Selection of M3 genotype short stem results of ray gamma 250 gray in Mentik Wangi rice

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Abstract. This study aims to determine the performance of Mentik Wangi rice at M3 generation mutant rice and select the M3 generation mutant plants as a result of 250 gray gamma irradiation which has short stems with high productivity. The research was carried out by planting 70 M² lines of 250 gray gamma irradiation and control plants. The variables observed were plant height, total number of tillers, number of productive tillers, flowering age, harvest age, panicle length, number of seeds per panicle, panicle bush thickness index, weight of 100 seeds, weight of seeds per clump. Following observation, data were analyzed descriptively and statistically compared using t-test to determine the difference of M3 generation of fragrant Mentik rice from 250 gray gamma irradiation with control plants (without irradiation). There are 24 individual selected lines of M3 generation of fragrant Mentik Wangi mutants from 250 Gy gamma ray radiation which have a short stem character and have higher productivity than control plants.

1. Introduction

One of the most widely cultivated food crops in Indonesia, especially in Java, is the Rice (*Oryza sativa* L.) plant. Fragrant Mentik rice is a food commodity that has a high economic value, which is an aromatic superior rice owned by Indonesia [1] Aromatic rice fragrant Mentik varieties are in great demand by other countries, so that in early 2009 it was exported abroad. The total initial export quota requested reached 11,000 tons. The details are 1,000 tons of organic rice, 2,000 tons of Mentik Wangi rice, and 8,000 tons of super quality IR 64 rice [2], so the aromatic rice of the Mentik Wangi variety has prospects for development. The Central Statistics Agency notes that Indonesia's rice exports have risen sharply in the past 4 years. Mentik Wangi rice has the potential to be developed because Mentik Wangi rice has several advantages, namely high prices because it is favored by the community because it has a fragrant odor and when cooked has a fluffier and white texture [3]

The determination about appropriate gamma-ray irradiation doses for mutation induction is the most important thing [4]. The radiation doses that are given depends on the type of plants, growth phase, size, hardness and material that will be mutated. The effective doses for rice plants range from
100-500 gray [5]. The objective of this research is to observe and select M3 mutants of Mentik Wangi from gamma ray irradiation and obtain short-stemmed and high productivity mutant plants.

2. Materials and methods
The materials used in this study are urea, Ponska, SP36, KCl, ZA, pesticides, control Fragrant Mentik rice seeds (without radiation), M2 generation mutant rice seeds that are irradiated by 250 Gy gamma rays that cover 70 lines.

The study was conducted to plant 70 M2 short stem lines. These strains were selected by the M2 mutant population. Each line was planted with 60 plants, as a comparison planted with varieties of Mentik Wangi (Elder M0) plants of 100 plants. The result data from the T test were analyzed descriptively by comparing the M3 generation of fragrant Mentik rice plants resulting from 250 Gy gamma ray irradiation with plants without treatment (control), whether the results of the T test were significantly different or not with plants without treatment (control).

There are five parameters was used on this research. Such as plant height, number of productive tillers, tassel magnitude index, weigh of the parquet and M3 mutant selection

3. Results and discussion

3.1. Plant height
Plant height is one parameter of the growth of a plant, growth itself is the result of metabolism of living cells that can be measured. According to Wasonowati [6] Addition of cell number and size influences plant height. The rate of tissue formation and cell division will be proportional to the growth of roots, stems and leaves. The rate of division and elongation of cells is directly proportional to the growth of roots, stems and leaves, if the rate of division and elongation is fast then growth will be fast.

| No | Lines     | Range | Average    |
|----|-----------|-------|------------|
| 1  | M3-250-G23-12 | 93-116 | 103.6 ± 9.94* |
| 2  | M3-250-G23-22 | 96-111 | 99.6±6.5*   |
| 3  | M3-250-G22-8  | 94-115 | 101.4±8.14* |
| 4  | M3-250-G22-13 | 90-118 | 98.6±11.22* |
| 5  | M3-250-G60-3  | 93-105 | 99.6±4.67*  |
| 6  | M3-250-G60-5  | 89-109 | 99.4±7.89*  |
| 7  | M3-250-G29-8  | 94-114 | 102.2±9.28* |
| 8  | M3-250-G62-2  | 80-94  | 87.2±5.89*  |
| 9  | M3-250-G62-6  | 77-96  | 89.8±6.76*  |
| 10 | M3-250-G62-17 | 89-99  | 94.2±4.32*  |
| 11 | Control     | 120-144| 133 ± 10.37 |

Based on the results of observations in table 1 shows the height of plants with shorter treatments compared to control plants. The treatment plants had the shortest height in the G62-6 strain with a 77 cm height and a range of 77 - 96 cm and a control plant height of 120 cm with a range of 120 - 144 cm. Gamma ray irradiation can cause morphological, physiological and mutational changes in a plant[7].

