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Gamma Ray Radiation Mutant Rice on Local aged Dwarf

[1]Abdul Haris, [1]Abdullah, [1]Bakhtiar, [1]Subaedah, [1]Aminah and [2]Kamaruzaman Jusoff

[1]Department of Agrotechnology, Faculty of Agriculture, Universitas Muslim Indonesia,
Jl.Urip Sumoharjo Km.5 Makassar 90231 South Sulawesi, Indonesia
[2]Department of Forest Production, Faculty of Forestry,
Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia

Abstract: There are two local rice varieties which are highly preferred by consumers due to the good quality of the rice is sticky rice (*Ase Lapang*) from Pangkep district and red rice (*Mandoti*) from Enrekang district. The objective of the research is to give local varieties of rice induce mutations *Ase Lapang* and *Mandoti* by gamma irradiation to obtain mutants early maturing rice-old local. This research used Completely Randomized Design (CRD) in factorial two factors. The results showed that 200 gray dose of radiation with the potential to generate mutants that are shorter and faster harvesting. But agronomic characters such as the percentage of grain contains the M1 generation showed that a very low percentage (27.47%) are very large percentage of empty grains with either radiation treatment on the *Ase Lapang* and *Mandoti* varieties. The implications are expected to obtain mutants that can produce early maturity and high rice production and these varieties are maintained continuity.

Key words: Gamma rays · Gray · Mutant · Ase lapang · Mandoti · Aged dwarf

INTRODUCTION

During the period 2008-2010 the growth of food crop production has consistently experienced significant improvement. Rice production in 2010 amounted to 65.98 million tons of dry unhusked (paddy), up 1.58 million tons (2.46 %) compared to production in 2009. The increase in production is expected to occur due to an increase in harvested area of 234.54 thousand hectares (1.82 %) and a productivity of 0.31 quintal / ha [1].

South Sulawesi is one of the major rice producing areas in Indonesia with different types of varieties developed. Among the different varieties, two of which are favored by consumers due to taste delicious rice is rice *Ase Lapang* from Pangkep regency and *Mandoti* from Enrekang regency. *Ase Lapang* and *Mandoti* varieties is no longer prevalent and only on certain areas. Cultivation is limited due to low production because of this variety, trunked tall and strong, aged in, no response to fertilization and the look is still diverse. Therefore it is necessary to obtain the local varieties, such as the age of the plant to obtain improved varieties that mature early maturing and high yielding.

The specialty of the local varieties is the ability to adapt to local environmental conditions and high economic value, so it requires special attention to the preservation of the germplasm. Induction of mutations by gamma radiation is one way to assemble the local rice varieties into new varieties that have some better properties than the parent.

One of the efforts made in order to keep high rice production is doing technique in rice varieties to give birth. In assembling the new varieties needed diversity. An effort to increase the diversity of mutations induced by. Mutations are changes in the genetic material (DNA or RNA), both at the level of gene sequences (called point mutations) as well as at the level of the chromosome. Mutation techniques can be used to increase the genetic diversity enabling plant breeders make the selection according to the genotype of the desired breeding objectives. Base pair substitution is the replacement of one nucleotide and partner in the complementary DNA strand with another pair of nucleotides. Inertia and deletions are additions or deletions of one or more nucleotides in a gene pair [2].

Corresponding Author: Abdul Haris, Department of Agrotechnology, Faculty of Agriculture, Universitas Muslim Indonesia, Jl.Urip Sumoharjo Km.5 Makassar 90231 South Sulawesi, Indonesia Tel: +6281241276688.

Induction of mutations in rice varieties is to get a lot done already, such as to obtain mutants that have the nature of disease resistance, early maturity and better productivity of germplasm origin. Through irradiation techniques (radiation) to produce mutants or plants that have mutations with properties expected after a series of testing, selection and certification. This radiation technique can also be done as a first step to getting old as early maturing mutants and subsequently as a material for further selection. Also requires a certain dose of radiation to obtain genetic variation. Physical and chemical mutagenesis has been used to increase the genetic variation in plants. More than 501 new varieties have been obtained from the mutant rice by applying different mutagenic agents in Rice (*Oryza sativa* L.) In Asia Pacific, there are approximately 343 mutant of rice has been released [3], Mutagen gamma irradiation has been widely used to cause many practical variations in rice and other crops [4].

