Adaptation test for upland rice genotypes in Balunijuk village rice fields with ultisol type

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To cite this article: E D Mustikarini *et al* 2022 *IOP Conf. Ser.: Earth Environ. Sci.* **1108** 012026

Adaptation test for upland rice genotypes in Balunijuk village rice fields with ultisol type

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Abstract. Innovation to produce upland rice superior varieties is by developing local upland rice varieties with high yield and lodging resistance. Upland rice varieties also must have high adaptability in suboptimal land. This research aims to identify and determine the upland rice line F8 that is tolerant to lodging with high yielding potential.The research was carried out from September 2021 to January 2022 in Balunijuk Village Rice Fields, Bangka Regency. This research was conducted using an experimental method. The design used was a Randomized Block Design (RBD). The treatments consisted of 5 F8 lines and 5 comparison varieties. Data analysis used ANOVA followed by Duncan Multiple Range Test (DMRT). The results showed that generally upland rice genotypes were not able to adapt to inundation conditions, low pH, and Fe stress. Genotypes that were able to adapt were PBM UBB 1 (red rice), Danau Gaung and 21B-57-21-21-23 line (white rice), with the lodging index of 0% for these three genotypes, and a Fe toxicity scale with a value of sensitive. The genotype with the lowest yield was Inpago 8 and 23F-04-10-18-18 line. Genotypes with leaf length, number of grain per panicle, number and weight of pithy seeds per plant height increased seed yield/plot.

1. Introduction

Rice plants are the main food commodity in Indonesia because they are the staple food source of most people [1]. This is due to the need for rice consumption that is increasing continuously Other paragraphs are indented. Fullfilment the food needs of the community is carried out with a strategy of increasing rice crop production [2]. The highest rice producing country is China, while Indonesia is the world's main importer of rice with 14% of the world's total rice traded [3].

Indonesia is still experiencing a shortage of rice due to the high per capita rice consumption of the Indonesian population [4]. The decline in rice production is due to unfavorable environmental conditions such as strong winds and high rainfall [5]. This can result in rice plants experiencing yield loss due to lodging.Plants that have a falling resistance have a production percentage of 26% higher than plants that do not tolerate lodging resistant [6].

Innovation to produce high-yielding varieties is by developing local rice varieties that are resistant to lodging resistant. This is because local rice has naturally been tested for resistance to various environmental pressures as well as pests and diseases, is tolerant of abiotic stress, and has good rice quality so that it is liked by many consumers in each location of growing and developing [7]. Currently, testing for the development of resistant varieties has reached the F8 lines of upland rice.

The F8 lines of lodging resistant upland rice is the result of a cross between local bangka rice and a lodging resistant variety that was carried out in 2017 and obtained the 1st generation lines (F1). The results of the F2 selection obtained the 56 best lines to be selected in F3 [8]. The F4 selection has obtained resistant lines with a plant height of less than 90 cm [9]. The power test preliminary results in the 6th generation obtained lines that can be used as candidates for new high-yielding varieties are 23A-56-20-07-20 and 23A-56-22-20-05 which are lines that have better damping resistance scores and higher production than other lines [10]. The test lines that has maximum yield power is 23A-56-22-20-05 with a production of 9.5 kg / plot (4.75 tons / ha) and 23A-56-20-07-20 has a production of 6.3 kg/ plot (3.15 tons / ha) higher than other lines that will be used for the selection of the 7th generation rice lines (F7) [11].

Several tests were carried out in determining production results on local rice varieties and lodging resistant, one of which was by going through the adaptation test stage. Adaptation tests are carried out to determine the advantages and interaction of varieties with the environment [12]. Lodging resistant varieties must have high adaptability in subptimal land. The aims to identify and determine the upland rice lines F_8 that is tolerant to high yielding potential.

2. Materials and method

This research was conducted in September 2021- January 2022. The research was carried out in the Rice Field Land of Balunijuk Village, Merawang District, Bangka Regency, Bangka Belitung Islands Province. The tools used in research activities are wood, scissors, hoes, tractors, lawn machines, analytical scales, machetes, earthen forks, drills, rulers, sprayers, meters and stationery. The materials used were 5 rice lines selected in F8 (19I-06-09-23-03, 21B-57-21- 21-23, 23F-04-10-18-18, 23A-56-20-07-20 and 23A-56-22-20-05), 5 comparative varieties used were Danau Gaung, Inpago 8, Inpago 12, Rindang 1 and PBM UBB1.

The research was conducted by experimental methods. The design used is a Randomized Block Design (RBD). The treatment consisted of 5 F8 promising upland rice lines, and 5 comparative varieties. Each level of treatment is divided into 3 groups. Each map is 2 m x 5 m in size consisting of 320 planting holes, with the number of 3 seeds in each planting hole. The samples observed in each map were 10 clumps, bringing the total sample to 300 clumps.The research was conducted through several activities. The activities consist of tillage, planting and embroidery, fertilization, maintenance, harvesting and post-harvest.The adaptation test was carried out by observing 10 plant samples per plant.