T test results showed all rice lines of Mentik Wangi irradiated 250 Gy gamma rays had significantly different height from the height of rice plants without irradiation (control). Irradiation causing plants to mutate and provide genetic changes in an individual, especially height will be shorter [8].
3.2. Number of productive tiller
The number of productive tillers is the total number of tillers in a clump that produces rice panicles. Productive chicks themselves are one of the components that influence the high and low yields of the crop itself. Number of productive tillers seen from the number of tillers growing in the vegetative phase and directly affecting the quality of grain produced, can be seen in table 5 (Table 2)

Table 2. Number of productive tillers of Mentik Wangi rice varieties from gamma ray irradiation of various doses

| No | Lines                      | Rage | Average       |
|----|----------------------------|------|---------------|
| 1  | M3-250-G23-12              | 9 – 22 | 15.60±4.67*  |
| 2  | M3-250-G23-22              | 10 – 22 | 15.60±4.83   |
| 3  | M3-250-G22-8               | 9 – 2   | 14.80±4.71   |
| 4  | M3-250-G22-13              | 12 – 14 | 13.20±0.84   |
| 5  | M3-250-G60-3               | 13 – 18 | 14.80±2.05   |
| 6  | M3-250-G60-5               | 9 – 16   | 12.40±2.05   |
| 7  | M3-250-G29-8               | 9 – 16   | 13.8±2.95    |
| 8  | M3-250-G62-2               | 7 – 16   | 10.80±3.42   |
| 9  | M3-250-G62-6               | 9 – 21   | 14±4.47      |
| 10 | M3-250-G62-17              | 11 – 16  | 12.60±1.95   |
| 11 | Control                    | 7 – 14   | 11±3         |

Based on table 2, the average number of productive tillers without treatment (control) is lower compared to rice plants with irradiation treatment. Mentik Wangi Paddy M3 250 Gy gamma ray irradiation has the highest average number of productive tillers in the M3-250-G23-12 and M3-250-G23-22 lines, 15.6. The M3-250-G23-22 strain had the lowest total tillering in 10 tillers and the highest was 22 tillers. Rice plants without treatment (control) have a range of 7-14 productive tillers with an average of 11. The occurrence of mutations will be more effective in producing high genetic diversity in the number of productive tillers [9].

3.3. Tassel magnitude index
The panicle thickness was determined by the number of panicle seeds divided by panicle length. The panicle thickness index is very important because most farmers are very fond of long and dense rice plants, therefore the panicle thickness index must also be considered [10]. The ideal rice plant that has long and thick panicles with large amounts of grain can be seen in table 3.

Table 8 shows the results of panicle dense index in plants without treatment (control) 5.56 with an average number of seeds per panicle 113.36 ears and panicle length of 25.54 cm. Rice plants which were irradiated with 250 Gy gamma rays had the highest visibility index in M3-250-G60-5 with an average number of seeds 79.4 ears and panicle length of 20.06 cm, with this the number of panicle seeds and panicle length affected panicle visibility index rice. Panicle length and number of panicle will affect the index of dense in rice plants [10].

T test results showed that there were only three strains that were significantly different from plants without treatment (control), namely M3-250-G62-2, M3-250-G62-6, M3-250-G62-17 thus the effect of gamma ray irradiation results occurred in individuals but randomly. Genetic changes that are produced do not occur in all individuals or occur randomly [11].
Table 3. Tassel Magnitude Index of Mentik Wangi rice varieties from gamma ray irradiation of various doses

| No. | Lines            | Lowest | Highest | Range    | Average     |
|-----|------------------|--------|---------|----------|-------------|
| 1   | M3-250-G23-12    | 3.29   | 4.28    | 3.29 – 4.28 | 3.67±0.43   |
| 2   | M3-250-G23-22    | 3.18   | 4.06    | 3.18 – 4.06 | 3.67±0.34   |
| 3   | M3-250-G22-8     | 3.7    | 5.12    | 3.7 – 5.12  | 4.32±0.58   |
| 4   | M3-250-G22-13    | 3.53   | 4.12    | 3.53 – 4.12 | 3.84±0.26   |
| 5   | M3-250-G60-3     | 3.58   | 4.23    | 3.58 – 4.23 | 3.97±0.91   |
| 6   | M3-250-G60-5     | 5.1    | 6.38    | 5.1 – 6.38  | 5.77±0.26   |
| 7   | M3-250-G29-8     | 3.38   | 3.8     | 3.38 – 3.8  | 3.65±0.17   |
| 8   | M3-250-G62-2     | 2.66   | 3.68    | 2.66 – 3.68 | 3.11±0.39*  |
| 9   | M3-250-G62-6     | 2.8    | 3.64    | 2.8 – 3.64  | 3.09±0.32*  |
| 10  | M3-250-G62-17    | 2.7    | 3.86    | 2.7 – 3.86  | 3.22±0.49*  |
| 11  | Control          | 3.32   | 5.36    | 3.32 – 5.36 | 4.33±0.73   |

3.4. Weight of the parquet

Clump weight of grump is the total number of grains obtained in one clump of rice plants. The contents of the grain and the number of grains affect the weight of this pile of grain, if the grain is fully loaded the higher the weight of the clump can be seen in table 4.

