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PJBS

ISSN 1028-8880

Pakistan Journal of Biological Sciences

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

OPEN ACCESS **Pakistan Journal of Biological Sciences**

ISSN 1028-8880
DOI: 10.3923/pjbs.2020.1253.1259

Research Article
Mutant Selection Short-stem of M2 Generation Mentik Wangi Rice Resulted from Irradiation with Gamma-ray

[1]Tias Ayu Pratiwi, [2]Rina Puji Lestari, [3]Parjanto and [3,4]Ahmad Yunus

[1]Undergraduate S1 Program, Agrotechnology Major, Universitas Sebelas Maret. Jl. Ir. Sutami 36A Surakarta 57 126, Central Java, Indonesia
[2]Department of Agronomy, Graduate School, Universitas Sebelas Maret. Jl. Ir. Sutami 36A Surakarta 57 126, Central Java, Indonesia
[3]Faculty of Agriculture, Universitas Sebelas Maret. Jl. Ir. Sutami 36A Surakarta 57 126, Central Java, Indonesia
[4]Center of Biotechnology and Biodiversity, Research and Development, Universitas Sebelas Maret. Jl. Ir. Sutami 36A Surakarta 57 126, Central Java, Indonesia

Abstract

Background and Objective: Mentik Wangi is local rice variety from Magelang, Central Java. This rice has superior properties, which is tender texture, has fragrant, but also has a long harvesting age and tall stems so that it easily collapses during heavy wind. The purpose of this study was to determine the performance of M2 mutants resulting from 150, 200 and 250 Gy gamma irradiation and to find out the plants to obtain short-stemmed, short-lived mutant plants with high productivity. **Materials and Methods:** The tools used in this study include tractors, hoes, rakes, sickles, stakes, code boards, gauges, rulers, raffia, scissors, analytical scales, newspapers, stationery. The materials used are M2 generation Mentik Wangi rice seeds which are the result of 250 Gy gamma-ray irradiation, control Mentik Wangi rice seeds (without radiation), urea fertilizer, Ponska, SP36, KCl, ZA and pesticides. Plant treatment includes weed control, irrigation, fertilization, pest and disease control and put nets to avoid bird attacks. The study was conducted using a simple design experiment. **Results:** The results showed the difference between Mentik Wangi rice M2 generation gamma-ray irradiation with control plants. The results of the selection of short-trunked mutant plants, short-lived and have high productivity. **Conclusion:** M2 selection obtain 11 plants mutant from irradiation with 150 Gy, 22 plants mutant from irradiation with 200 Gy and 24 plant mutant from irradiation with 250 Gy that have short stems and high productivity.

Key words: Mentik Wangi, local variety, irradiation, selection, mutation, gamma-ray

Citation: Pratiwi, T.A., R.P. Lestari, Parjanto and A. Yunus, 2020. Mutant selection short-stem of M2 generation Mentik Wangi rice resulted from irradiation with gamma-ray. Pak. J. Biol. Sci., 23: 1253-1259.

Corresponding Author: Ahmad Yunus, Faculty of Agriculture, Universitas Sebelas Maret. Jl. Ir. Sutami 36A Surakarta 57 126, Central Java, Indonesia
Center of Biotechnology and Biodiversity, Research and Development, Universitas Sebelas Maret. Jl. Ir. Sutami 36A Surakarta 57 126, Central Java, Indonesia

Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Local rice variety is a potential genetic resource of genes that control important properties in rice. High genetic diversity in local rice can be utilized in rice breeding programs in general. Identification of important characteristics found in local rice needs to be carried out to identify the properties that could be beneficial to plant breeding program[1]. One of the local varieties developed by plant breeding is Mentik Wangi rice. Mentik Wangi is one of the leading aromatic rice owned by Indonesia[2]. Mentik Wangi is local rice originating from Magelang, Central Java. The type of aromatic rice Mentik Wangi has the potential to be developed because the Mentik Wangi rice has several advantages, namely its aroma, flavor and texture, the Mentik Wangi rice has a fluffier texture. Wangi Mentik rice has the same characteristics as local rice others such as having a long plant life and plant posture higher[3].

