

Attachment III Country Report

FNCA Progress Report¹

Participating Country: BANGLADESH

FNCA Sub-project Title: Improvement of Composition or Quality in Rice.

Sub-project Title of Bangladesh:

Induced mutation for higher protein, amylose and yield in salt tolerant rice landraces by gamma irradiation.

Abstract

Four salt tolerant rice landraces were collected from two coastal districts of Bangladesh and their protein content were estimated along with IR 64 following micro-Kjeldahl method. The protein content ranged from 7.90 to 9.94% while it was 8.06 for IR 64. M₁ plants of these salt tolerant rice were raised in the field from gamma irradiated (350 Gy) seeds in boro season (December, 07–May, 08). Mutated M₁ plants of Morichshail (early maturing and blackish panicle) were harvested separately while M₁ plants of each population were harvested separately in bulk and were grown separately as M₂ populations in the following aman season (July-December, 2008). In addition, seeds of two salt tolerant rice Ashfal and Morichshail were also irradiated this year (aman, 2008) with 350 Gy gamma ray and M₁ plants were grown in the field. Optimization of media composition for *in vitro* regeneration of plants from mature seeds has been established. Murashige and Skoog (MS) medium fortified with 2.0 mg⁻¹ 2,4-D was found suitable for induction of callus while 2.0 BA + 0.2 NAA (mg⁻¹) appeared best for regeneration of shoot from callus. IBA at a concentration of 0.5 mg⁻¹ in MS medium was found optimum for rooting of shoot. Irradiated seeds of salt tolerant rice Takshoyl were also used for *in vitro* organogenesis and 16 green plants of the said variety are now growing in the pot with vigor.

¹ Report presented in the FNCA Mutation Breeding Workshop held in Da Lat, Vietnam from 27-31 October, 2008.

Breeding of Low Amylose Content in China

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Abstract

Rice mutation breeding of low amylose content (LAC) in China had been started since 2006. Nineteen collected restorers, as CR10, CR17, CR128, CR86, CR501, had been irradiated using gamma ray with doses of 250 for LAC breeding. Selections were conducted in M₂ populations with desirable agronomic traits and 578 M₂ lines were obtained in 2007. 435 M₃ lines were primary analyzed for low amylose content with rapid measurement in 2008 and 12 mutant lines from 3 restorers were preserved. Among them, 3 lines crossed with the other varieties with good quality and 6 crosses were obtained.

Induced Mutation to Improve Selected Breeding Lines Derived from an Inter Sub-specific Cross²

Sobrizal³, Carkum², Winda Puspitasari², and Masrizal⁴

Abstract

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 var. IR36 and Japonica rice var. Koshihikari were constructed. IR36 is an improved rice variety, tolerance to various pests and diseases, and adapted well in Indonesian rice growing areas. Whereas, Koshihikari is a very popular Japanese variety and known having good cooking and edibility with low amylose content. As much as 568 pure lines derived from this cross were selected, and among them two lines, KI 237 and KI 432 were irradiated by 200 Gy gamma ray to induced mutation for improvement of some undesirable characters of these lines. Both KI 237 and KI 432 have high yield potentials, but susceptible to lodging for KI 237 and late maturity for KI 432. Selections were conducted in M₂ populations with emphasize on plant height for population derived from irradiated KI 237 and days to heading for population derived from KI 432. Selections and purifications were continued in M₃ generation and finally, one dwarf M₃ line, two semi-dwarf M₃ lines, and one early maturity M₃ line were selected. Five hundreds of unselected M₃ lines are also maintained in order to preparing plant materials for screening of amylose contents. Purification will be continued, and screening of amylose contents and other characters related to grain quality will be conducted in M₅ generation. The lines with various content of amylose would be useful as genetic resources for improvement of grain quality to meet the wide preference variability of consumers. Besides, 5000 F₅ lines derived from a cross of Diah Suci / Pandan Wangi were also constructed. Selections of these lines for agronomical characters and performance in the field will be conducted in M₆ generation.

² Presented at The 2008 FNCA Mutation Breeding Workshop, Dalat, Vietnam.

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Country Report

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Abstract

The mutant strains of *Koshihikari* obtained by gamma ray irradiation and EMS treatment were selected and backcrossed with *Koshihikari* to eliminate the undesirable characters except the low amylose trait. After raising F₁ and F₂ generation, we investigated F₃'s agronomic characters and amylose content. The amylose content varied from 2.5% to 10.0%, but in general, most of these strains had amylose content of 5% or less. The investigations of culm length among original mutants and F₃ lines showed that five mutant lines were shorter than the original variety, but in two F₃ lines the culm length became closer to *Koshihikari*. Three rice varieties, namely *Hitomebore*, *Akitakomachi* and *Nipponbare* were irradiated with gamma rays and an ion beam. The respective M₁ generations have been cultivated and their M₂ grains were currently screened for the glutinous and semi-glutinous mutants and six mutants with low amylose contents were newly selected.

Mutation Breeding for Varietal Improvement of Irrigated Rice under Minimal Water Conditions

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Abstract

This is a national multi-institutional project originally proposed to screen for new mutant varieties of rice under minimal water requirement with improved quality characters such as resistance to blast disease and high yield. Seeds of two potential genotypes of popular varieties, MR211 and MR219 had been irradiated using gamma rays with doses of 50, 100, 150, 200, 300, 400 and 500Gy. Radiosensitivity tests for both genotypes had been carried out and LD50 observed based on growth reduction of seedlings after irradiation were 370Gy for MR211 and 470Gy for MR219. Effective doses selected for the main experiment based on LD50 were 300 and 400Gy and seeds were multiplied until M4 generation. A laboratory test was first carried out to find out the effect of different levels of PEG (0, 10, 20, 30, 40 and 50%) on seed germination. Maximum tolerance for most of the rice cultivars under minimal water requirement was observed at 40%. Selected mutants families were screened in the field with minimal water condition in M3 and M4 generations. At present, 38 mutant lines were selected based on their performance under water stress and will be further tested in the next M5 generation with other potential agronomic characters such as high yield and low amylose content.

