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Multilocation Test Of Mutants (M4) Local Red Rice Sigah In Maninjau And Padang

*Irfan Suliansyah, Yusniwati, Fadilla Arishadea
Agronomy Masters Program, Andalas University, 25163, Indonesia
Jl. Mount Juaro Block A/9, Surau Gadang, Nanggalo, Padang, 25146, Indonesia
E-mail: fadillaarishadea@gmail.com
* email:irfan.suliansyah@gmail.com

ABSTRACT

The 4th generation of mutant brown rice from the experimental cultivation of the 3rd generation mutant has problems in plant characteristics and various genetic traits. In the research results of the 3rd generation of mutants, in the initial objectives, several mutants with production levels were obtained, namely early-mature mutants and significant plant height. However, some mutants have unstable plant characters and traits, so a multi-location test of cultivation of the 3rd generation mutant was carried out at two locations with different elevations in order to obtain a 4th generation mutant which is more stable and has uniform characters and properties. This research was conducted in Jorong Sungai Batang, Tanjung Raya District, Agam Regency with a medium elevation level of 637,032 m above sea level and in Surau Gadang Village, Nanggalo District, Padang, with a minimum elevation level of 10.363 m above sea level. This research was carried out from December 2019 to April 2020. The materials used were M3 harvested red rice seeds of the Sigah genotype, namely mutant numbers MG13, MG9, MG2-209, MG5-58, MG6, and control seeds of the red rice genotype Sigah. The purpose of the study was to obtain diversity and determine the stability of agronomic characters in the production of local red rice yields of the West Sumatran Sigah M4 variety at two different elevations of the cultivation environment. From the results of the research, it was found that the diversity and agronomic characteristics of plants were quite stable in mutants numbered MG13, MG2-209, and MG5-58 with early plant age and stable growth in the generative and vegetative phases.

Keywords: *Multilocation test, two elevations, characterization, Sigah mutant*

1. INTRODUCTION

Paddy *(Oryza sativa* L.) brown rice in Indonesia is one of the germplasm plasma whose existence is becoming increasingly rare due to the planting of new superior rice varieties. Brown rice is generally grown as gogo rice in areas with low production, poor quality, and poor crop growth. Sigah local brown rice has a long life with very high plant criteria and is vulnerable to pest and disease attacks.

According to (Sitaresmi et al. 2013), local rice nutfah plasma has certain genetic advantages.

Local rice has been cultivated for generations, so the genotype has adapted well to various land and climate-specific climates in its development area. In addition, local rice naturally has resistance to pests and diseases, is tolerant to abiotic strangle, and has good quality, so that it is favored by communities in its growing and growing locations.

West Sumatra is one of the Indonesian provinces whose territory is traversed by the equator. Climate conditions in West Sumatra are in the form of wet tropical forests that allow rain throughout the year with even intensity. This condition makes West Sumatra one of the centers of high genetic diversity. The most specific plant in West Sumatra is plasma nutfah paddy (Swasti *et al.,*2007). Local varieties are varieties that have existed and been cultivated for generations by local farmers in an area, to the point where they have become a specific variety of the area, and its protection and preservation have become the responsibility of the state. (Stone and Glover 2017)

Breeders have been made easier to harness the advantages of local rice varieties with information on genes that control the advantages of local rice varieties and need to be complemented by genetic analysis both conventionally and molecularly (Sobrizal, 2016).

Suliansyah *et al.* (2017) have performed gamma-ray irradiation of sigah and Banu Ampu genotype brown rice. The results showed that a 200 gy dose of irradiation produced 0.08% mutants, a dose of 300 gy produced 0.09% mutants. The results of the planting of sigah genotype brown rice in stage M3 obtained 8 mutant genjah and 7 mutants high in plants and the number of saplings that can already be categorized as stable mutants.

(Sitaresmi et al. 2013) stated that utilizing local varieties takes into account the specific advantages that rice varieties cultivated at specific planting sites have, so it is necessary to test the mutant-mutant varieties produced at several locations with different elevations of plain heights. The stability of genetic traits in the results of planting stage M3 was seen by conducting a Local Mutant Multilocation Test for Local Red Rice (*Oryza Sativa* L.) at Two Different Locations**,** especially in Maninjau and Padang.

