DIVERSITY OF STRAIN EVALUATION THREE RICE (ORYZA SATIVA) FENOTIPE GAMMA RAY IRRADIATED THE RESULTS OF GROWTH AND PRODUCTION

Sumarji
Kadiri Islamic University, Kediri, Indonesia

ABSTRACT

Induction of mutations by gamma-ray irradiation is known as one of the techniques to develop new rice genotypes. The purpose of this study will provide a gamma ray irradiation on the growth and diversity of production lines AC6DH1-103, KA0048 and KA0052. The second objective is to obtain the optimum dose to increase growth and production lines AC6DH1-103, KA0048 and KA0052. The study of mutations induced by gamma-ray irradiation on the seeds, using completely randomized design with two factors, the first factor is genotype, namely: AC6 DH1 103, KA0048 and KA0052. The second factor is the dose of gamma-ray irradiation, namely: 0, 100, 150 and 200 Gy. Place rice improvement research through mutation induction performed at the Center for Application of Isotopes and Radiation Technology, National Nuclear Energy Agency (Batan), Jakarta Friday Market using Gamma Chamber-type 4000A and planting a seed irradiation and mutant screening conducted in the green house of the Faculty of Agriculture, Islamic University of Kadiri Kediri. Evaluation of agronomic characters of M0 generation potential mutants showed that the variation of the strain and the growing power of the radiation dose. Largest growing power of each strain ie, strain DH1 AC6 103 100% dose of 200 Gy, 84% KA0048 and KA0052 dose of 100 Gy 74% dose of 150 Gy. AC6 DH1 strain 103 (M0) is more responsive to gamma-ray irradiation proved significant interaction was found on the variable contains the number of seeds, number of seeds per hill and empty weight of 100 seeds compared to the control.

KEYWORDS: *rice, mutation induction, mutant strains*

I. INTRODUCTION

Rice (Oryza sativa L.) is the staple food for the majority of the Indonesian population. The demand for these commodities from year to year increase in line with the increase of population, the population growth rate on average 1:34% per year (BPS, 2008).

Increased pressure rice production is a challenge for survival ever achieved self-sufficiency in rice in Indonesia in 1984 and achieved back in 2008 The number of national rice production in 2009 is estimated at 62.56 million tons, an increase of 2:24 million tonnes (3.71%) compared to rice production in 2008 (60.62 million tons). The increase in production is expected to occur due to an increase in harvested area 341.56 thousand hectares (2.77%) and also increase productivity by 0:44 quintal / hectare or 0.9% (BPS, 2008; State Secretariat 2009).

One of the breeding program is to increase genetic diversity. Possible efforts to expand the genetic variation of plants is hybridization, mutagenesis and induction of somaclonal variation in in vitro culture (Pattee and Stalker, 1995).

1.1 Load Mutation

Mutation techniques in the field of plant breeding, can be used to increase the genetic diversity that allows plant breeders make the selection according to genotype breeding objectives desired. Mutations can occur naturally or artificially induced. Artificial induction of mutation can expand the genetic diversity of plants through changes in the composition of genes derived from the plant itself. Spontaneous mutation (naturally) not able to provide genetic diversity rapidly and accurately, therefore, methods to induce mutations is an important issue to be known in order to improve and increase the productivity of crop plants (Ahloowalia and Maluszynsky, 2001).

Mutation induction can be done with mutagenic treatment of certain materials to the reproductive organs of plants such as seeds, stem cuttings, pollen, root rhizome, also callus tissue culture. Mutagenic materials are often used in plant breeding research is classified into two groups: chemical mutagens (chemical mutagens) and mutagens (physical mutagens). Physical mutagens can be as ionizing radiation (ionizing radiation). Some kinds of physical mutagens include X-rays, gamma rays, beta rays, neutrons, and particles of aselerator that can release energy (ionization) when passing through matter or irradiated (Rahayu, 2009).

Table 1. Characteristics of this type of radiation, Oktavina (2011).

Type of Radiation	Source	Description	Energy
X-ray	X-ray machines	Electromagnetic Radiation	50-300 k V
Gamma rays	Radio isotopes and nuclear reactions	Electromagnetic Radiation	Until a few Me V
Neutron	Nuclear reactors and accelerators	Particles does not change	<1 eV to MeV
Beta particles	Radio isotopes	Form of electron	Until a few MeV
Alpha particles	Radio isotopes	Helium core	2-9 MeV
Proton	Nuclear Reactor	Hydrogen nucleus	Until a few GeV

1.2 The Aim Load Mutation

Mutation breeding aims to create a broad variability, so that the available material selection to select mutants with expected properties. The success of plant breeding depends on the genetic variability of plants. To achieve the goal of breeding is to know the value of existing genetic diversity (Poehlman, 1983). According Mikaelsen (1980), mutation breeding method is the right choice for the properties of the genetic variability that is very narrow. The advantages of this method are a shorter time than conventional methods.

Plant material that is commonly used both as an object and the radiation is pollen, seeds biji- plants and crops growing. Seed irradiation technique is preferable to irradiation plants are growing, due to the effects of the radiation field needs to get done extensive irradiation. Seeds are usually small in large quantities can be irradiated together or transported with ease. Which is actually a seed embryo, is an important phase in the growth cycle of plants (Suseno, 1966).

