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Character of Local Rice Mutant '*Ase Banda*' as Result of Gamma Ray Irradiation

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Abstract

The purpose of this study is to induce mutations of local varieties of rice (*Ase Banda*) with gamma ray irradiation to obtain early duration and high yield of local rice mutants. This study was designed using randomized block design (RAK) in one factor. The factor is the level of irradiation done without radiation (R0) as a control group, radiation at 200 Gray (R1) and radiation with 300 Gray (R2). Each treatment was repeated three (3) times using 50 plants for each treatment. The result of this research showed that local rice at either 200 Gray of radiation (R1) and 300 Gray (R2) obtained shorter plant height than those not in the radiation (R0). A number of tillers higher than those not in the radiation (R0) and the flowering dates obtained faster than the (R0). It is still expected that desired character of local rice mutant '*Ase Banda*' to be used as an advanced breeding material.

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Introduction

One of the efforts done to gain high rice production is engineered rice plant until delivery yielding rice varieties. In assembling new varieties, it is necessary to have the diversity. One effort in increasing the diversity is by implementing mutation induction. Mutations change in the genetic material (DNA or RNA), either at the level of gene sequence (called a point mutation) or at the degree of the chromosome. Mutation techniques can be used to increase the genetic diversity that allows breeders to conduct the selection of plant genotypes according to the desired breeding purpose.

South Sulawesi province of Indonesia is one of the major rice producing areas in Indonesia with different types of varieties developed. Among the different varieties, there are one such local variety favored by consumers because of the delicious taste. The referred rice is *Ase Banda* of Barru Regency. *Ase Banda* variety today is no longer easily found, it is only observed in certain areas. The limited cultivation caused by low production, tall and vigorous growth, not in response to fertilization inputs. It is, therefore, necessary for having repairs and assembly of the local variety. It is done by implementing improvements to get the early age maturing of the plant and high yield.

Induction of mutations by gamma ray radiation is one way to assemble the local rice varieties into new varieties that have some better properties than the parent. It is necessary to improve the local varieties into varieties that have properties in addition to the rice tasty and high adaptability. Also, the variety can produce high yield and

early age duration. Radiation treatment tends to accelerate plant took the flower which direction can cause rapid harvest (Muhidin et al., 2015).

Some ways to expand the genetic diversity in the selection can be reached, such as by collecting local material collection, introducing it to and from the world, crossing and artificial mutation (Mugiono, 2001). Mutations occurred in the positive direction and passed it on to the next generation is a mutation desired by breeders (Pospodarsono, 1986).

Based on the description, the formulation of research problems are, as follows:

a. Is gamma ray radiation can cause varieties of local rice mutants *Ase Banda* with morphological diversity and quality of the rice remained.
b. At what concentration of gamma ray radiation can produce mutant early duration and high yield.
c. How is the different from morphological characters, age of the plant and yield of rice plants as a result of gamma ray radiation lead to the next generation of mutants (M1).

Framework research

Reduced biodiversity in Indonesia provided the inspiration to do security for biological diversity (Harris et al., 2015). More than 15 years of various studies aimed to investigate the effect of radiation treatment or additional treatment before and after the radiation so that the result will be more focused and more practical. Since then the use of artificial mutation in plant breeding began to grow in developing countries, particularly in asia. Some varieties of crops artificial mutation has acquired and developed a new variety (Mugiono, 2001).

Research by the induction of gamma ray radiation in rice crops has been done, such as to obtain mutants that have the nature of disease resistance, early maturity and better productivity of germ-plasm origin. In Asia Pacific, there are approximately 343 mutants of rice were released (Ahloowalia et al., 2004), while in Indonesia until the end of 2006 BATAN has produced 13 varieties of paddy, namely varieties of *Atomita 1, 2, 3, 4, Cilosari, Merauke, Woyla, Kahayan Winogo, Diah Suci, Yuwono, Mayang* and the last is *Mira* which is one variety of paddy and upland rice which is called *Situ Gintung*. Priority activities in breeding by induced mutation aimed at improving rice varieties, the early maturity, short plant morphology, resistant to attack by pathogens and droughts and that consumers preferred the taste quality (Soejono, 2003). This research was conducted by the flow diagram of conceptual framework of research as shown in Fig. 1.