Multilocation tests were conducted in two different elevation regions to obtain diversity values on crop yields and to determine the stability of agronomic characteristics in the production of sigah mutant local rice *products.* Determination of the height of the growing place can be done using a GPS device. The difference in the height of the place will affect the distribution of existing light. The higher a place gets, the less intense the light that reaches the surface. Areas with high altitudes have the least light distribution when compared to medium and low-lying plains. This will result in differences in the existing microclimate.

Research objectives

The purposes of this study are:

1. Gaining the diversity value in crop yields when cultivated in two different elevations of regions.
2. Knowing the stability of agronomic character in the production of local brown rice products of West Sumatra Sigah M4 variety at two different cultivation environments' elevations.

2. RESEARCH METHODS

The experiment was conducted in December 2019 to April 2020 at two locations; Jorong Labuah Nagari Sungai Batang Tanjung Raya District of Agam Regency with an altitude of ±637,032 mdpl and Surau Gadang Village of Nanggalo Padang District with an altitude of ±10,363 mdpl. The tools used were hoes, rakes, sickles, scissors, meters, *seedbeds,* label stake, analytical scales, bird trap nets, raffia ropes, envelopes, labels, cameras, stationery and scales. The materials used in the study were the seeds of the control plant, the target mutant strain of the purifying stage at the M3 stage consisting of MG13, MG9, MG2-209, MG5-58, MG6 and the control seeds of the brown rice *genotype Sigah.* Fertilizers used were Urea fertilizer, SP36, KC1, pesticides and other materials used in rice cultivation.

Research Methods

This research method was an experiment with Split Plot Design in Group Random Design (RAK), which consisted of 2 factors and 3 groups. Main plot (Factor A): planting location consisting of two levels; A1 = Location of Padang A2 = Location of Agam. Child plot (Factor B): mutant hope consisting of six mutants, namely D = (CONTROL), D1 = (MG13), D2 = (MG9), D3 = (MG2-209), D4 = (MG5-58), and D5 = (MG6). Each unit of experiment was planted with a size of 2.5 m x 2.5 m with a planting distance in tiles of 25 cm x 25 cm so that there were 100 individuals per plot of experiments. The determination of samples was done randomly with the number of 5 clumps of samples per bed. Analbernass data consisted of analbernass variety to find out genetic and environmental interactions, and there was a real difference in the results of analbernass observational data then duncan's New Multiple Range Test (DNMRT) at the level of α0.05 (5%).

Implementation

The implementation of multiplication test experiments in stage M4 is carried out because of its purpose related to the target of mutant strains and mutant genes, especially in the aspect of stability of changes in genetic traits that already exist in mutants from the M3 purification stage. Observation of agronomic character was carried out based on the guide system. Standard rice SES (Nasrudin and Kurniasih 2018) Tile harvesting was done during optimal optimization, and was harvested by leaving two rows on the left and the right side of the tile. The procedures for the implementation of experiments, crop maintenance and observation included several aspects, those were land preparation, seed preparation, and seed seeding, labeling and planting for implementation. Irrigation, Fertilization, Weeding, Harvesting and Observation consisting of observations of Flowering Age (day), Number of Productive Saprings (stems), Number of Non-Productive Sapves (stems), Malai Length (cm) Total Grain Amount Per Malai (grain), and Total Grain Weight Per Malai (g).

3. RESULTS AND DISCUSSIONS

a. Flowering Age (day)

1. Flowering age table (days)

Mutant	Flowering age		Average Mutant
	Maninjau	Field	
Control	75,5	73,1	74.3 a
MG13	62,1	60,5	61.3 e
MG9	68,8	66,0	67.4 c
MG2-209	65,1	63,0	64.1 d
MG5-58	63,8	61,5	62.6 de
MG6	71,5	70,1	70.8 b
Average	67,8	65,7	66,7
Location	A	B	

Description: numbers followed by the same letter on the same row and on the same column are not real according to the DNMRT advanced test at the level of 5%.