Data analysis was carried out in this study on the observed character of the overall treatment using ANOVA with a confidence level of 95%. If the effect is real and has a very real effect, it will be followed by Duncan's Multiple Range Test (DMRT) test at the level of α 0.05.

3. Results and discussion

3.1. Analysis of Characters Observed in the Generative Phase

Adaptation test research using 5 F8 rice lines selected with national varieties as a comparison to obtain lines that have high production yields compared to comparison varieties. The results of the observation of the F8 lines that have been selected have a lodging index with a value of 0% where the lines is categorized as very resistant to lodging resistant. This is evidenced by the state of rice that does not experience reclining during rainfall and high wind speeds.

Rainfall and wind speed data in the study area from August 2021 to January 2022 obtained data from the nearest region, namely Pangkalpinang. The average rainfall during August 2021 to January 2022 is 272.083 mm with 21.66 days/month. The average wind speed in August 2021 to October 2021 was 4.216 with the south, while in November 2021 to January 2022 the wind direction was heading west.

The results of ANOVA showed that there were several characters that had a very significant differenceon all observed rice lines, namely plant height, amount of grain per panicle, harvest age, and flowering age. The leaf length character shows a significant difference on all rice genotypes, while the character of the number of saplings. The further test used is the DMRT test by looking at the genotype or line that is best [13]. This is because the lines that have gone through the test will show superior yield density compared to comparison varieties [14]. The results showed that, rice plants with the Danau Gaung genotype and PBM UBB 1 had high values and were significantly different from other genotypes, while the genotype 23A-56-22-20-05 had a low high value among other genotypes (Table 1).

Table 1. Average Plant Height, Leaf Length, Harvest Age Average Flowering Age and Amount of Grain Per Panicle as well as DMRT test results

Genotypes	Plant Height (cm)	Leaf Length (cm)	Harvest Age (DAP)	Flowering Age (DAP)	Amount of Grain Per Panicle (grain)
19I-06-09-23-03	95.493b	32.673bc	96.000bcd	61.000d	108.733bc
21B-57-21-21-23	96.603b	32.416bc	100.666b	65.666bc	91.033c
23F-04-10-18-18	98.563b	32.416bc	95.000bcd	60.000de	98.766bc
23A-56-20-07-20	95.556b	25.313c	90.666cd	55.666e	74.400c
23A-56-22-20-05	75.496c	27.020c	95.000bcd	60.000de	72.300c
Danau Gaung	130.603a	39.766ab	97.333bc	62.333cd	162.966a
Inpago 12	106.720b	31.006bc	95.000bcd	60.000de	143.433ab
Inpago 8	108.526b	30.506bc	101.666b	66.666b	112.933bc
Rindang 1	106.810b	36.70abc	87.333d	60.000de	118.133bc
PBM UBB 1	127.580a	45.843a	113.000a	76.666a	106.000bc

Note: numbers in the same column followed by the same letter indicate no significant differencebased on a DMRT of α 0.05

All lines show different genotype character values against comparisson varieties. Plant height is influenced by the genetic factors of a cultivar, namely differences in genetic makeup [15]. It is influenced by the non-uniformity of growth of each cultivar that has a morphology and special characteristics [16]. The height of rice plants can be used as a growth benchmark but cannot be used as a determinant of high production yields. Upland rice plant heights of lines 23A-56-22-20-05 to the category of rather short rice plants. This is in line with the provisions of the criteria for the height of the rice plant upland (Rice Standard Evaluation System) which is divided into three categories, namely: rather short (<90 cm), medium (90-125 cm), and tall (>125 cm) [17]. The leaf length of the PBM UBB 1 genotype has a high leaf length value compared to other genotypes except Danau Gaung and Rindang 1. Selection of leaves is carried out with a length of >30 cm or exceeding the length of the panicle, since long leaves can increase yield power [18]. This is because the leaves are suppliers of photosynthetic results that are directly related to rice panicles so that if the lines with leaf lengths >30 cm and erect, they have the potential to be selected.

The flowering age shows that, the PBM UBB 1 genotype has the longest flowering age and differs markedly from other genotypes with a value of 76.66 DAP. Each genotype has a different vegetative growth duration, so sooner or later the flowering time is different [19]. Each plant has different growth characteristics caused by differences in plant genetic traits so that the longer the vegetative growth of plants, the longer the appearance of flowers will so long [20]. The harvest age character shows that, the PBM UBB 1 genotype has the longest harvest life and is significantly different from other genotypes. The genotype with the fastest harvest life is at Rindang 1. Plants will show the maturity of the harvest if the total energy adopted has reached a certain level that varies from each plant [21]. Harvest age can also be influenced by the yield components, namely the number of saplings, the length of panicles and the number of seeds per panicle, if the higher the yield component, the longer the harvest life will be [22]. This is because the large amount of grain per panicle will cause a longer filling and ripening period so that the harvest life in plants is longer. The amount of grain is influenced by the genotype of the plant in the form of the number of saplings, the number of panicles, the length of the panicles, the branches of the primary and secondary panicles, and the weight of 1000 seeds [23].