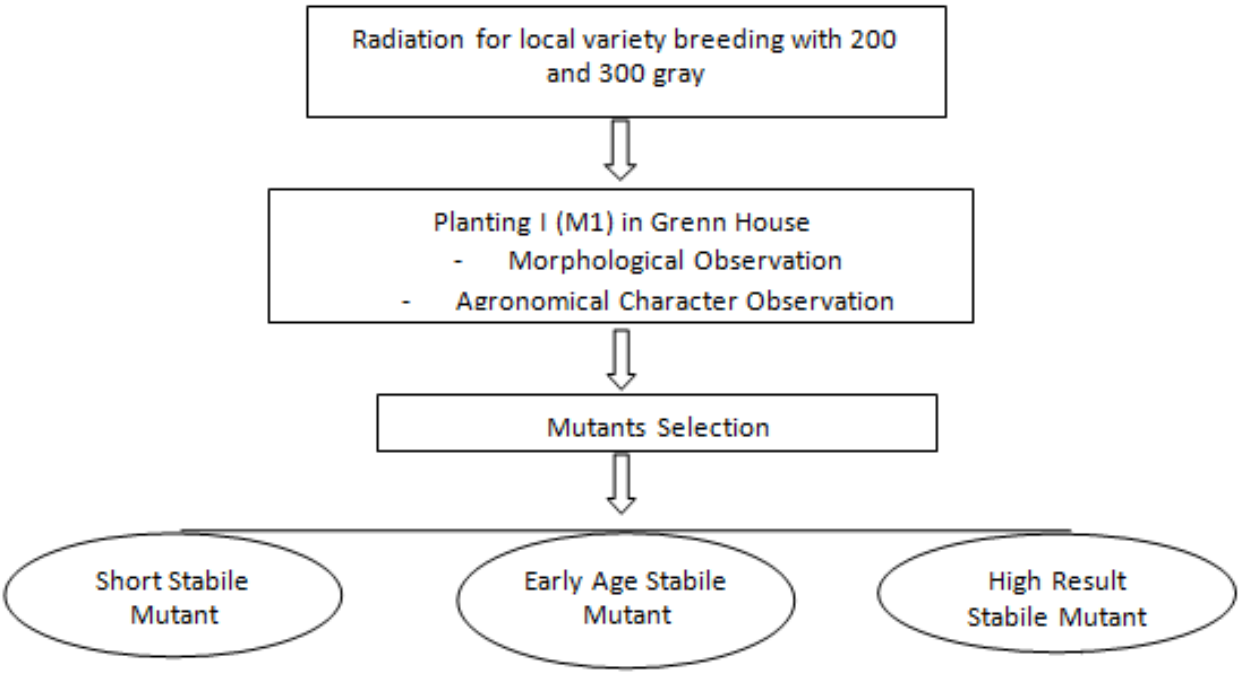

Fig. 1: Flow chart of concept framework research.

Research method

This research was conducted at the Center for Isotope and Radiation Applications of BATAN Jakarta, Indonesia, and Plant Laboratory, Faculty of Agriculture UMI which will last for six months, begun from September 2015 to February 2016.

Implementation

The plant material used is M1 from local varieties of rice (*Ase Banda*) which is originally from Barru regency, precisely the border area between Barru regency and Pare-pare. Rice seed of *Ase Banda* variety was irradiated with gamma rays consisting of three levels, namely, 0 Gray, 200 Gray, and 300 Gray. At each treatment, it was classified into three groups as replication. Each treatment on a test was taken 50 seeds so that there were 450 plants. The flowchart of research stages involved can be seen in Fig. 1 above.

This study was designed using completely randomized design (CRD) in the pattern of the factor with the level of treatment that is without radiation (R0) radiation with 200 Gray (R1) and radiation with 300 Gray (R2). Each treatment was repeated three (3) times using 50 plants for each repetition. For statistical analysis BPS (2013) was followed.