The average flowering life of each control plant and red rice mutants ranged from 62.1 days in the MG13 code mutant to 75.5 days in the control plant when calculated from the beginning of the plant. The shortest average flowering life was produced by mutant code MG13 with an average of 61.3 days. Each mutant had a difference in flowering age at two different elevation locations. Every mutant cultivated in Padang had a faster flowering age when compared to the location of Maninjau.

The age of flowering affected the age of harvest. When the flowering age was longer, the age of harvest is also getting longer. Harvest life can also be affected by the components of the yield, namely the number of sapves, the length of malai, and the number of seeds per malai (Simanhuruk, 2010). The differences that occured in the vegetative growth of plants are likely due to genetic and environmental factors. Different mutants will show different appearances after interacting with certain environments (Sitaresmi et al. 2013)

Each plant, especially rice plants, had different growth characteristics. This is due to differences in the genetic properties of each plant so that the longer the growth of plants in the vegetative phase, the longer the appearance of flowers becomes longer (Purwanto, Palobo, and Tirajoh 2020) The supply of asymptotes can decrease if the flowering age is slower. This is due to the lack of vegetative growth that can cause the resulting bulle to become hollow ((Istiyanti, Wulandari, and Widowati 2021)

Conclusions that can be drawn from observations of the average flowering life of mutant red rice plants Sigah showed that the height of the surface plains can affect the flowering age in each mutant plant resulting from the M4 multilocation test in two locations with different elevations.

b. Number of Productive Sapves (stems)

2. Table of number of productive sapves (stems)

Mutant	Number of productive sap children	
	Maninjau	Field
Control	5.3 A	73.1 A
MG13	23.6 B	60.5 A
MG9	12.6 B	66.0 A
MG2-209	27.3 A	63.0 B
MG5-58	17.3 A	61.5 A
MG6	17.6 A	70.1 A

Description: numbers followed by the same letter on the same row and on the same column are not real according to the DNMRT advanced test at the level of 5%.

The average character of the number of productive saplings in each mutant of the Sigah red rice plant is no different. Mutants with the code MG2-209 obtained the highest average with a value of 27.3 in the lowlands of Padang while mutants with the code MG9 ha the highest value at 66.0 for the plains of the maninjau medium.

Based on the results that have been obtained against the character of the number of productive saplings, some mutant strains cultivated in two different elevation locations have reached the desired number of productive saplings because they have a very significant difference with *the sigah genotype* brown rice control plant. This can be seen from the difference in the number of productive saplings of *sigah genotype* brown rice control plants with an average of 5,333 in Maninjau and 7,667 in Padang. While the number of productive saplings is mostly owned by mutant MG2-209 with an average number of productive saplings of 27,333 stems in Maninjau and 24,333 stems in Padang.

c. Number of Non-Productive Sapves (stems)

3. Table of average number of non-productive saplings (stems)

Mutant	Non-productive sap children		Average Mutant
	Maninjau	Field	
Control	2,3	0,6	1.5 d
MG13	6,0	5,0	5.5 b
MG9	4,6	2,6	3.6 c
MG2-209	6,0	8,6	7.3 a
MG5-58	8,0	7,3	7.6 a
MG6	8,6	7,6	8,1 a
Average Location	5,9 A	5,3 B	5,64

Description: numbers followed by the same letter on the same row and on the same column are not real according to the DNMRT advanced test at the level of 5%.

The character number of non-productive saprings in each mutant sigah red rice plant had a significant difference in number. It can be affected by the environmental conditions and physical properties of each mutant. Mutants with the code MG6 earned the highest average for the number of nonproductive saplings with an average score of 8.6 in the padang lowlands. Mutants with the code MG2-209 have the highest value with 8.6 for the plains of the Maninjau medium.