Based on the record of the FAO / IAEA (International Atomic Energy Agency), Mutant Cultivars Data Bank, through the application of nuclear techniques, have resulted in as many as 2,252 cultivars mutant cultivars until the year 2000 as many as 1,072 cultivars of cereal crops, legumes or legume cultivars 311, industrial 81 cultivars, 66 cultivars of vegetables, 59 oil-producing cultivars, 111 cultivars and other crops. As many as 552 cultivars of horticultural crops, including ornamentals, vegetables, fruits and other crops. Tracing the source of radiation or mutagen used, gamma rays are the most widely used mutagen or 64.5% of the 1,589 mutant cultivars direct result of mutation (Amin and Carsono, 2008).

1.3 Gamma Ray Radiation Dose

Irradiation doses were used to induce the formation of diversity largely determine the success of mutant plants. According Broertjes and Van Harten (1988), a range of doses of gamma radiation on various types of ornamental plants and to plant carnations range has been tested at an interval that is still quite wide, ie between 25-120 Gy. Irradiation on seeds, generally use the higher dose range than in other plant parts. The more levels of oxygen and water molecules (H2O) in the irradiated material so the more free radicals are formed so that the plants become more sensitive (Herison, et al., 2008). For it is necessary to find the optimum dose that can effectively produce mutant plants, which generally occurs at or slightly below the value of LD50 (Lethal Dose 50). LD50 is the dose that causes 50% mortality of the irradiated population.

Morphological identification is an activity to see the character of a cultivar that can be visually distinguished between phenotype-phenotype. The character is generally a high heritability, easily seen, and appeared in all environmental conditions. Quantitative morphological diversity including plant height, number of tillers, days to flowering, total number of grains per panicle, fur length, stem diameter, panicle length, weight of 100 grains, grain size, number and length of segments. Qualitative morphological diversity include grain morphology, stems, and leaves (Agency for Agricultural Research and the National Germplasm Committee, 2003).

II. RESEARCH METHOD

AC6DH1-103 rice improvement research, KA0048 and KA0052 through mutation induction performed at the Center for Application of Isotopes and Radiation Technology, National Nuclear Energy Agency (Batan), Jakarta Friday Market using Gamma Chamber-type 4000A. Planting seeds irradiated (M0) was conducted in August-December 2012 in the green house the Faculty of Agriculture, Islamic University of Kadiri, Kediri, East Java.

The tools used for the characterization of plant morphology such as Gamma Chamber-type 4000A, plastic bucket for seedling media, size 10 kg poly bags, tape measure, paper lid and a set of stationery such as books, pencils, pens, rulers, markers, bows and etiquette.

The materials used are 3 genotypes of rice with 4 doses of irradiation that is AC6DH1-103 0Gy, AC6DH1-103 100Gy, AC6DH1-103 150Gy, AC6DH1-103 200Gy, 0Gy KA0048, KA0048 100Gy, 150Gy KA0048, KA0048 200Gy, 0Gy KA0052, KA0052 100Gy, 150Gy KA0052, KA0052 0Gy. Planting medium paddy soil, manure, and fertilizer NPK: 15-15-15.

M0 generation of the experiment performed using completely randomized design (CRD) Non-Factorial consists of 3 genotype is AC6DH1-103, KA0048 and KA0052 with 0Gy irradiation, 100 Gy, 150Gy and 200Gy. Each treatment consisted of 100 seeds with three replications.

To determine the effect of each factor and their interactions in plants M0, then the data were analyzed using analysis of variance (F test) at the 5% level. When the test results obtained by the real difference then followed by a comparison test between treatments using the Least Significant Difference (LSD) at the 5% level.

The numbers selected in the selection of M0 sowing nursery tub, then planted in the green house. The process of planting, maintenance, analysis of morphological character and conducted the same agronomic properties such as the planting of rice seed radiation results (M0).

Analysis of agronomic properties include observations of the number of filled grains per panicle, total number of total grain per panicle, 100 grain weight, grain length and width, panicle length, long fur. Character quantitative observations was done before harvest and after harvest except days to flowering at the time of exit flower panicles 10-30%.

Measurements of plant height in units of cm measured from the base of the stem to the tip of the highest panicle (excluding fur). Scoring: Short (paddy: <110 cm, gogo: <90 cm), medium (paddy: 110-130 cm, gogo: 90-125 cm) and height (paddy:> 130 cm, gogo:> 125 cm).

Leaf length is measured in units of cm below the flag leaf. Measurements were taken at the flowering growth phase. Scoring: Very short (PJD <21 cm), short (PJD 21≤40 cm), medium (PJD 41≤60 cm), length (PJD 21≤40 cm), and very long (PJD> 80 cm).

Leaf width measurements made on the widest part of the leaf on the leaves below the flag leaf in units of cm. Measurements were taken at the flowering growth phase.

Total number of tillers, number of productive tillers and the number of unproductive tillers counted after full flowering phase s / d phase of maturation.