Observation

Morphological characters

The observations of morphological characters include:

1. The height of the plant: It was observed in every two (2) weeks since two (2) weeks old plants after planting until two (2) weeks old plants.

2. The number of tillers: It was calculated a number of seedlings when plants were in bloom.

3. Flowering age: It was calculated the number of days took the plants after planting until the first panicles appeared in each plant.

Results

Plant height

The result observation of data showed that the height of local variety *Ase Banda* varied with the treatment type and the varianceis are presented in Table 1. The variance demonstrated that the use of gamma ray radiation is having very significant effect on rice plant height.

Table 1. Height average of rice plant (cm) at various dose of gamma rays.

Treatment	Average	NP. BNT 0.05
200 Gray	132.17[b]	
300 Gray	127.00[b]	24.96
0 Gray	182.29[a]	

Description: Numbers followed by different letters are significantly different.

The BNT test result (LSD) as in Table 1 shows that the rice plant with the best average height growth was gained in the dose of 300 Gray. It is not so far different from the 200 Gray, but significantly different from 0 Gray.

Number of tillers

The data of tiller number of rice plants observation and variance are shown in Table 2. The analysis result of variance demonstrated that the treatment of radiation and without radiation is having very significant effect on the life of flowering in rice plants.

Table 2. Tillers average (stems) at different doses of gamma rays.

	Average	NP. BNT 0.05
200 Gray	18.60a	
300 Gray	16.45b	1.92
0 Gray	22.13a	

Description: Numbers followed by different letters are significantly different.

The BNT test result (LSD) 0.05 as in Table 2 shows that without using radiation that is 0 Gray shows the best average number of tillers, it is significantly different from 300 Gray and 200 Gray gamma radiation treatment.

Flowering age

The data observation on flowering date of rice plants and variances are shown in Table 3. The variance analysis of the results showed that the radiation treatment significantly affected the life of flowering in rice plants.

Table 3. Flowering date average (day) at various doses of gamma rays.

Treatment	Average	NP. BNT 0.05
200 Gray	77.44b	
300 Gray	75.35b	3.54
0 Gray	107.84a	

Description: Numbers followed by different letters are significantly different.

Discussion

The success of the growth of a plant is controlled by several factors, including the characteristics of the plant. Thus, this research aims to suppress the growth of local rice *Ase Banda* to get early maturity through the induction of gamma ray radiation. The decrease in plant height can occur because of irradiation. This irradiation causes damage to the chromosomes of plants, resulting in disruption of the plant. Ionization due to irradiation can lead to groupings of molecules along the ion path is left behind because of irradiation that can cause gene mutations or chromosomal dredged (Zunariyah, 2012). Agronomic properties of M1 variety as result of 200 and 300 Gray radiation shows that there are significant differences with the irradiated on the parameters of harvesting, the amount of grain, the percentage of dry grain and grain contains (Harris et al., 2013).

Results on the parameter of height average of rice crop variety *Ase Banda* on gamma ray radiation with a dose of 300 Gray get the expected results. It is not significantly different from 127.00 cm to 200 Gray, namely 132.17cm, but it is significantly different from 0 Gray (182.29cm). Different genotypes will show a different appearance after interacting with the environment and cultivation techniques or different treatment. It is in the same boat with Syafrullah's opinion (1995), each of crop varieties has different characteristics which are determined by the interaction between genetic trait, the growth environment, and engineering management.

The seedlings number of rice plant variety *Ase Banda* without radiation treatment 0 Gray gives the highest score is 22:13 tillers. This is due to the absence of radiation treatment so that the plant was not damaged and no mutations in plants. *Ase Banda* rice plant variety at a concentration of 300 Gray provides its low point 16.45 tillers. This is caused by the high concentration given on the rice plants seed so that damage the genes in plants.

The date of flowering in *Ase Banda* variety at 300 Gray of radiation treatment got the best value at only 75.35 days, not significantly different from 200 Gray that scored 77.44, significantly different from radiation treatment at 0 Gray provided the longest flowering date that is 107.84 days.

Conflict of interest statement

Authors declare that they have no conflict of interest.

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