There was a noticeable difference between the average number of non-productive saplings at each planting site, which was 5,944 stems in Maninjau and 5,332 stems in Padang. This suggested the effect of planting locations on the number of nonproductive sapouts that appear in each clump of plants in each of the different mutants. Significant differences indicated the influence of differences in elevation of the name location and characteristics of each mutant.

d. Malai Length (cm)

4. Table average malai length (cm)

Mutant	Length of malai		Average Mutant
	Mainjau	Field	
Control	15,9	13,8	14.88 e
MG13	25,6	22,8	24.10 a
MG9	22,9	22,7	21.80 b
MG2-209	23,8	23,3	23.58 a
MG5-58	19,0	17,2	18.12 d
MG6	20,8	20,1	20.47 c
Average Location	21,3 A	20,0 B	20,49

Description: numbers followed by the same letter on the same row and on the same column are not real according to the DNMRT advanced test at the level of 5%.

The long character of mutant malai with the code MG13 obtained the highest value of 25.6 cm on the plains of the Maninjau medium. Mutants with the code MG2-209 were the highest malai length value of 23.3 cm for the padang lowlands. The length of malai can be affected by the number of productive sapouts. The number of productive sapouts that are more able to cause malai was getting shorter, while the number of productive sapouts that are few causes the malai to grow longer (Herawati et al. n.d.)

Significant differences in the total amount of grain per malai indicated an influence between the difference in elevation, padang lowland cultivation sites and maninjau medium plains with each mutant. A negative relationship can occur between the length of malai and the amount of malai.

(Bian et al. 2013)obtained data on the number of malai that were highly correlated with the number of sapfuls that grow. This suggested that different genetic systems were responsible for the number of saplings at the final number.

e. Total Grain Amount Per Malai (Grains)

5. Table of average amount of total grain per malai (grain)

Mutant	Total grain amount		Average Mutant
	Maninjau	Field	
Control	56,6	62,3	59.5 b
MG13	66,0	70,0	68.0 a
MG9	61,0	64,0	62.5 b
MG2-209	65,0	69,3	67.1 a
MG5-58	63,6	73,3	68.5 a
MG6	60,6	65,3	63.0 b
Average	66,1	67,3	64,7
Location	A	B	

Description: numbers followed by the same letter on the same row and on the same column are not real according to the DNMRT advanced test at the level of 5%.

The total grain amount character per malai in mutants with the code MG13 obtained the highest value of 66.0 grains on the plains of the Maninjau medium. Mutants with the code MG6 obtained the lowest total grain value in the Maninjau medium plain with a value of 60.6 grains per malai. The highest total grain value per malai in the padang lowlands was found in mutant code MG13 with 70.0 grains per malai and the lowest value is found in mutant code MG9 which is 64.0 grains per malai.

Based on the results obtained against the character of the average amount of total grain per malai, some mutant strains cultivated at two different elevation locations have reached the average amount of total grain per the desired malai and have with the control plant brown rice genotype *Sigah.* The average amount of total grain per malai is owned by mutant MG5-58 who with planting cultivation locations in Padang have an average amount of total grain per malai of 73,333 grains.

Observations of the seed number per clump showed that differences were influenced by other components of the results, such as the number of sapves, the length of malai, and the number of seeds per malai. If the component of the result is getting higher, then the number of seeds per clump is getting higher as well (Purwanto, Palobo, and Tirajoh 2020) The number of seeds per malai can be affected by the number of sapves and the length of the malai. If the results in the number of sapouts and the length of malai get a high score, then the number of seeds per malai is also high (Sharifi et al. 2017)

f. Total Grain Weight per Malai (g)

6. Table of average total grain weights per malai (g)

Mutant	Total grain weight		Average Mutant
	Maninjau	Field	
Control	0,5	0,5	0.5 f
MG13	1,6	1,8	1.77 b
MG9	1,6	1,5	1.59 c
MG2-209	2,4	2,7	2.58 a
MG5-58	.,M	1,3	1.28 d
MG6	0,8	0,9	0.90 e
Average	1,3	1,4	1,4
Location	B	A	

Description: numbers followed by the same letter on the same row and on the same column are not real according to the DNMRT advanced test at the level of 5%.