MATERIALS AND METHODS

The research was conducted at the Center for Isotope and Radiation Applications (PATIR) Jakarta, Faculty of Agricultural Green house Universitas Muslim Indonesia (UMI) Makassar, takes place from June to December 2012.

The plant material used is local varieties of rice seed origin Pangkep (*Ase Lapang*) and local rice origin Enrekang district (*Mandoti*). Rice seed varieties *Lapang* and *Mandoti* in gamma-ray radiation consists of three levels namely: 0 Gray; 200 Gray and 300 Gray. At each treatment combination were grouped into three groups as replicates. Each test taken each 50 seed.

The research design was designed by using a completely randomized design (CRD) in factorial two factors. The first factor is varieties consisting of two varieties; *Ase Lapang* varieties (V1) and *Mandoti* (V2), while the second factor consists of three levels, namely without radiation treatment (R0) radiation with 200 gray (R1) and radiation with 300 gray (R2). Each treatment was repeated 3 times using 50 plants for each replication.

Observation of morphological characters include: Plant height and number of tillers. Observations agronomist properties include covering, panicle length, number of grains, the percentage of grain (grain) hollow and contains the percentage of grain harvesting.

Planting Mutant Selection Results of M1: Indicated mutant rice plants as crops replanted M1. The second planting is done following the same design pattern with M0 planting, as well as the process of seeding, planting, maintenance. The characters are the same as observed in M0 and M1 are directed to see more diversity of agronomic character mutated considered whether there segregation is through the characters.

RESULTS AND DISCUSSION

Character Generation Plant Morphology M0: M0 generation plants derived directly from seeds that have been irradiated. Observations of plant height in the M0 generation showed a significant effect between plants irradiated with the not irradiated, where the results of further testing LSD (0.05) shows that the radiation dose of 300 gray obtain the shortest plants and significantly different from the dose of 200 gray and without radiation. This analysis also showed that the higher dose of radiation shorter plants produced gamma-ray radiation in rice seeds can lead to mutations in various segments of chromosomes of an embryonic cell. The results are consistent with research conducted who found that radiation doses of 200-300 gray mutant was able to induce the rice seed varieties IR64 and Hawara Bunar [5]. The results of the mutation is most easily seen in case of change in shape, size or color of the plants that were not irradiated and irradiated [6]. Variables which showed that the number of seedlings of both varieties were observed, There is no difference in *Ase Lapang* and *Mandoti* between the irradiated seeds and are not radiated. Observations can be seen in Table 1.

Nature Agronomist M0 Generation Plants: M0 agronomic observed by panicle length, harvesting age, number of grains, the percentage of filled grain and grain hollow. Results of data analysis showed that there were significant differences in harvest parameters, number of grains, the percentage of empty grains and grain contains.

Harvesting observations indicate that there are significant differences in terms of age of harvest, where plants of both varieties were irradiated (*Ase Lapang)* and the old (*Mandoti*) faster harvest (147.83-148 days, 50 days) compared to seed plants that are not irradiated (150 days). Decline in harvest rate of the irradiated seeds compared to seeds that are not irradiated by 1.45%. At panicle length variables are also shown not seen any real influence among the plants that are not irradiated with radiation either on the (*Ase Lapang* or (*Mandoti*) varieties. Treatment of gamma radiation in rice resulted in several genes can be mutated in the same time, because muatagen are treated in tissue or cell will be on target at random [7]. Dose radiation affects the physiological and

Table 1: Plant high (cm) and number of tillers rice varieties (*Ase Lapang*) and (*Mandoti*) M0 generation gamma ray radiation results.