The number of chicks counted generative phase when the plants are in bloom, assuming at that time no longer tebentuk new chicks. Age flowering was observed when the first panicle emerged from each plant. The analysis is done based on morphological characters Guide System Characterization and Evaluation of Rice (Agency for Agricultural Research and the National Germplasm Committee, 2003).

The inability of the panicle out fully considered as a genetic defect. Environmental factors and disease also affect these properties. Score includes: All panicle and neck out, whole panicle out of the neck is, Malai only appears limited to the neck panicle, panicle Most Malai out and not come out.

Observations of grain length in units of cm as measured from the base of grain under sterile lemma until the end of the grain (apiculus) of the lemma and palea fertile. In the hairy grain, seed length is measured to the point that is equivalent to the tip apiculus. Number example: 10 points on average in the maturation phase. Score consists of: Very long (> 7.50 mm), length (6.61 to 7.50 mm) and Medium (5.51 to 6.60 mm)

Seed width averaged 10 seeds measured in mm as the widest distance between the lemma and palea. In the maturation phase of grain.

Weight of grain 100 grains were measured by taking a random sample of 100 grains pithy dried until the moisture content of 13% and appropriately weighed in grams. In the maturation phase.

III. RESEARCH IMPLEMENTATION

Bed planting paddy soil organic matter mixed in the form of manure in the ratio of 9: 1 (paddy soil: manure). Ground repeatedly stirred to homogeneously sized polybag then put into 10 kg.

Seeding can be done simultaneously with the preparation of media. Prior to seeding the seeds are soaked in water for approximately 24 hours. Furthermore, the drained seeds are sown in seedling media that has been prepared. If it is known to grow the seed is low, can be treated with ZPT or seeds can be ripened until the radicle. Seedling age of 21 days after sowing (DAE) ready for transplanting.

Transplanting is done in the morning or evening, to avoid the high temperatures so that the seeds are not frozen. Planting is done by the plant removed one by one from the bed cultivated seedlings and roots remain intact. Transplanting is done a number of plants / polybag. Stitching dead or damaged plants can be done at the age of 7 days after transplanting (DAT) for all treatments with seedlings that had been prepared in order to cook rice in unison. Weeding by pulling the weeds that grow around the rice plants, to reduce nutrient retrieval competition between the two, so that fertilizer and nutrients can be absorbed by plant roots to the fullest.

Fertilization with compound fertilizer (NPK: 15-15-15) as much as 3 grams / polybag at planting time, four, and seven weeks after planting.

Watering dikocor using a water hose in the morning or evening, once a week watering is reduced to bare earth and roots grow well. In the generative phase of intensive irrigation, so that the grain contains full. In the conduct of research does not occur pests and plant diseases. Rice ready to harvest indicator grains and panicle contains ducked, yellow 80%, grains if pressed with two fingers feel hard.

IV. RESULT AND DISCUSSION

1. Power grow

M0 generation comes directly from seeds that have been irradiated. Observations rice growing power generation M0 showed a different pattern of growth in each strain (Figure 1).

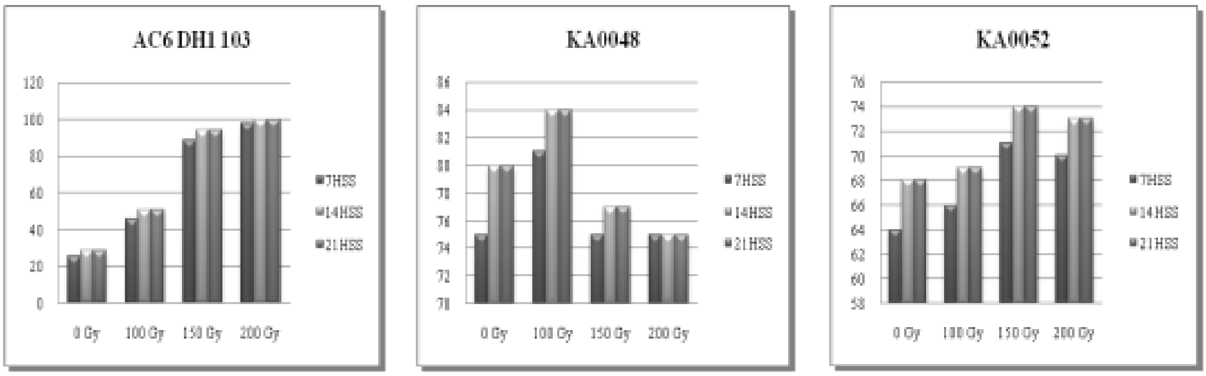

Figure 1. Graph AC6DH1-103 growing power lines, KA0048 and KA0052 irradiation 0, 100, 150 and 200 Gy, ages 7, 14 and 21 DAP (days after planting).

Strain KA0052 AC6DH1-103 and showed that the increase in irradiation dose of 0, 100, 150 and 200 Gy able to increase the percentage to grow the seed. AC6DH1-103 growing power lines in order are as follows 29%, 51%, 94% and 100%. Ability to grow strain KA0052 respectively 68%, 69%, 74% and 73% (Figure 4). Irradiation at high doses can cause chemical changes (Poespodarsono, 1988) which break dormancy and trigger germination. The more levels of oxygen and water molecules (H2O) in the irradiated material, it will be the more free radicals are formed so that the plants become more sensitive (Herison et al., 2008).