Wangi Mentik rice has characteristics including the form of rice oval, brownish yellow grain and the aroma of typical fragrant rice Fragrant Mentik. In addition to having advantages, local varieties of rice also have weaknesses including a relatively long harvest age, the plant is too high so it easily collapses[4]. Mentik Wangi rice has the advantage that can be used in development of plant breeding program through gamma-ray irradiation to obtain better properties. Gamma-rays have often been used to induce plants to mutate. Due to the importance of rice plants for the lives and livelihoods of the population, efforts are made to obtain varieties that can produce large yields in various ways, one of which is by mutation selection[5] so that it can be used to form plants with superior traits through plant breeding activities.

The purpose of this study is to increase the rice seeds of Mentik Wangi variety of breeding results that have superior quality especially short stems, early maturity and high productivity from gamma-ray irradiation.

MATERIALS AND METHODS

Study area: The study was conducted from March-November, 2018 in the rice fields of Karangpung village, Kismoyoso village, Ngemplak District, Boyolali Regency.

Tools, materials and method

Tools: The tools used in this study include tractors, hoes, rakes, sickles, stakes, code boards, gauges, rulers, raffia, scissors, analytical scales, newspapers, stationery.

Materials: The materials used are M2 generation Mentik Wangi rice seeds which are the result of 250 Gy gamma-ray irradiation, control Mentik Wangi rice seeds (without radiation), urea fertilizer, Ponska, SP36, KCl, ZA and pesticides. Plant treatment includes weed control, irrigation, fertilization, pest and disease control and put nets to avoid bird attacks.

Method: The study was conducted using a simple design experiment. Each plant code is planted on a single line containing obtain 11 plants mutant from irradiation with 150 Gy and control, 22 plants mutant from irradiation with 200 Gy and control and 24 plant mutant from irradiation with 250 Gy and control. Observations were carried out by observing the performance of all individual Mentik Wangi rice mutant plants resulting from 150, 200 and 250 Gy gamma-ray irradiation and plants without irradiation (control).

Data analysis: Data were analyzed descriptively by comparing each rice mutant plant with a control plant then followed by T-test. Observation variables included plant height, harvest age, flowering age, number of seed per panicle and mutant selection.

RESULTS

Plant height: The results of the Mentik Wangi irradiation 150 Gy rice plant are classified as medium plants indicated by an average height of 113-125 cm rice plants. Fragrant Mentik rice plants are classified as high control with an average plant height of 147.9 cm. Table 1 shows that the lowest plant height in the 150 Gy gamma-ray treatment plant code M2-150-T143 with a range of plant height 107-120 cm and the highest plant in the plant code M2-150-T12 range 119-132 cm whereas in control plants with a range plant height 137-159 cm.

Table 1: Height of Mentik Wangi rice plants of M2 generation from 150 Gy gamma ray irradiations

No.	M2 strains	Range	Average (cm)
1	M2-150-T143	101-119	113.40±6.11*
2	M2-150-T218	110-120	115.40±3.20*
3	M2-150-T55	115-119	117.40±3.41*
4	M2-150-T113	113-126	119.10±4.56*
5	M2-150-T170	111-124	117.70±5.06*
6	M2-150-T116	114-124	118.90±5.34*
7	M2-150-T130	110-129	120.90±7.58*
8	M2-150-T15	118-129	123.50±3.78*
9	M2-150-T11	115-131	123.60±5.44*
10	M2-150-T12	117-137	125.70±6.43*
11	Control	134-170	147.90±10.99*

Number followed by the sign (*) is significantly different from the control based on the test results $t\alpha = 0.05$

Table 2: Height of Mentik Wangi rice plants of M2 generation from 200 Gy gamma ray irradiations

