

Annex 3. Session Summary

Session Summary of FNCA 2019 Workshop on Mutation Breeding Project

Session 1 Follow-up on Sub-project on Sorghum and Soybean

Follow-up report on the Sub-projects in Sorghum and Soybean was presented. The summary is as follows:

1. Sub-project on Drought Tolerance in Sorghum and Soybean

(Mr. Arwin, BATAN, Indonesia)

Soybean research in Indonesia has 4 topics: (a) Improve soybean varieties for early maturity (less than 75 days) and super early maturity (less than 70 days); (b) Improve soybean varieties for tolerance to a-biotic stresses (drought, acid soil); (c) Improve black soybean varieties for bigger grain size, and (d) Improve soybean varieties for shade-tolerance.

For improving soybean tolerance to a-biotic stresses, especially drought tolerance, we bred six promising mutant lines from the parent and two of them have been released as varieties, namely “Kemuning 1” and “Kemuning 2”. The potential yield of those varieties is 3.51 t/ha and the average yield is 2.87 t/ha. For improving soybean varieties on early maturity, we bred six promising mutant lines and conducted multi location trials in many places and many provinces in Indonesia. For improving black soybean varieties for bigger grain size and improving soybean varieties for shade tolerance, we conducted mutant selection, purification and multi location trial.

Session 2 Country Report on Mutation Breeding of Major Crops for Low-input Sustainable Agriculture under Climate Change

Nine member countries presented current progress and plan for the project on Mutation Breeding of Major Crops for Low-input Sustainable Agriculture under Climate Change. The brief summaries are as follows:

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

Fifteen advanced promising mutant lines were selected from carbon ion beam and gamma irradiated population of B11, BRRIdhan47, and also Lombur rice land races. Some of them are ready for sending to perform regional trials. Most of them were selected for higher yield, early & late maturity, lodging resistant, suitable for cultivation in rain feed condition, bold grain and also long grain fine rice. Most of them are suitable for both cultivation in Aus and Aman seasons.

China (Prof. Qingyao Shu, ZU)

Weedy rice has become a serious pest in direct-seeded rice production in China. Radiation techniques were used to produce rice mutants resistant to a herbicide that kills weedy rice.

One such mutant line has been developed and demonstrated in the fields so far, and more mutated populations have been developed for four other varieties. Additionally, early maturing and other types of mutants have been identified and tested.

Indonesia (Mr. Arwin, BATAN)

Two promising rice mutant lines derived from “Rojolele” is going to be released as new varieties, namely “Rojolele Srinar” and “Rojolelele Srinuk”. “Rojolele Srinar” has a potential yield of 9.75 t/ha and an average yield of 8.07 t/ha, and the amylose content is 23.3%. “Rojolele Srinuk” has a potential yield of 9.22 t/ha and an average yield of 8.07 t/ha, and the amylose content is 15.9%.

Japan (Dr. Hase Yoshihiro, QST)

Information about the number and the types of induced mutation is of significance for the implementation of proper mutagenesis. Recent advances in high-throughput sequencing technologies have greatly accelerated the understanding of the molecular nature of mutations, however, only a few studies have been conducted to characterize the mutations induced by gamma rays. We performed quantitative and qualitative characterization of the induced mutation by acute /chronic gamma ray and carbon-ion irradiation in Arabidopsis, in order to provide a more complete picture of the induced mutation by ionizing radiations.

Malaysia (Dr. Sobri Bin Hussein, Nuclear Malaysia)

In 2019, Malaysian Nuclear Agency has moved one step forward in the area of mutation breeding by signing the Memorandum of Understanding (MoU) with Certified Seed Company HMN (M) Sdn. Bhd and Bayer Co. (MALAYSIA) Sdn. Bhd. on 29 April 2019. With this agreement, HMN (M) Sdn. Bhd. will help Malaysian Nuclear Agency to produce certified seeds, multiply and commercialize Malaysian Nuclear Agency’s rice mutants. In the meantime, field trials also showed that the production cost was reduced by 10%, mainly due to the reduction in fertilizers and pesticides usage.

Mongolia (Dr. Dolgor Tsognamjil, IPAS)

The mutant wheat variety Darkhan-172 was registered as a drought tolerant variety for high mountain area in Mongolia in 2018. For the multi-location trail and seed multiplication, the mutant wheat line Darkhan-122 is being grown in Bornuursoum, Tuv province, in Kharkhorum, Uvurkhangai province and at the experimental station in Dornod provinces, Mongolia.

Omskaya-38, Toboyskaya wheat varieties and Alagerdene barley variety were treated by ion beam and gammy ray, respectively, in various doses to shorten growth duration and to enhance yield stability and lodging resistance. Totally 3,296 progenies of wheat mutant lines, and 2,800 progenies of barley mutant lines in M₁-M₄ generation were planted in 2019. Complete data will be available after harvest in October 2019. Seven rice varieties (M₂-M₆) have been tested for early maturity and high yielding in Mongolian condition.

The Philippine (Mr. Fernando Aurigue, PNRI)

Mutation breeding for low-input sustainable agriculture has been focused on Traditional Rice Varieties, specifically Azucena, an aromatic tropical Japonica with good eating quality and the preferred upland varieties in the Cordillera of Luzon, Western and Eastern Visayas, and parts of Mindanao despite its very tall height that is prone to lodging, low-tillering characteristics and inherently low-yield.

The objective is to develop a mutant variety with improved agronomic and yield characteristics, but with the same grain quality as the original material. Among mutants evaluated, 12 lines had significantly shorter height, earlier maturity, more tillers, more panicles and spikelets, and higher yield than Azucena but retained the slender shape, soft texture, low amylose content, and high gelatinization temperature of Azucena.

Thailand (Dr. Kanchana Klakhaeng, RD)

- 1) The cost of rice production depends on good seeds and good management which will impact maximum yield.
- 2) Application of plant growth-promoting rhizobacteria (PGPR), a beneficial microbial component to promote plant growth, resulted in increasing the efficiency of the rice plant in receiving more water and nutrients from the soil.
- 3) Application of PGPR + 75% N according to soil analysis (i.e. compared to conventional application) can be used for rice production to reduce the rice production cost.

Vietnam (Dr. Le Duc Thao, AGI)

From 2008 to 2019, by gamma rays, Vietnam has released 13 new mutant varieties (11 for rice and 2 for soybean). Of those, outstanding rice varieties are Khang dan Mutant, DT39 Quelam and DT80. As for soybean, DT2008 is the outstanding variety with the highest yield and tolerance ability in our soybean breeding history. Beside that, for the first time by the mutation method, Vietnam obtained the black soybean mutant variety DT2008DB, which has almost the same characteristics as DT2008, high nutrition and omega fatty acid content, and is excellent for food use.

Besides that, by ion beam irradiation, we obtained promising rice mutant lines for further evaluation: 6 (M₇), 6 (M₆), 31 (M₅), 39 (M₄), 145 (M₂). As for soybean, some favoring variations have been found such as dwarf stem (10 cm shorter than the origin) and early maturity.

In future, we will continue testing promising lines and need further support to irradiate other crops such as peanut by ion beam.