Grain Quality Improvement in Rice (*Oryza sativa* L.) Through Induced Mutation Breeding^{1/}

Lapade, A.G., A.O. Grafia, A.C. Barrida, and F.G. Rivera^{2/}

Abstract

The general objective of this project is to develop rice mutants with desirable agronomic characteristics and improved grain quality (increased protein and low to intermediate amylose contents using radiation induced mutation.

The result of the studies in the M2 and the M3 generations are presented. Rice seeds derived from the irradiation doses of 200 and 300 Gy were grown in the M2 and M3 generations including the control and IR64 check variety. Protein content and amylose contents of rice grains were determined using the semi-micro Kjeldahl and iodine staining methods, respectively.

Low tillering capacity, reduction in height, early flowering and low percentage sterility in the M2 generations were likewise shown in the M3 generation. The length of panicle and number of grains per panicle of the selected plants were slightly higher than the control IR72 and IR64 check in the M3 generation planting. The weight of 100 seeds of rice from 200 and 300 Gy was comparable with the control.

Protein content of rice grains at 200 Gy ranged from 6.00 to 8.25% while those at the 300 Gy ranged from 5.62 to 7.75 %. On the other hand, protein content of IR72 control (7.81 to 8.56 %) and IR64 (6.3 to 8.25 %) were comparable with the 200 Gy but slightly higher than those at 300 Gy.

Amylose content varied significantly among treatments doses of 200 and 300 Gy. Intermediate to high amylase content was obtained from 31 samples at 200 Gy and only 22 from 300 Gy. Both IR72 control and R64 check showed intermediate to high amylose contents. Two samples each from 200 and 300 Gy have low to intermediate amylose content.

^{1/} Paper presented in the Forum for Nuclear Cooperation in Asia (FNCA) 2008 Workshop on Mutation Breeding, October 27 to 31, 2008, Dalat, Vietnam.

^{2/} Supervising Science Research Specialist and Head, Senior Science Research Specialist, Science Research Specialist II and Science Research Specialist II of the Agricultural Research Section, Atomic Research Division, Philippine Nuclear Research Institute (PNRI), respectively.

Rice Mutation Breeding for Various Grain Qualities in Thailand

Mr. Suniyom Taprab

Present for FNCA Sub-project Meeting "Improvement of Composition or Quality in Rice"
October 27-31, 2008. Dalat City, Vietnam

Abstract

Mutation breeding of LPA rice in Thailand had been started since 2003. I was started on a popular high yielding variety (SPR1) with 200 Gy of gamma ray irradiation. Later, we induced mutation in another HYV such as RD23, PSL2, CNT1 and CNT80. In 2004, 619 M3-LPA mutant lines of SPR1 were derived and continuously selected for desirable agronomic traits in advance generation to M6. Three advanced homozygous lines of those M6 such as SPR1'03G1Cs-PTT-2-3-3-1-1, SPR1'03G1Cs-PTT-9-6-2-1-1 and SPR1'03G1Cs-PTT-1-8-2-1-1 are being evaluated for grain yield and quality in various environments. SPR1'03G1Cs-PTT-2-3-3-1-1 and SPR1'03G1Cs-PTT-9-6-2-1-1 had been analyzed for IP5, IP6 and Fe contents. The results showed lower quantity of IP5, IP6 and total IP in those two mutants than in original SPR1. Fe content in those two mutants and original SPR1 are almost equal. Allelism tests (lpa1-1) are being initiated. Currently, we detected 69 M5-LPA lines from RD23 and 67 M4-LPA lines from PSL2. In addition, M3 seed of CNT1 and CNT80 are being assayed for phytic acid content.

Improvement of Combined Aromatic Rice by Using Mutation and Related Techniques

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Abstract

Under FNCA Program, in Vietnam during 2007-2008, some groups of breeders and biologists continue effective collaborations in efforts for pureline selections under field trials of rice mutants and their crossings with high quality and tolerance in Mekong River Delta (South Vietnam) and Red River Delta (North Vietnam).

- Dr. Nguyen Thi Lang et al. in Omon Rice Research Institute (Cantho) have selected by MAS and obtained many promising lines for low phytic acid levels at M5-M6 from OM 1490 and OMCS 2000 varieties and screened some local cultivars.

- Dr. Do Khac Thinh et al. in Institute of Agriculture Sciences, South Vietnam have continued field trials for some combinations of aromatic rice and mutant lines with wide adaptability.

- Dr. Le Xuan Tham et al. in Provincial Department of Science & Technology Lamdong and Provincial Department of Agriculture & Rural Development Soctrang have released some promising pure lines and combined crossings of aromatic mutant lines in Soctrang Province (by center of Mekong Delta). These combinations of true breeds with special high quality were awarded National Medals of Labour in 2007-2008 and released for large scale productions in multilocations. Direct analysis of nutritive ingredients of aromatic rice combinations (2AP, Fe, P, Zn, Cr,... and protein, amylose), particularly some Red ST combined lines were shown to offer possible high Fe content germplasms for new varieties and further breeding.

- Dr. Le Huy Ham et al. in Institute of Agriculture Genetics, Hanoi and other groups in North Vietnam have developed some useful markers strictly related to genes and characters for selections of promising mutant lines with high yields and good tolerance to drought and salinity.