No.	M2 strains	Range	Average (cm)
1	M2-200-G107	101-110	105.90±4.51*
2	M2-200-G97	102-120	106.12±3.71*
3	M2-200-G59	102-110	106.20±4.21*
4	M2-200-G53	96-106	101.40±4.95*
5	M2-200-G48	98-108	103.00±5.23*
6	M2-200-G34	104-109	106.20±2.70*
7	M2-200-G29	104-109	106.40±2.72*
8	M2-200-G10	105-108	106.50±1.72*
9	M2-200-G197	105-109	107.20±1.93*
10	M2-200-G147	104-110	107.20±3.01*
11	Control	127-138	132.80±5.47

Number followed by the sign (*) is significantly different from the control based on the test results tα = 0.05

Table 3: Height of Mentik Wangi rice plants of M2 generation from 250 Gy gamma ray irradiations

No.	M2 strains	Range	Average (cm)
1	M2-250-G23	115-130	122.3±5.14*
2	M2-250-G62	100-126	113.0±8.93*
3	M2-250-G60	94-135	119.1±11.75
4	M2-250-G57	114-138	124.2±6.95
5	M2-250-G97	112-132	123.3±6.18
6	M2-250-G29	104-125	116.9±5.82*
7	M2-250-G22	113-127	120.7±4.59*
8	M2-250-G11	114-132	122.0±6.05*
9	M2-250-G68	110-139	122.1±7.48
10	M2-250-G96	111-133	123.2±7.13
11	Control	123-140	132.8±5.47

Number followed by the sign (*) is significantly different from the control based on the test results tα = 0.05

Table 4: Flowering and harvesting age of Mentik Wangi rice plants of M2 generation from 150 Gy gamma ray irradiations

No.	M2 strains	80% flowering age (days)	Harvesting age (HST)
1	M2-150-T143	59	90*
2	M2-150-T218	57	88*
3	M2-150-T55	58	89*
4	M2-150-T113	57	89*
5	M2-150-T170	54*	88*
6	M2-150-T116	57	90*
7	M2-150-T130	59	91*
8	M2-150-T15	57	90*
9	M2-150-T11	57	90*
10	M2-150-T12	59	91*
11	Control	65	120

Number followed by the sign (*) is significantly different from the control based on the test results tα = 0.05

Table 2 shows that control plants have an average plant height of 132.80 cm with a range of 127-138 cm. The 200 Gy gamma-ray irradiation treatment shows the shortest plant height found in the M2-200-G53 strain which has a 96 cm plant height with an average height of 101.40 cm and a range of 96-106 cm. Height while the longest plant height is found in the M2-200 strain-G197 which has a plant height of 105 with an average height of 107.20 cm and a height range of 105-109.

Table 5: Flowering and harvesting age of Mentik Wangi rice plants of M2 generation from 200 Gy gamma ray irradiations

No.	M2 strains	80% flowering age (days)	Harvesting age (HST)
1	M2-200-G107	58*	88
2	M2-200-G97	58*	88
3	M2-200-G59	58*	88
4	M2-200-G53	58*	88
5	M2-200-G48	58*	89
6	M2-200-G34	59	89
7	M2-200-G29	59	89
8	M2-200-G10	58*	90
9	M2-200-G197	58*	91
10	M2-200-G147	58*	91
11	Control	71	120

Number followed by the sign (*) is significantly different from the control based on the test results tα = 0.05

All M2 mutant plants which were irradiated by 250 Gy gamma-rays had shorter stems than controls. The shortest plant height of fragrant Mentik rice from 250 Gy gamma irradiation was found in the M2-250-G60 strain with an average of 113 cm. Fragrant Mentik rice T test results of 250 Gy gamma-ray irradiation showed that not all strains had plant height that was significantly different from the control plants (Table 3).

Table 4 presented the fastest flowering age of Mentik Wangi in M2-150-T170 plant code reaches 54 HST. While the longest in plant code M2-150-T143, M2-150-T130, M2-150-T12 reaches 59 HST and flowering age in control plants (without radiation) reaches 65 HST. The flowering age of 150 Gy gamma-ray radiation treatment significantly affected the flowering age of the control treatment (without radiation).

Control plants have a flowering age of 71 HST. Control plants have a harvest age of 120 HST. M2 fragrant rice from gamma irradiation of 200 Gy has a flowering age range of 58-59 HST and a harvest age of 88-91 HST (Table 5).