Percentage strain KA0048 growing power increased at 0 Gy irradiation and 100 Gy was 80% and 84%, then decreased ability to grow at 150 and 200 Gy irradiation at 77% and 75% (Figure 1). Ismachin (1988) states that the amount of damage to plants depends on the magnitude of a treatment, the higher the dose the greater the commission of plant physiological damage that ended in the incidence of death. It is also in accordance with the opinion Broertjes and Van Harten (1987) which states that at low irradiation dose range, the ability of plants to survive high, but the low mutation frequency, whereas the high dose range, high mutation frequency but the ability of plants to survive low .

2. Vigor seeds

Transplanting seedlings performed at the age of 21 DAE (days after extension). Seedling height observations made on 10 seedlings, measured from the base of the stem to the tip of the longest leaf in units of cm (Figure 2).

0 1 2 3	0 1 2 3	0 1 2 3
A galur AC6DH1-103	**B** galur KA0048	**C** galur KA0052.

Figure 2. High seedling age of 21 days after planting (0) 0Gy, (1) 100Gy, (2) 150Gy and (3) 200Gy, Characterization and scores based on SES (IRRI 1996).

Table 2: Results of High Observation Seeds

Radiation treatment	x ± SD (cm)		
	AC6DH1-103	KA0048	KA0052
0 Gray	20.24 ± 0.90	30.87 ± 1.63	29.45 ± 2.16
100 Gray	20.38 ± 0.92	29.36 ± 2.21	29.38 ± 1.04
150 Gray	20.23 ± 1.04	29.44 ± 1.34	29.02 ± 1.63
200 Gray	20.89 ± 1.09	29.18 ± 2.02	29.46 ± 1.52

The observation of high seed age 21 days after sowing showed no interaction of the high seed irradiation results (Table 2). Strain AC6DH1-103 age 21 days after sowing leaved 2 up to 3, whereas strain KA0048 and KA0052 leafy 3 up to 4.

Leaves a very important observation as a reference if plant growth and development is going well, because it leaves is one of the vital organs as the photosynthesis of plants. The earliest sign of the existence of leaf development by Salisbury and Ross (1992) is the outermost cell division followed by daughter cell that causes a bulge that is primordial leaves.

3. Ability lambing

Results of analysis of variance for a variable number of tillers vegetative phase showed a diverse interaction between treatment and irradiation dose strains of rice plants. Separately treatment increased doses of irradiation on the strain AC6DH1-103 significant effect on the growth in the number of tillers ages 14 to 56 days after planting, strain KA0048 produce a noticeable difference at 28 and 56 days after planting, whereas strain KA0052 produce a noticeable difference in the 14 and 28 days after planting observations. The mean number of tillers irradiation results shown in Table 3.

Table 3: Average number of tillers irradiated

Treatment	14 (DAP)	28 (DAP)	42 (DAP)	56 (DAP)
AC6DH1-103				
0	2.049 a	4.217 a	6.926 a	7.823 a
100	2.560 ab	5.098 b	8.500 b	9.183 c
150	3.294 c	6.431 c	9.980 c	10.431 d
200	2.608 b	5.176 b	7.784 ab	8.000 b
LSD 5%	0.538	0.932	1.054	1.133
KA0048				
0	7.376	14.865 b	16.782 b	17.362 b
100	4.792	9.208 a	11.354 a	11.412 a
150	6.471	9.157 a	10.667 a	11.137 a
200	5.438	10.025 a	13.288 ab	14.599 ab
LSD 5%	ns	2.222	3.562	4.184
KA0052				
0	5.938 a	11.182 a	16.387	29.926
100	6.806 b	13.324 b	17.968	30.822
150	7.216 b	14.176 bc	19.490	29.765
200	7.137 b	15.235 c	17.863	30.078
LSD 5%	0.776	1.620	ns	ns

Note: Numbers are accompanied by the same letter in the same observation parameters showed (ns) no significant difference based on the Least Significant Difference test (LSD) at the level of p = 0.05 level; DAP = Days After Planting.

Based on Table 3, it appears that the strain AC6DH1-103 age of 14 and 56 dap 0 Gy irradiation resulted in significant number of tillers less than the irradiation of 100, 150 and 200 Gy. The number of tillers vegetative phase are most numerous in AC6DH1-103 strain 150 Gy irradiation with an average increase of 43.41% from 0 Gy irradiation.

Irradiation DAP strain KA0048 age 14 showed no significant effect on the number of tillers. Observations age 28 and 56 DAT showed that irradiation of 100, 150 and 200 Gy real sequentially generates less number of tillers with an average decline of 34.79%, 33.61% and 23:12% from 0 Gy irradiation.

Irradiation strain KA0052 ages 14 and 28 DAT showed significant effect on the number of tillers. Irradiation of 100, 150 and 200 Gy real sequentially generate more number of tillers with an average increase of 17:59%, 24.96% and 30.69% from 0 Gy irradiation. However, increase in the number of tillers was not significantly different at the age of 42 and 26 dap.