The high low growth and yield of plants are influenced by two factors, namely internal which include genetic and external traits including environmental factors such as climate, soil and biotic factors [24]. The difference in the number of saplings is influenced by both factors. This is because the different number of saplings of each variety has different gene properties. The formation of the number of panicles is influenced by the number of productive saplings, if the number of productive saplings formed is small then the number of panicles will decrease [25]. The greater the number of broad union saplings, the greater the number of panicles per unit area on the plant system.

This is due to the rate and speed of grain filling, which is influenced by changes in temperature and environment during growth, temperature, and environment during the grain filling period [26]. If, the temperature and intensity of irradiation are low, the process of photosynthesis does not run normally so that the grain filling process does not occur. Empty grain affects rice production yield, the higher the percentage of hollow grain, the lower the rice yield will be. Low weight of pitted seeds per plant is due to the small amount of grain per panicle and the high amount of empty grain per panicle [27]. The weight of 1000 grains has the highest average weight value obtained in the PBM UBB 1 genotype, which is 28.13 grams. The lowest average weight of 1000 grains is 23.00 grams in lines 23A-56-22-20-05. The difference in weight of 1000 grains is caused by the balance between the source and sink so that it affects the grain filling process and affects the weight of the seeds [28].

The genotype tested had the highest yield per plot of 1217.13 grams obtained in the PBM UBB 1 variety. The test lines that has the highest yield per plot is the 21B-57-21-21-23 lines of 1029.85 grams (1.03 kg/plot) followed by lines 19I-06-09-23-03 which is 958.75 grams (0.96 kg/plot). High yield power is supported by the character of short stems, the number of saplings is large with fat and long grain grains, so that it can be used to obtain rice crops that are in accordance with the target of breeders [29]. The high and low yields are influenced by yield components such as the number of productive saplings, the number of seeds per clump, the weight of 1000 grains, and the percentage of grain contents.

3.2. Fe poisoning analysis

The results of observations of Fe poisoning in upland rice plants, namely in lines I9i-06-09-23-03, 21B-57-21-21-23, 23F-04-10-18-18, 23A-56-22-20-05 and comparative varieties namely Danau Gaung, Inpago 12, Rindang 1 and PBM UBB 1, had a poisoning rate of 50-69% with an average scale of 7 from the rice genotype which was categorized as slightly heavy or sensitive which was seen from leaf changes in the entire rice tested, except in lines 23A-56-20-07-20 and Inpago 8 which have different scale levels.

Table 2. Scoring Of Rice Genotype Fe Poisoning

Genotype	Fe Poisoning Scale	Category
19I-06-09-23-03	7	A bit heavy or sensitive
21B-57-21-21-23	7	A bit heavy or sensitive
23F-04-10-18-18	7	A bit heavy or sensitive
23A-56-20-07-20	5	Medium
23A-56-22-20-05	7	A bit heavy or sensitive
Danau Gaung	7	A bit heavy or sensitive
Inpago 12	7	A bit heavy or sensitive
Inpago 8	5	Medium
Rindang 1	7	A bit heavy or sensitive
PBM UBB 1	7	A bit heavy or sensitive

Plants that are tolerant of environmental stress have the ability to adapt morphologically and physiologically [10]. Symptoms are stunted tillering growth and formation, many leaves (almost all leaves) are brown in color or have reddish-brown or yellow-orange spots. If iron is absorbed excessively from plant needs, it will cause plant poisoning. Not all land used is subject to reductions that can cause poisoning for plants. Not all land used is subject to reductions that can cause poisoning for plants.Iron poisoning in rice plants can reduce production by up to 90% where root development is hampered due to inhibition of nutrient uptake from the soil which results in low production [30].The high level of Fe2+ contained in the new opening paddy fields, which was used in this experiment, has affected the growth of all rice varieties grown.

4. Conclusions

Genotypes that were able to adapt in Balunijuk Village rice fields were PBM UBB 1 variety for red rice, Danau Gaung and 21B-57-21-21-23 line for white rice, with a lodging index of 0% for these three genotypes, and a Fe toxicity scale with a value of sensitive. The genotype with the lowest yield was Inpago 8 and line 23F-04-10-18-18. Genotypes with leaf length, number of grain per panicle, number and weight of pithy seeds per plant height increased seed yield/plot.

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