The Mentik Wangi rice M2 from 250 Gy gamma-ray irradiations has a flowering age of 58 days and harvesting age ranges from 88-90 days. Mentik Wangi M2 mutant from the irradiation of 250 Gy gamma-rays has a shorter flowering and harvest life than the control plants. The shortest crop age is found in the M2-250-G97, M2-250-G11 and M2-250-G96 lines, which is 88 days after planting (Table 6).

Number of seed per panicle: T-Test Results the number of seeds per clump in Wangi Mentik M2 rice 150 Gy gamma-ray treatment showed a significant effect with control. The highest average seed weight per family in the highest 150 Gy gamma-ray treatment is M2-150-T 170 of 77.07 g. For the lowest seed weight per family, M2-150-T143 was 41.20 g and the average control treatment was 73.38 g (Table 7).

Table 6: Flowering and harvesting age of Mentik Wangi rice plants of M2 generation from 250 Gy gamma ray irradiations

No.	M2 strains	80% flowering age (days)	Harvesting age (HST)
1	M2-250-G23	59	91
2	M2-250-G62	59	91
3	M2-250-G60	58*	90
4	M2-250-G57	58*	90
5	M2-250-G97	58*	88
6	M2-250-G29	58*	89
7	M2-250-G22	58*	89
8	M2-250-G11	58*	88
9	M2-250-G68	59	90
10	M2-250-G96	58*	88
11	Control	71	120

Number followed by the sign (*) is significantly different from the control based on the test results tα = 0.05

Table 7: Number of seed per panicle of Mentik Wangi rice plants of M2 generation from 150 Gy gamma ray irradiations

No.	Strains	Range	Average (cm)
1	M2-150-T143	29.99-52.41	41.20±11.21*
2	M2-150-T218	46.01-75.43	60.72±14.71*
3	M2-150-T55	41.51-58.24	49.87±8.36*
4	M2-150-T113	40.31-83.12	61.72±21.40
5	M2-150-T170	62.46-91.68	77.07±14.61*
6	M2-150-T116	47.40-63.58	55.49±8.09*
7	M2-150-T130	34.87-60.39	47.63±12.76*
8	M2-150-T15	28.75-74.62	51.68±22.93*
9	M2-150-T11	34.37-70.71	52.54±18.17*
10	M2-150-T12	33.87-68.65	51.26±17.39*
11	Control	56.92-89.85	73.38±16.46

Number followed by the sign (*) is significantly different from the control based on the test results tα = 0.05

Table 8: Number of seed per panicle of Mentik Wangi rice plants of M2 generation from 200 Gy gamma ray irradiations

No.	Strains	Range	Average (cm)
1	M2-200-G107	124-170	146.88±23.07
2	M2-200-G97	145-188	166.46±21.43*
3	M2-200-G59	125-154	139.18±14.66
4	M2-200-G53	131-153	141.70±10.90
5	M2-200-G48	125-155	140.06±14.60
6	M2-200-G34	99-133	116.00±17.31
7	M2-200-G29	131-171	150.60±19.99
8	M2-200-G10	124-178	151.22±26.83
9	M2-200-G197	118-185	151.62±33.49
10	M2-200-G147	122-168	145.04±22.98
11	CONTROL	108-144	126.06±17.79

Number followed by the sign (*) is significantly different from the control based on the test results tα = 0.05

Based on Table 8 shows that the control plants have an average number of seeds per panicle that is 126.06 with a range of 108-144. M2-200-G97 lines have the highest number of seeds per panicle with an average of 166.46 range from 145-188 while the lowest number of seeds per panicle is M2-200-G34 strain with an average of 116.00 range 99-133. This shows that the results of 200 Gy gamma-ray irradiation did not have a significantly different effect with control plants (without irradiation).