4. The length and width of leaf

Results of analysis of variance for a variable length of leaves showed varying interaction between treatment and irradiation dose strains of rice plants. It is also found in the variable width of the leaf. As reported by Harsanti & Isaac (1999), treatment of gamma radiation in rice plants resulted in several genes can be mutated in the same time, due to the mutagen treated in tissues or cells will be on target at random.

Irradiation resulted in strains AC6DH1-103 real influence on the length and width of the leaf. Irradiation of 100, 150 and 200 Gy boost leaf length by 15.94%, 25.08% and 24.23% from 0 Gy irradiation. While the observation of leaf width 150 and 200 Gy irradiation increased by 8:05% and 7.83% from 0 Gy irradiation (Table 4).

Irradiation strain KA0042 there is no significant interaction on the character length of the leaves, however, 150 and 200 Gy irradiation was able to increase the width of the leaves at 3:40% and 3:38% from 0 Gy irradiation (Table 4).

Observations strain KA0052 100 Gy irradiation resulted in a decrease panjangdaun of 6:08% and amounted to 5.64% leaf width from 0 Gy irradiation. The length and width of the leaves is a quantitative morphological characters and is controlled by many genes cumulatively (Chang and Li, 1991).

Table 4 Average agronomic response of rice plants irradiated M0 generation 0, 100, 150 and 200 Gy. Pranggang MH 2012.

Treatment	JA	JAP	TT (cm)	PjD (cm)	LD (cm)	SD	SDB	SdtB	Aroma
AC6DH1-103									
0	14.841	11.801	61.166a	29.060a	1.481a	Tegak <45°	Sedang ±45°	Sedang ±45°	Tdk Wangi
100	14.866	11.385	66.858b	33.692b	1.480a	Tegak <45°	Sedang ±45°	Sedang ±45°	Tdk Wangi
150	14.706	13.020	70.549b	36.346b	1.601b	Tegak <45°	Sedang ±45°	Sedang ±45°	Tdk Wangi
200	12.431	10.059	70.275b	36.101b	1.597b	Tegak <45°	Sedang ±45°	Sedang ±45°	Tdk Wangi
BNT 5%	tn	tn	5.472	2.870	0.046				
KA0048									
0	19.153b	13.216b	124.058c	53.658	1.942a	Tegak <45°	Sedang ±45°	Sedang ±45°	Wangi
100	12.042a	10.604a	108.896ab	55.278	1.953a	Tegak <45°	Sedang ±45°	Sedang ±45°	Wangi
150	17.275b	12.549b	105.843a	52.856	2.008b	Tegak <45°	Sedang ±45°	Sedang ±45°	Wangi
200	20.768b	15.789c	112.750b	53.495	2.007b	Tegak <45°	Sedang ±45°	Sedang ±45°	Wangi
BNT 5%	3.115	1.880	5.267	tn	0.046				
KA0052									
0	29.926	25.324	89.884	45.984b	1.555ab	Tegak <45°	Sedang ±45°	Sedang ±45°	Tdk Wangi
100	30.822	25.783	86.971	43.189a	1.467a	Tegak <45°	Sedang ±45°	Sedang ±45°	Tdk Wangi
150	29.765	26.039	89.039	49.647b	1.599ab	Tegak <45°	Sedang ±45°	Sedang ±45°	Tdk Wangi
200	30.078	24.882	92.529	49.596b	1.665b	Tegak <45°	Sedang ±45°	Sedang ±45°	Tdk Wangi
BNT 5%	tn	tn	tn	4.148	0.132				

Note: Numbers are accompanied by the same letter in the same observation parameters showed no significant difference based on the Least Significant Difference test (LSD) at the level of p = 0.05 level; tn = not significantly different; Characterization and scores based on SES (IRRI 1996).

5. Angle leaf and flag leaf angle

Angle is the angle openness leaves to the stem end of the leaf was measured on the first leaf after leaf flag, erect (<45 °), moderate (45-90 °), horizontal (90 °) and drooping type (> 90 °). The observation to variable angles leaf and flag leaf angle that strains AC6DH1-103, KA0048 and KA00052 have karater types erect leaf angle <45 ° and the angle bedera leaf type is ± 45 ° (Table 5). More erect leaf angle expected due role in improving the reception area light, in addition to immediately pass water that falls onto the leaves, thereby reducing the load on the leaf surface (Dewi et al., 2009). According to Chang and Li (1991), is recessive erect leaf angle to the angle of fall leaves and possibly correlated with high yield.

6. Angle rods

Trunk angle was observed in the milk ripe stage to the maturation phase. Classification of the upright trunk angle (<30 °), moderate (± 45 °), open (± 60 °), scattered (> 60 °) and trunk / lowest part of the ground surface. The observation to variable angles that strain AC6DH1-103 rods, KA0048 and KA00052 have karater angle stem types are (± 45 °).

7. Aroma

Observations carried out when the plants scent flowering phase. The observation AC6DH1-103 and get strain KA00052 not fragrant, perfumed KA0048 (aromatic).