	Radiation Dose			
Type varieties	Without Radiation	Radiation 200 gray	Radiation 300 gray	Average
		Plant High (cm)		
Ase Lapang	150.51	140.02	135.36	141.96
Mandoti	148.50	139.98	137.66	142.05
Average	149.51 c	139.99 b	136.51 a	
		Number of Tillers		
Ase Lapang	20.17	21.67	22.67	21.50
Mandoti	19.17	22.43	22.50	21.37
Average	19.67 b	22.05 a	22.58 a	

Note: Number followed by the same letter in the same row not significantly different at the 0.05 LSD

Table 2: Tassel length (cm) and harvest rice varieties (*ase lapang)* and (*mandoti*) M0 generation gamma ray radiation results

	Radiation Dose			
Type Varieties	Without Radiation	Radiation 200 gray	Radiation 300 gray	Average
		Harvest Time (Days)		
Ase Lapang	150.00	148.33	147.67	148.67
Mandoti	150.00	148.67	148.00	148.89
Average	150.00 c	148.50 b	147.83 a	
		Tassel Length		
Ase Lapang	22.45	21.90	22.10	22.15
Mandoti	22.18	22.88	22.35	22.47
Average	22.32 a	22.39 a	22.22 a	

Note: Numbers followed by the same letter in the same row not significantly different at the 0.05 LSD

Table 3: Number of grain (seed) and fill percentage, percentage of grain grain rice empty varieties of *Ase Lapang* and *Mandoti* M0 generation gamma ray radiation results.

	Radiation Dose			
Type Varieties	Without Radiation	Radiation 200 gray	Radiation 300 gray	Average
		Number of Grain (seed)		
Ase Lapang	89.53	90.43	93.27	91.08
Mandoti	90.30	90.73	94.33	91.79
Average	89.92 b	90.58 b	93.80 a	
		Percentage of Grain Fill (%)		
Ase Lapang	88.33	27.70	25.17	47.07
Mandoti	89.50	27.23	24.53	47.09
Average	88.92 a	27.47 b	24.85 b	
Percentage of Empty Grain (%)				
Ase Lapang	0.82	69.37	73.03	47.74
Mandoti	0.88	70.01	74.02	48.30
Average	0.85 a	69.69 b	75.53 c	

Note: Figures followed by the same letter in the same row not significantly different at the 0.05 LSD

morphological plant growth. Seedlings exposed to relatively low doses of gamma rays (1-5 Gy) developed normally, whereas the growth of plants irradiated with high doses of gamma rays (50 Gy) was significantly inhibited [8]. Effectiveness of different doses of irradiation obtained different growth habits [9].

Observations amount of grain, grain percentage and grain contains empty shows that there is a real effect between seed radiation with the results in Table 3 is not irradiated.

Advanced test analysis results showed that the highest amount of grain obtained from paddy (*Ase Lapang and mandoti*) were irradiated with a dose of 300 gray and significantly different from the dose of 200 gray and are not irradiated. However, from the analysis of grain contains the highest percentage obtained in varieties that are not irradiated by the percentage of grain contain as much as 88.92% and significantly different from the percentage of grain contains varieties obtained at 200 and 300 gray radiation respectively obtained 27.47% and 24.85%. This suggests that higher doses of radiation given the lower the percentage of grain contains obtained. Percentage of empty grain which shows that the varieties are not irradiated obtained the smallest percentage of empty grain is 0.85% and significantly different varieties irradiated with the largest percentage of empty grains obtained at the 300 gray dose of radiation to the percentage of grain empty as much as 75.53%.

Results of data analysis in Table 1, 2 and 3 of the morphological and agronomic characters have gained some character changes between the irradiated seeds were not irradiated with that of morphological characters such as plant height is shorter than that are not irradiated seeds, harvest faster on irradiated seeds. However, an important character who describes agronomic improvements such as the percentage of filled grain have not been obtained even irradiated seeds produce the smallest percentage of filled grain while the largest percentage of empty grains in the irradiated seeds. This is consistent with research conducted [5] which showed that the gamma radiation of 200-300 gray lower productive tiller number and percentage of filled grain percentage of empty grains while increasing the M0 generation.

Character Generation Plant Morphology M1: M1 generation plants from seeds produced by plants M0 generation. Planting new generation of M1 runs about 6 weeks so the data is analyzed observations of plant height and number of tillers of plants aged 6 weeks.

Table 4: Plant height (cm) and number of tillers rice varieties of *Ase Lapang* and *Mandoti* M1 generation gamma ray radiation results.