Table 9: Number of seed per panicle of Mentik Wangi rice plants of M2 generation from 250 Gy gamma ray irradiations

No.	Strains	Range	Average (cm)
1	M2-250-G23	39.64-126.45	81.70±28.13*
2	M2-250-G62	41.95-96.29	53.17±16.04
3	M2-250-G60	12.35-96.97	54.53±22.31
4	M2-250-G57	65.76-93.81	77.28±11.26*
5	M2-250-G97	42.68-93.2	64.30±13.1*
6	M2-250-G29	22.14-98.79	62.36±20.6
7	M2-250-G22	76.12-151.15	103.96±22.18*
8	M2-250-G11	41.52-93.03	62.75±15.76
9	M2-250-G68	19.0-83.08	57.38±17.68
10	M2-250-G96	35.81-103.31	57.26±20.63
11	Control	20.02-56.54	42.72±11.54

Number followed by the sign (*) is significantly different from the control based on the test results tα = 0.05

Table 10: Individual selection of M2 Mentik Wangi rice from 150 Gy gamma ray irradiations

No.	Strains	Selected individuals	Plant height (cm)	Seed yield (g)
1	M2-150-T143	9	118	10.32
2	M2-150-T218	2	112	11.74
		3	115	13.67
		7	117	12.45
3	M2-150-T55	19	119	10.53
4	M2-150-T113	1	117	14.87
		9	113	13.89
5	M2-150-T170	2	123	12.33
		14	113	11.36
		17	113	10.32
6	M2-150-T116	1	119	11.53
7	Control		148	11.74

In Table 9, the yield of crop seeds shows an increase in seed yield that varies in all M2 mutants in Mentik Wangi rice compared to control rice. The highest seed yield per plant was found in the M2-250-G22 strain with an average weight of 103.96 grams. T-test results showed that not all lines of M2 generation fragrant Mentik rice plant results of 250 Gy gamma-ray irradiation had a significantly different weight of rice from the control plants. Four strains have a significantly different weight of grain per clump ie M2-250-G23, M2-250-G57, M2-250-G97 and M2-250-G22.

M2 mutant selection: Based on Table 10 findings that individual selection of M2 generation Mentik Wangi rice plants irradiated by 150 Gy selected 11 mutant plants for the next generation. Data shows that the plants selected were M2-150-T143-9, M2-150-T218-2, M2-150-T218-3, M2-150-T218-7, M2-150-T55-19, M2-150-T113-1, M2-150-T113-9, M2-150-T170-2, M2-150-T170-14, M2-150-T170-17 and M2-150-G116-1. Selected crop yields have an average range of 112-112 cm.

Based on Table 11, individual selection of Mentik Wangi M2 generation of rice produced by 200 Gy gamma-ray irradiations, there are 22 selected plants. Data shows that the

Table 11: Individual selection of M2 Mentik Wangi rice from 200 Gy gamma ray irradiations

No.	Strains	Selected individuals	Plant height (cm)	Seed yield (g)
1	M2-200-G107	13	100.0	54.80
		17	101.0	80.46
		20	103.0	105.91
2	M2-200-G97	3	99.2	124.62
		8	100.0	43.20
3	M2-200-G59	13	103.0	101.73
		18	100.0	86.71
4	M2-200-G53	9	97.0	72.28
		10	101.0	98.22
		11	91.0	77.68
5	M2-200-G48	2	97.0	82.82
		4	96.0	43.25
		5	98.0	60.20
		7	99.0	72.37
6	M2-200-G34	1	102.0	27.21
		2	103.0	90.07
7	M2-200-G29	3	103.0	76.19
		11	102.0	65.87
8	M2-200-G10	12	104.0	51.3
9	M2-200-G197	5	103.0	67.73
10	M2-200-G147	2	102.0	89.49
		9	104.0	58.11
11	Control		148.0	11.74

Table 12: Selection of M2 generation, short stem Mentik Wangi mutants resulting from 250 Gy gamma-ray irradiation