8. Character Agronomy

Important characters depicting rice agronomic improvements include: increasing the number of productive tillers, panicle length, grains per panicle contents, empty seeds per panicle and weight of 100 seeds. Efforts to improve upland rice varieties, among others, aimed to obtain early maturing rice

and increase yield potential, resistance to major constraints such as blast disease (Pyricularia orizae L.), the troubled land teradap adaptability and grain quality favored by the public (Mugiono & Rustandi 1991; Soejono 2003).
Observations agronomic properties obtained data showing that the irradiation dose led to significant differences in some agronomic characteristics of plants M0 with native plants. Data on agronomic variables shown in Table 5.

9. Number of tillers

Observations made at the time the number of tillers plant dumps full phase. Based on (Table 5) can be explained that the increase in irradiation dose strain AC6DH1-103 no interaction on a variable number of tillers and number of productive tillers. AC6DH1-103 strains have the ability to give birth is the type (10 s / d 19 tillers per hill).
Observations strain KA0048 at 100 Gy of radiation resulted in a decrease in the number of tillers of 37.13% of the dose of 0 Gy, however, 150 and 200 Gy irradiation resulted in the number of tillers were not significantly different from 0 Gy dose. The smallest number of productive tillers present in 100 Gy irradiation with a decrease of 19.76% from 0 Gy, while the number of productive tillers were observed at 200 Gy irradiation with 19:47% increase from 0 Gy. Strain KA0048 has childbearing-type medium (10 s / d 19 tillers per hill).
Strain KA0052 observations indicate that irradiation of 100, 150 and 200 Gy no interaction on a variable number of tillers and number of productive tillers. Strain KA0052 has very many types of childbearing (> 25 tillers per hill). The number of chicks that many would be better if the offset amount is a lot of productive tillers.

10. Height of plants

Measurements of plant height measured from the base of the stem to the tip of the panicle teringgi (excluding fur) using the unit centimeters. Observations showed that the increased strain AC6DH1-103 irradiation dose of 100, 150 and 200 Gy significantly increased the plant height respectively 9:31%, 15:34% and 14.89% from 0 Gy irradiation. AC6DH1-103 strains have short plant height category (<110 cm).
The observation of strain KA0048 showed that irradiation of 100, 150 and 200 Gy real able to reduce plant height by 13.92%, 14.68% and 9:12% from 0 Gy irradiation. Strain KA0048 has a plant height categories were (110 s / d 130 cm).
KA0052 strains plant height measurements showed that the irradiation of 100, 150 and 200 Gy did not cause a significant difference from the 0 Gy dose. Strain KA0052 has a shorter plant height category (<110 cm).
Observations agronomic properties obtained data showing that irradiation causes a noticeable difference in most agronomic properties of M0 generation with native plants. Data on agronomic variables listed in Table 5.

Table 5 Mean agronomic response of rice plants to irradiation M0 generation 0, 100, 150 and 200 Gy. Pranggang MH 2012.

Perlakuan	UBt (hss)	UT (hss)	Panjang Malai (cm)	BI/Ml	BH/Ml	Bobot 100 (Gram)	PjBj (mm)	LBj (mm)
AC6DH1-103								
0	63-84	145	16.071	16.071a	60.689a	1.744a	6.523	3.683
100	63-84	145	18.644	18.644b	113.978b	1.711a	6.480	3.681
150	63-84	145	18.687	18.687b	104.933b	1.899b	6.585	3.806
200	63-84	145	18.544	18.544b	96.689b	1.927b	6.584	3.748
BNT 5%			tn	1.276	29.960	0.131	tn	tn
KA0048								
0	63-77	135	24.376	65.089	93.911	2.272	8.569	3.302
100	63-77	135	27.956	72.689	76.778	2.309	8.588	3.273
150	63-77	135	22.042	52.689	66.044	2.159	8.479	3.149
200	63-77	135	24.016	60.000	87.800	2.354	8.513	3.289
BNT 5%			tn	tn	tn	tn	tn	tn
KA0052								
0	56-70	128	23.364	80.844b	60.289	2.053	9.474	2.585
100	56-70	128	24.378	60.867ab	80.244	2.073	9.454	2.595
150	56-70	128	24.500	80.156b	73.378	3.615	9.475	2.661
200	56-70	128	23.436	50.489a	77.378	2.089	9.526	2.699
BNT 5%			tn	20.006	tn	tn	tn	tn

Note: Numbers are accompanied by the same letter in the same observation parameters showed no significant difference based on the Least Significant Difference test (LSD) at the level of $p = 0.05$ level; tn = not significantly different; Characterization and scores based on SES (IRRI 1996).

11. Age pregnant

Age pregnant AC6DH1-103 strains ranged from 63 DAE, with the longest bunting period is 21 days. Strain KA0048 has a lifespan equal to AC6DH1-103 bunting is 63 hss with period of 14 days pregnant. While most of short bunting age strain KA0052 owned between 56 hss with periods of 14 days pregnant.

12. Age of plants

Age of plants counted in days after sowing to 85% of grains in the panicles are ripe (yellow). Based on harvest age grouping (P) were performed Lopez et al. (1993), strain KA0048 and KA0052 strain early duration ($110 < P \leq 115$ DAP). (Whereas the old AC6DH1-103 strain is ($115 < P \leq 125$ DAP).