Type Varieties	Radiation Dose Without Radiation	Radiation 200 gray	Radiation 300 gray	Average
Plant Haight (cm)				
Ase Lapang	73.83	50.17	52.43	58.82
Mandoti	64.38	56.55	57.97	59.63
Average	69.11 b	53.36 b	55.20 b	
Number of Tillers				
Ase Lapang	6.75	9.42	9.58	8.58
Mandoti	6.77	9.33	9.30	8.47
Average	6.76 a	9.38 b	9.44 b	

Note: Numbers followed by the same letter in the same row not significantly different at the 0.05 LSD

Observations of plant height in M1 generation at the age of 6 week after planting showed a significant effect between plants irradiated with the not irradiated, where the results of further testing LSD (0.05) shows that the radiation dose of 200 gray obtain the shortest plant (53.36 Cm) and significantly different from treatment without radiation that produces tall plants with 69.11 cm. While the variable number of puppies at the age of 6, the week after planting has not shown any effect of radiation treatment given on the seed of *Ase Lapang* and *Mandoti* (Table 4.).

Based on the observations and data analysis, it has been done both in generation M0 and generation M1 (M1 generation was only 6 week after planting) shows that rice seed radiation results have the potential to be developed in the next generation is expected to have morphological and agronomic characters better than native plants. Research reports suggests that the greater the chances of a mutation in the offspring generation self-pollinated seeds irradiated from the M1 generation [10]. The generation of segregation has occurred in the loci that mutate so that the probability that a new character or a character will be even greater.

Essential character of this study are expected improvement morphological characters such as the shorter plants, so the plants do not easily fall which will reduce the quantity and quality of production. Besides improved agronomic traits such as age are also very necessary so that the harvest is early maturing faster and higher production due to the low productivity of these two varieties are varieties of (*Ase Lapang*) and (*Mandoti*).

Research with gamma radiation induced in rice plants have been carried out, including obtaining mutants that have the nature of disease resistance, early maturity and better productivity of germ plasma origin. Induced mutations to obtain Al-tolerant rice have also been done [11, 12]. Similarly, research conducted to obtain mutants of early maturing in *Cisadane* varieties [13].

Mutation goal is to enlarge the variations of a mutated plant. It was demonstrated for example by variations in nutrient content or morphology and appearance of plants. The greater the variation, the breeders or people who worked to assemble a superior cultivars, the greater the opportunity to choose the desired crop. Through irradiation techniques of radiation to produce mutants or plants that have mutations with properties expected after a series of testing, selection and certification [14].

The effects of gamma ray radiation can cause genetic changes in somatic cells (somatic mutations) can be derived and can result in changes in phenotype. Such changes can occur locally at the level of the cell or group of cells. Irradiation can induce changes in chromosome structure that is happening breaking chromosomes.

In Asia Pacific, there are approximately 343 mutants of rice have been released [15] while in Indonesia until the end of 2006, PATIR has produced 13 rice varieties, ie varieties Atomita 1, 2, 3, 4, Cilosari, Merauke, Woyla, Kahayan, Winogo, Holy Diah, Yuwono, Mayang and the last one is Mira who is paddy and upland rice varieties namely one Situ Gintung. Priority activities in breeding with induced mutations directed at the improvement of rice varieties, namely early maturity, short plant morphology, resistance to pathogen attack and drought as well as the quality of consumer preferred taste [16]. Mutations can be used to increase the genetic diversity [17].

Research is creating diversity in gamma-ray radiation from local varieties that exist in South Sulawesi is roomy in *Ase Lapang* and *Mandoti* varieties for obtain mutants that have better properties than the parent, such as early maturity and high production. The results showed that gamma radiation 300 gray-lived mutants obtained 1.45% shorter than the parent, but on the production of grain contains still lower than the parent.

CONCLUSION

Induction of mutations by gamma radiation capable of creating change in morphological characteristics and agronomic characters of *Ase Lapang and Mandoti* varieties to be observed by plant height and harvest. 200 gray dose of radiation has the potential to generate mutants that are shorter and faster harvesting. But agronomic characters such as the percentage of grain contains the M0 generation showed that a very low percentage (27.47%) are very large percentage of empty grains with either radiation treatment on the *Ase Lapang* and *Mandoti* varieties. Gamma-ray radiation with the potential to create diversity so as to obtain mutants with morphological characteristics and desirable agronomic characters such as plant low, short lifespan and high production, this research should be continued because diversity will appear in the next generation and in the end of the diversity that can arise selected to obtain mutants in accordance with the desired character.

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