The total grain weight character per malai in mutants with the code MG2-209 obtained the highest value of 2.4 g on the plain of the Maninjau medium. Mutants with the code MG6 obtained the lowest total grain weight value per malai in the Maninjau medium plain with 0.8 g per malai. The highest total grain weight value per malai in the padang lowlands was found in mutant code MG2-209 which was 2.7 g per malai and the lowest value was found in mutant code MG6 which was 0.9 g per malai.

The average total grain weight per mutant malai MG9, MG2-209, MG5-58 and MG6 brown rice genotype *Sigah* padang location which showed a real difference to the average weight of total grain per malai control plant red rice genotype *Sigah* is 1,533 g, 2,700 g, 1,316 g and 0.973 g.

A noticeable difference between the total grain weight per mutant malai and the control of *the Sigah genotype* brown rice crop also occurred on average between the two planting sites. *Sigah's genotype* brown rice control plants both planting sites had an average of 0.50 g, while mutant MG13, MG9, MG2-209, MG5-58 and MG6 *sigah* brown rice rice plants were 1.77 g, 1.59 g, 2.58 g, 1.28 g and 0.90 g, respectively.

Based on the results obtained against the character of total grain weight per malai, some mutant strains cultivated at two different elevation locations reached total grain weight per malai with significant differences from *the sigah genotype* brown rice control plant. This can be seen from the difference in total grain weight per malai of *sigah genotype* brown rice control plant with an average of 1,394 g in Maninjau and 1,481 g in Padang.

4. CONCLUSIONS

The research that has been carried out has concluded that there is an influence of elevation at the two planting locations, namely the Maninjau medium plain and the Padang lowland on the yield of several M4 mutants. Some mutants that have good stability are mutants with code MG13, MG2-209, and MG5-58.

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REFERENCE

Bian, Miao, Meixue Zhou, Dongfa Sun, and Chengdao Li. 2013. “Molecular Approaches Unravel the Mechanism of Acid Soil Tolerance in Plants.” *The Crop Journal* 1(2): 91–104.

Herawati, R et al. “Assessment of Aluminum Tolerant of Double Haploid Lines for Developing New Type of Upland Rice.”

Istiyanti, Eni, Retno Wulandari, and Indah Widowati. 2021. “Technical Efficiency of Semi Organic Rice Farming In Sleman Regency, Special Region of Yogyakarta.” In *E3S Web of Conferences*, EDP Sciences. CONF, 2047.

Nasrudin, Nasrudin, and Budiastuti Kurniasih. 2018. “Growth and Yield of Inpari 29 Rice Varieties on Raised-Bed and Different Depths of Sunken-Bed in Saline Field.” *Ilmu Pertanian (Agricultural Science)* 3(3): 135–45.

Purwanto, O D, F Palobo, and S Tirajoh. 2020. “Growth and Yield of Superior Rice (Oryza Sativa L.) Varieties on Different Planting Systems in Papua, Indonesia.” *SVU-International Journal of Agricultural Sciences* 2(2): 242–55.

Sharifi, Peyman et al. 2017. “Evaluation of Genotype× Environment Interaction in Rice Based on AMMI Model in Iran.” *Rice Science* 24(3): 173–80.

Sitaresmi, T et al. 2013. “Utilization of Local Rice Germplasm Varieties in the Assembling of Superior Varieties.” *Iptek Tanaman Pangan* 8(1): 22–30.

Suliansyah, I., Dwipa, I., Yusniwati. 2017. Local Brown Rice Rice Development of West Sumatra; Characterization, Biotic and Abiotic Resistance Tests

and Character Improvement. Final report of Andalas University professor's research grant.
Stone, Glenn Davis, and Dominic Glover. 2017. “Disembedding Grain: Golden Rice, the Green Revolution, and Heirloom Seeds in the Philippines.” *Agriculture and Human Values* 34(1): 87–102.
Swasti, E., I. Suliansyah and A.A. Sharif. 2007. Exploration, identification and establishment of rice plasma collection from West Sumatra. Research Institute of Andalas Padang University.