13. Panicle character

Observation variable strain release panicle panicle AC6DH1-103 has character only appears limited to the neck panicle, whereas strain KA0048 and KA0052 has a whole character out of panicles and neck (Figure 3).

A galur AC6DH1-103 **B** galur KA0048 **C** galur KA0052

Figure 3 Measurement of discharge panicle morphological characters, (1) the flag leaf angle, (2) the panicle neck, (3) long panicles.

Irradiation AC6DH1-103 strains produce a mean index number of the content, and the number of empty weight of 100 seeds is greater than 0 Gy irradiation. In observation of the amount of seed contents, irradiation of 100 Gy irradiation was not significantly different from 150 and 200 Gy, respectively resulted in a mean increase of 16:01%, 16:27% and 15:39% from 0 Gy irradiation. However, observations of the number of seeds irradiated region contribute to an increase in the average vacuum of 87.81%, 72.90% and 59.32% compared to 0 Gy irradiation. In observation of 100 seed weight of 100 Gy irradiation was not significantly different from 0 Gy irradiation. Increased radiation dose of 150 Gy and 200 Gy resulted in significant effect with an increase in the average 8.91% and 10:47% from 0 Gy irradiation.
In the observation variable length and width of seeds, irradiation does not produce a significant effect (Figure 7). AC6DH1-103 strains have long character-type seeds were (5.51 to 6.60 mm), while the strain KA0048 and KA0052 has a seed length character type is very long (> 7.50 mm). Strain KA0052 irradiation of 100, 150 and 200 Gy resulted in the number of seeds significantly different contents penururan mean 24.71%, 0.85% and 37.55% from 0 Gy irradiation.

A galur AC6 DH1 103 **B** galur KA0048 **C** galur KA0052

Figure 4. Measurement of seed morphological characters, (PjBj) long grain, (LBJ) seed width.

Irradiation produces no real effect on most variables strain KA0048 observations. Found a real influence on the content amount of strain KA0052 observation that irradiation of 100, 150 and 200 Gy resulted in the number of seeds were significantly different contents penururan averaged 24.71%, 0.85% and 37.55% from 0 Gy irradiation.
Mutant rice plants that have the potential to be developed in the next generation are expected to have morphological and agronomic characters were equal to or better than native plants. Research reports Herison et al. (2008) states that the greater the chances of a mutation in the generation of self-pollinated offspring of irradiated seeds, namely the generation of M1 or M2. In the generation of segregation has occurred in the loci mutated so that the probability that a new character will be even greater.

V. CONCLUSION

1. Irradiation produces variations in power grow. Largest growing power of each strain ie, strain AC6DH1-103 100% 200 Gy irradiation, 84% KA0048 and KA0052 irradiation of 100 Gy irradiation of 150 Gy 74%.
2 strain AC6DH1-103 (M0) is more responsive to gamma-ray irradiation proved significant interaction was found in the contents of a variable number of seeds, number of seeds per panicle and empty weight of 100 seed irradiation compared to 0 Gy (control).

REFERENCES

[1] Ahloowalia, BS, Maluszynsky, M. 2001 A new paradigm of induced mutations in plant breeding. Euphytica 118: 67-173.
[2] Anonymous. 2007 Rice Knowledge Bank. Agency for Agricultural Research and IRRI. National Commission Germplasm. 2003, 58 p.
[3] Chang, T.T. 1979 Crop genetic resources Plant Breeding Perspectives. Centr. Agric. Publ. And Doc., Wageningen. p. 83-103.
[4] Djojosoebagio. 1988 Fundamentals of Radioisotopes and Radiation in Biology. Inter-University Center. Bogor: Bogor Agricultural University. Indonesia.