No.	Strains	Selected individuals	Plant height (cm)	Seed yield (g)
1	M2-250-G23	6	119	61.60
		12	115	104.18
		24	116	75.94
2	M2-250-G62	1	104	41.95
		2	103	56.04
		6	107	44.29
		15	100	28.24
3	M2-250-G60	1	94	12.35
		8	109	48.27
4	M2-250-G57	1	114	93.81
		4	119	75.97
5	M2-250-G97	16	117	62.71
		17	112	75.13
		18	119	55.67
6	M2-250-G29	1	104	22.14
		8	112	70.67
7	M2-250-G22	7	119	95.21
		8	113	97.38
		9	115	76.12
8	M2-250-G11	10	114	41.52
		14	115	68.64
9	M2-250-G68	1	116	56.52
		15	110	19.00
10	M2-250-G96	1	114	103.31
		3	111	42.68
11	Control		148	11.74

plants selected were M2-200-G107, M2-200-G97, M2-200-G59, M2-200-G53, M2-200-G48, M2-200-G34, M2-200-G29, M2-200-G10, M2-200-G197and M2-200-G147 (Table 11).

Table 12 shows the results of the selection of M2 generation fragrant Mentik rice mutants from 250 Gy gamma-ray irradiation obtained 25 selected plants. Selected plants are better plants than control plants according to the observed variables. The results of the M2 generation mutants were M2-250-G23 lines in plant numbers 6,12 and 24. M2-250-G62 lines in numbers 1,2 and 6. M2-250-G60 lines in plant numbers 1 and 8. Strain M2-250-G57 at plant numbers 1 and 4. M2-250-G97 lines at numbers 16.17 and 18. M2-250-G29 lines at plant numbers 1 and 8. M2-250-G22 lines at plant numbers 7, 8 and 9. M2-250-G11 strain on plant numbers 10 and 14. M2-250-G68 strain on plant numbers 1 and 15. M2-250-G96 strain on plant numbers 1 and 3.

DISCUSSION

The short heightened plant is favorable as the target of rice breeding. Pheng *et al*.[6] stated that the ideal rice height is around 90-100 cm. Based on observation data, the height of Mentik Wangi rice with irradiation is relatively shorter than that of control plants (without radiation), as seen in Table 1-3. The treatment of 150 Gy gamma-ray irradiation showed that the shortest plant height was found on the M2-150-T143 strain which had a plant height of 101 cm. The treatment of 200 Gy gamma-ray irradiation showed that the shortest plant height was found on the M2-200-G53 strain which had a plant height of 96 cm. The treatment of 250 Gy gamma-ray irradiation showed that the shortest plant height was found on M2-250-G60 strain which had a plant height of 94 cm. This is in accordance with Dewi and Dwimahyani[7] stating that short stem mutants often arise from plants that have mutations and are characterized by changes in plant height. Plants that are not too high are the objectives of the study, this synergizes the productivity of Mentik Wangi rice plants. According to Meliala *et al*.[8] states that the ideal height of rice plants is around 90-100 cm. Therefore, further research is needed to be able to reach a more mature and stable age.

Flowering age is the time when individual plants emerge flower[9]. According to Ismachin and Sobrizal[10], the faster flowering age is highly correlated with faster age of crop harvesting. The observation of the age of the flowering of Mentik Wangi rice M2 from gamma-ray irradiation can be seen in Table 4-6. Based on Table 4-6, the generation M2 of Mentik Wangi rice from gamma-ray irradiation has a faster flowering age and harvest age compared to the control plant (without irradiation). The Mentik Wangi rice M2 from 150 Gy gamma-ray irradiations has a flowering age of 54 days and harvesting age ranges from 88 days. The Mentik Wangi rice M2 from 200 Gy gamma-ray irradiations has a flowering age of

58-59 days and harvesting age ranges from 88-91 days. The Mentik Wangi rice M2 from 250 Gy gamma-ray irradiations has a flowering age of 58 days and harvesting age ranges from 88-90 days. This shows that M2 fragrant rice M2 from 200 and 250 Gy gamma irradiations has experience mutations that affect the age of the flowering of rice plants. This is in accordance with Wahdah *et al.*[11] that state gamma-ray irradiation is influential to obtain plants with a character of faster flowering age and harvesting age. According to Hambali and Lubis[12] that new superior varieties are rice groups which have age characteristics ranging from 100-135 HSS (days after spread) and many tillers (more than 20 shots per clump).