Table 4. Weight of Parquet of Mentik Wangi rice varieties from gamma ray irradiation of various doses

| No. | Lines            | Rage     | Average (gr) |
|-----|------------------|----------|--------------|
| 1   | M3-250-G23-12    | 16.95 – 24.59 | 20.58±3.77   |
| 2   | M3-250-G23-22    | 14.32 – 29.16 | 20.12±5.96   |
| 3   | M3-250-G22-8     | 11.82 – 30.96 | 23.01±7.34   |
| 4   | M3-250-G22-13    | 13.69 – 23.36 | 17.46±3.63*  |
| 5   | M3-250-G60-3     | 14.81 – 22.1  | 19.48±3.34*  |
| 6   | M3-250-G60-5     | 11.37 – 21.36 | 17.91±4.25   |
| 7   | M3-250-G29-8     | 10.5 – 28.2   | 19.45±6.59   |
| 8   | M3-250-G62-2     | 12.57 – 20.38 | 16.12±3.09*  |
| 9   | M3-250-G62-6     | 12.6 – 32.53  | 20.76±7.32*  |
| 10  | M3-250-G62-17    | 18.3 – 27.92  | 23.71±4.37   |
| 11  | Control          | 18.84 – 49.57 | 20.58±3.77   |

Based on table 4, the highest plant weight without irradiation (control) was 49.57 gr with an average clump weight of 20.58 gr. M3 rice plants with 250 Gy gamma ray irradiation had the highest clump weight at 32.53 gr with an average clump weight of 20.76 gr. One of the characteristics of superior rice plants is producing high-yielding grain. If water drainage is considered properly, it will be very productive in the future for rice plants [12].

3.5. M3 mutant selection

Selection is done by comparing each individual rice plant irradiated by 250 Gy gamma irradiated rice with no treatment (control) in each observation variable (plant height, total tillers, productive tillers, age of harvesting, age of flowering, panicle length, weight of 100 seeds, weight clumps, panicle flashiness index and number of panicle seeds). First the selection is done by finding the 10 best lines of 35 lines planted. After getting the 10 best lines, selected with short-stemmed criteria and high clump weight. This selection produced 24 individual plants from 50 existing plants, can be seen in table 11 (Table 5).
Table 5. Mutant selection M3 Mentik Wangi rice varieties from gamma ray irradiation of various doses

| NO. | M3 Lines       | Number of Selected Plant | Plant height (cm) | Weight of Parquet |
|-----|----------------|--------------------------|------------------|-------------------|
| 1.  | M3-250-G62-2   | 32                       | 92               | 20.38             |
|     |                | 10                       | 83               | 17.31             |
| 2.  | M3-250-G62-6   | 27                       | 96               | 32.63             |
|     |                | 2                        | 88               | 19.84             |
|     |                | 3                        | 86               | 18.34             |
| 3.  | M3-250-G62-17  | 23                       | 89               | 24.53             |
|     |                | 61                       | 91               | 20.12             |
|     |                | 57                       | 99               | 27.92             |
|     |                | 26                       | 98               | 27.7              |
| 4.  | M3-250-G29-8   | 34                       | 94               | 28.2              |
| 5.  | M3-250-G60-3   | 49                       | 101              | 22.1              |
|     |                | 37                       | 93               | 22                |
|     |                | 7                        | 105              | 21.43             |
| 6.  | M3-250-G60-5   | 52                       | 102              | 18.57             |
|     |                | 10                       | 103              | 21.36             |
| 7.  | M3-250-G22-8   | 61                       | 103              | 26.7              |
|     |                | 57                       | 94               | 20.2              |
|     |                | 29                       | 98               | 25.36             |
| 8.  | M3-259-G22-13  | 33                       | 93               | 15.79             |
|     |                | 34                       | 90               | 17.81             |
| 9.  | M3-250-G23-12  | 16                       | 95               | 24.59             |
| 10. | M3-250-G23-22  | 10                       | 99               | 22.14             |
|     |                | 31                       | 96               | 19.62             |
|     |                | 14                       | 96               | 29.16             |
| 11. | Control        | 145                      | 145              | 32.29             |

The selection of M2 generation fragrant Mentik rice mutants as a result of 200 Gy gamma ray irradiation has a high range of 87-100 cm. Plant individuals with the lowest height in the M3-200-G59-18 with plant number 1 is 87 cm. Individual plants with the highest clump weight are found in the M3-200-G29-11 strain with a plant number 105, 78.19 g.

4. Conclusion
Based on the research results of the Short Generation Mutant Fragrant Mentik rice M3 M3 gamma irradiation irradiation results obtained conclusions namely: there are differences in the performance of agronomic traits of mentic rice There were 24 selected mutant lines of Mentik Wangi rice generation M3 resulting from 250 Gy gamma ray radiation which had short stem characters and had higher productivity than con.

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