaysia had sent MR219, MRQ74, MR211 and Pongsu Seribu to JAEA for ionbeam irradiation. Radiosensitivity test were carried out and optimum doses for those variety has been identified. 31 mutant lines of MR219 irradiated with 60Gy ion beam had been analysed for determination of physic-chemical characteristics such as amylose contents, alkaline spreading value (ASV), equilibrium water content (EWC) and lipid. The results from this study showed that ion beam radiation caused some great performance changing in the agronomic traits of some mutant lines as compared to the control. Based on overall data recorded, ML21 had the greatest performance in term of yield.

The Philippines (Ms. Adelaida C. Barrida, PNRI)

Gamma and ion beam irradiations were used for improving the grain quality and agronomic characteristics of IR 72. In the gamma irradiated selections, four mutant lines with intermediate amylose content using the quantitative method were selected at 300 Gy and one line at 200 Gy. Increased in the protein content was obtained on those plants irradiated with 200 Gy gamma rays at M4 generation.

Thailand (Dr. Suniyom Taprab, RD)

Rice mutation breeding had been applied since 1965 with KDML105 gamma irradiation. Through conventional pedigree selection, high quality glutinous mutant derived and released in 1977 designated RD6. One year later, another non-glutinous mutant with as good quality as its wild type (KDML105) had been released. These 2 mutant varieties contribute more than a half of rain-fed rice production. In 1981, glutinous photo-insensitive mutant, RD10, had been released. It had been derived from mutation induction by fast neutron in 1969. It made big increasing in glutinous rice production since it could be grown in any period of time during our cropping season.

Vietnam (Ms. Dao Thi Thanh Bang, AGI)

Mutation induction is useful tool for rice breeding improvement in case of changing one or two characters but not disturbing the rest characters. Improving productivity of quality rice variety is

aim of research. Mutant variety DT39 Quelam has been created from Bacthom 7 variety by Cobalt-60 gamma-ray source with the dose 200Gy. Main charaters of new variety are 14 % higher yield than the origin with amylase contents of 17.8% and protein contents of 9.1% , and better resistant to bacterial leaf blight than Bacthom 7. New variety has been certified as new variety in January 2013. The project is performed from summer season 2008.

Session 2 Five-Year Plan for Next Project on Mutation Breeding of Rice for Sustainable Agriculture

All participating countries introduced their 5-year plan for next project on Mutation Breeding of Rice for Sustainable Agriculture, as follows:

Bangladesh (Dr. A.N.K. Mamun, BAEC)

To overcome the effect of climate change and also improve rice productivity, we should develop high yielding, early material rice variety with abiotic stress tolerance by using gamma and carbon ion beam radiation as well as in vitro techniques. It is also necessary to give effort to reduce the use of water, chemical fertilizers, and pesticides.

China (Dr. Shu Qingyao, ZU)

The objective for the next 5 years are to elucidate the effect of gamma rays and ion beam irradiation on rice genome to reveal the features of induced mutation and to develop mutant lines with heat tolerance, weak photoperiod sensitivity and long grain shape for super-yielding hybrid rice cultivar. New technologies like next generation sequencing methods will be deployed in the study.

Indonesia (Dr. Sobrizal, BATAN)

To fulfill the Indonesian rice demand, the national rice production should be increased. It can be achieved by increasing yield / ha and increasing rice harvesting index through growing high yielding and early maturity of rice varieties. In this research, breeding of rice varieties for high yielding and early maturity will be conducted through a wide cross and mutation techniques.

Japan (Dr. Minoru Nishimura, IRB)

Three topics were proposed as follows.

1) Mutants expressing phenotypes of glutinous endosperm, chlorophyll b deficiency, endosperm protein deficiency, dwarfism, and shortened plastochron were analyzed. The result shows that of the 24 mutations 15 were small deletions (1-16bp), four were large deletions (9.4-129.7kbp), three were single-base substitutions, and two were inversions. These results suggest that gamma irradiation is more likely to induce deletions between 1 and several ten bp or those of around 10kbp or more.
2) Mutants with cool tolerance at the booting stage by gamma-ray irradiation from 5 original varieties with different tolerance were selected. More tolerant mutants than original variety could not be obtained. It was also reported that recent high temperature stress in summer deteriorated the grain quality of many varieties.
3) To increase the biomass of plants more than before, combining the advantage of mutation breeding and cross breeding was emphasized.