The number of seeds per panicle is one indicator of rice production. Controlling the emergence of tillers can significantly increase the number of seeds that can spur the formation of filled grain per panicle[13]. Based on Table 7-9, control plants have an average number of seeds per panicle with a range of 20.02-144. This shows that the results of 150, 200 and 250 Gy gamma-ray irradiations give a significantly different effect from the control plants (without irradiation). The treatment of 150 Gy gamma-ray irradiation showed that the highest number of seed per panicle was found on the M2-150-T170 strain which had an average of 77.07. The treatment of 200 Gy gamma-ray irradiation showed that the highest number of seed per panicle was found on the M2-200-G97 strain which had an average of 166.46. The treatment of 250 Gy gamma-ray irradiation showed that the highest number of seed per panicle was found on the M2-250-G22 strain which had an average of 103.96.

Plant breeding uses selection to select individual plants that have superior properties. Based on Table 10, results of individual selection of M2 generation Mentik Wangi rice plants irradiated by 150 Gy selected 11 mutant plants for the next generation. Based on the objectives of this study, the most important selection indicators are plant height and seed weight per clump. Table 5 shows that the plants selected were M2-150-T143-9, M2-150-T218-2, M2-150-T218-3, M2-150-T218-7, M2-150-T55-19, plant codes, M2-150-T113-1, M2-150-T113-9, M2-150-T170-2, M2-150-T170-14, M2-150-T170-17 and M2-150-G116-1. Selected crop yields have an average range of 112-112 cm. Haris *et al.*[14] stated that gamma-ray irradiation has the potential to create diversity to obtain mutant plants with morphological characteristics and agronomic characteristics desired.

The results of research on M2 Mentik Wangi rice from the results of 200 Gy gamma-ray gamma irradiations showed a wide variety of visible changes (phenotypes) and genotypes. Based on Table 11, individual selection of Mentik Wangi M2 generation of rice produced by 200 Gy gamma-ray irradiations, there are 22 selected plants. Selected plants characterized by better plant properties than control plants according to the observed variables. This shows that the administration of gamma-ray irradiation results in mutations that could produce better plants. In accordance with Taryono *et al.*[15], plant breeding through mutation has a considerable role in improving plants and producing superior plants.

Table 12 shows the results of the selection of M2 generation fragrant Mentik rice mutants from 250 Gy gamma-ray irradiation obtained 25 selected plants. Selected plants are better plants than control plants according to the observed variables. The results of the M2 generation mutants were M2-250-G23 lines in plant numbers 6,12 and 24. M2-250-G62 lines in numbers 1,2 and 6. M2-250-G60 lines in plant numbers 1 and 8. Strain M2-250-G57 at plant numbers 1 and 4. M2-250-G97 lines at numbers 16, 17 and 18. M2-250-G29 lines at plant numbers 1 and 8. M2-250-G22 lines at plant numbers 7, 8 and 9. M2-250-G11 strain on plant numbers 10 and 14. M2-250-G68 strain on plant numbers 1 and 15. M2-250-G96 strain on plants numbers 1 and 3. [15]states that plant breeding through mutation has a significant role in improving plants and producing superior plants. This statement is consistent with the results of observations because M2 generation fragrant Mentik rice irradiated by 250 Gy gamma-rays is better than plants without irradiation (control).

CONCLUSION

M2 generation of Mentik Wangi rice produced by 150, 200 and 250 Gy gamma-ray irradiations has shorter plant height compared to control plants. There are other improvements in the generation of M2 Mentik Wangi rice from the results of 150, 200 and 250 Gy gamma irradiation, such as plant height, flowering age, harvest age, number of productive tillers, panicle length, number of seeds per panicle, the weight of 100 seeds, the weight of grain per clump and index of panicle intensity.

SIGNIFICANCE STATEMENT

This study found the results of M2 rice mutant selection resulting from gamma-ray irradiation with short stem results and short plant life. This research will help researchers to develop rice varieties which are one of the staple foods in the world. Thus the new theory about rice plants that have short stems and short life span can be accepted by the public or researchers to be able to be used as further research until the yield test later.

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