[5] Dwimahyani. 1991 Study of the properties of upland rice. Minutes of Meeting of Scientific Applications of Isotopes and Radiation in Agriculture, Animal Husbandry and Biology. 30 to 31 October 1990 New York: BATAN.
[6] Gaul, H., 1977 Mutagent effects in the first generation after seed treatment. In: Manual on Mutation Breeding, Technical Reports Series. No. 119, IAEA, Viena.
[7] Gomez, K.A. and A.A. Gomez. 1984 Statistical procedures for agricultural research. 2nd ed. John Wiley and Sons, Inc. 680 p.
[8] AJF Griffiths, SR Wessler, Lewontin RC, Gelbart WM, DT Suzuki, Miller JH .. 2005 Introduction to Genetic Analyses. Ner York: WH Freeman and Company.
[9] Hang, T.T. and C.C. Li. 1991 Genetics and Breeding. In Luh, B.S (Ed). Rice. Van Norstrand Reinhold. NY, USA. p. 23-101.
[10] Harsanti L, Ishak. 1999. Evaluasi si fat agronomis galur mutan padi Arias (Oryza sativa L.) pada generasi R3M4 dan R4M5. Penelitian dan Pengembangan Aplikasi Isotop dan Radiasi. Jakarta:BATAN. Indonesia.
[11] Herawati T, Setiamihardja R. 2000. Pemuliaan Tanaman Lanjutan. Bandung: Universitas Padjadjaran. Indonesia.
[12] Herison C, Rustikawati, Sutjahyo SH, Aisyah SI. 2008. Induksi mutasi melalui iradiasi sinar gamma terhadap benih untuk meningkatkan keragaman populasi dasar jagung (Zea mays L.). Jurnal Akta Agrosia 11:57-62.
[9] Hang, T.T. and C.C. Li. 1991 Genetics and Breeding. In Luh, B.S (Ed). Rice. Van Norstrand Reinhold. NY, USA. p. 23-101.
[10] Harsanti L, Isaac. 1999 Evaluation of the agronomic fat Arias mutant strains of rice (Oryza sativa L.) on R3M4 and R4M5 generation. Research and Application Development of Isotopes and Radiation. Jakarta: BATAN.
[11] Herath T, Setiamihardja R. 2000 Advanced Plant Breeding. London: University of Padjadjaran. Indonesia.
[12] Herison C, Rustikawati, Sutjahyo SH, SI Aisha. 2008 Induction of mutations by gamma-ray irradiation on the seeds to increase the diversity of a population base of maize (Zea mays L.). Deed Agrosia Journal 11: 57-62.
[13] Hidayat, E.B. 1985 Anatomy of seed plants. ITB: Bandung. Indonesia.
[14] Isaac. 1997 Selection of somaclonal early maturity rice plant genotype R1, R2 and R3. Zuriat 8: 8. [In] Harsanti L, Isaac. Evaluation of agronomic trait of rice mutant lines Arias (Oryza sativa L.) on R3M4 and R4M5 generation. Research and Application Development of Isotopes and Radiation. Jakarta: BATAN. Indonesia.
[15] M. 1988 Ismachin plant breeding by artificial mutation. Application Center Isotopes and Radiation Technology Jakarta: BATAN.
[16] Maluszynsk, i M., Ahlowalia, BS, Sigurbjornsson B. 1995 Application of in vivo and in vitro mutation techniques for crop improvement. Euphytica 85: 303-315.
[17] Mohr, H., Schopfer. 1995 Plant Physiology. Springer-Verlag. Berlin.
[18] Mugiono, 1991 T. Rustandi Dwarf Mutant Varieties Cisadane Minutes of Meeting of Scientific Applications of Isotopes and Radiation in Agriculture, Animal Husbandry and Biology. 30 to 31 October 1990 New York: BATAN.
[19] Nio, S.A., F.E.F. Kandou. 2000 Growth response of rice (Oryza sativa L.) and Upland Rice in the Early Vegetative Phase Drought. Eugenia 6: 270-273. Isotopes and Radiation Application Development. Jakarta: BATAN. Indonesia.
[20] Z. Oktavina 2011. Effect of gamma irradiation on the growth of Dendrobium orchid hybrid schulerri x May Neal Wrap the In Vitro
[21] Pattee, HE, Stalker, HT, 1995 Advances in peanut science. American Peanut Research and Education Society, Inc. Stillwater, USA.
[22] S. Poespodarsono 1986 Basic knowledge of Plant Breeding. Bogor Agricultural University. Bogor. Indonesia.
[23] Purnamaningsih R, I. 2003 Mariska embryonic rice callus regeneration after selected with Al and low pH. Pioneering Research Seminar and Plant Biotechnology. Bogor 23-24 September 2003. Indonesia.
[24] Purnamaningsih R, I. 2008 Testing Mariska numbers expectation resistant rice Al and low pH results in vitro selection with nutrient culture. Journal of Agro Biogen 4: 18-23.
[25] Purwoko BS, IS Goddess, DW Utami, Suwarno. 2005 Assembling the aluminum tolerant Upland rice double haploid plants from anther culture results. HB Reports XI. SBRC / IPB.73 p.
[26] Rahmatika, W. 2009 Effect of the percentage of N (Azolla and urea) on growth and yield of rice (Oryza sativa L.).
[27] R. Ratma 1988 study the influence of gamma irradiation on the incidence of induced mutations in soybean. The results of the study from 1981 to 1987. Application Center of Isotopes and Radiation Technology. Jakarta: BATAN. Indonesia.
[28] Soedjono, S. 2003 Applications of somaclonal variation and induced mutations in plant breeding. Journal of Agricultural Research. 22 (2): 70-78.

[29] Sudrajat DJ, M. 2009 Prospects Zanzibar gamma radiation technology in improving the quality of forest seeds. Info Seed Vol. 13 No. June 1, 2009: 158-163.
[30] Suhartini, T. 2009 Morphological characters of genetic diversity of wild rice species (Oryza spp). Germplasm Bulletin 14 (1): 17-26.
[31] Sumarji. 2007 Rice Cultivation and Crops, Unesa Press, Surabaya. Indonesia.
[32] B. Suprihatno 2007 Rice Varieties Description Subang. Center for Rice Research.
[33] Sutisna, Mugiono. 1991 Appearances Some Hope Upland Rice Mutant Strains. Minutes of Meeting of Scientific Applications of Isotopes and Radiation in Agriculture, Animal Husbandry and Biology. 30 to 31 October 1990 New York: BATAN.

AUTHOR BIOGRAPHY

Ir. Sumarji, MP. Islamic University of Kadiri, Kediri. Indonesia.