Korea (Dr. Si-Yong Kang, KAERI)

Some of mutation breeding researches in rice were suggested for next 5-year research plan of the FNCA meeting among the ongoing research projects of the KAERI. One of suggested researches will be continuing the composition and salt tolerance breeding in rice. The other will be conducted mainly on mutagenesis of ion-beam irradiated rice seeds.

Malaysia (Dr. Abdul Rahim Bin Harun, Nuclear Malaysia)

Challenges rice production in Malaysia is abiotic stress due scarcity of water in the future due to climate change and rice blast disease which severelly infected rice granarry area recentlly in 2012. Therefore Malaysian will propose the induce mutation breeding for the production of new varieties of high yield rice with low water consumption and resistance rice mutant to blast disease in line with the theme of FNCA Project on Mutation Breeding of Rice for Sustainable Agriculture. By having mutant can withstand with law water input and variety resistance to blast disease, the farmers can reduce the use of chemical and increase income.

Mongolia (Dr. Bayarsukh Noov, PSARI)

The mutation breeding in Mongolia has been conducted by PSARI since 1970's. But, mutation breeding tool mainly used for the enhancement of genetic diversity in wheat through and over 20,000 mutant lines of wheat developed and used for new variety improvement and also a few mutant varieties released.

Agriculture sector in Mongolia has been confronting numerous climate change challenges including severe drought, distribution of harmful pest and diseases, degradation of the grassland, etc. The mutation breeding technique has been successfully used for crop improvement activities among regional countries as most potential and easy tool for combating climate change affects. Recognizing, potential of mutation breeding technique Mongolia will carry out experiments on the development of drought tolerant and diseases resistant new varietes of wheat and barley through the combined use of mutation breeding and molecular technique.

The Philippines (Ms. Adelaida C. Barrida, PNRI)

Improvement of Traditional Rice Varieties by Gamma Irradiation

The characteristics of traditional rice varieties are tall, late maturing, susceptible to lodging, seasonal, low yielding and susceptible to pest and diseases. With the application of gamma irradiation it is hope to improve the agronomic characteristics of these rice varieties. The study aims to develop mutants with improved agronomic traits and can adapt at organic farming.

Thailand (Dr. Suniyom Taprab, RD)

When photoperiodism and dosages of gamma ray were considered, it was found that 20 Kr (200 greys) and 30 Kr (300 greys) induced different frequency of mutation on amylose content. Both 20 Kr and 30 Kr induced similar distribution of mutants in case of photoperiod sensitive. Among photoperiod insensitive mutants derived from RD15, 20 Kr induced higher amylose while 30 Kr induced lower amylose than its wild type. M7 mutants showed bigger grain size but shorter length than their wild types. Aromatic rice with low amylose content were obtained from KDML105 mutants. Newly found aromatic rice with high amylose content derived from RD15

mutants could not be detected on its 2-acetyl-1 pyrroline compound. Those mutants might contain other volatile aromatic compound.

Vietnam (Ms. Dao Thi Thanh Bang, AGI)

50% of rice area production in Vietnam is not good condition for cultivation due to flooding, drought, salinity, pest and disease problem. Beside that, Vietnam is one of countries affected by climate change and by increase of sea water. Mutation induction of rice variety is power full tool to fill the duty. Local variety is selected from gene bank resources for irradiation treatment. Selection process is started from M2 generation. Mutated lines will be put into stress condition for drought, salinity or pest and disease artificial infection in order to select the best tolerant lines for difficult conditions. Next generation will be continued for selection in field condition and evaluation agronomic trait. Out put of project: select 2-3 mutant varieties to develop in larger scale and submit for new varieties.