Drought tolerance test of various potential local rice genotypes in Aceh West-South Region at vegetative stages

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Abstract. Aceh has a lot of local rice genotypes that locally cultivated in West- South Region Aceh. The potential of local rice as a source of genes have not been evaluated and identified of drought tolerance. Abiotic stresses such as drought are serious things that affected plant productivity. This study aimed to determine the drought tolerance of several potential local rice genotypes in South-West Region Aceh as parents (P1) in order to become the basic population in creating the new high yielding varieties that were resistant to drought. This study was carried out in Randomized Block Design (RDB) with 3 replications. The observed variables were: Plant height and Number of tiller per clumps at 10, 20, 30 and 40 days after planting, root length, number of roots, wet and dry weight of roots at days 40 after planting. The study found that the treatment of drought stress significantly affect the plant height and number of tillers, best result was found at rangan lango genotype. Based on the research results, it can be concluded that there are 3 genotypes of local West-South Aceh region that are potentially resistant to drought stress in the vegetative Stage, namely the Lango genotype, Arias genotype and Pade Manggeng genotype.

1. Introduction

Aceh has a lot of rice genotypes that locally cultivated especially in West-South Region Aceh. West-South region of Aceh are one of areas that rich of local rice diversity, and need to be identified and utilized as a source of genes in the assembly of new superior varieties to support food security and sustainable agriculture. [1] reported that Aceh local rice varieties are very diverse.

In plant breeding programs, local rice as a source of genes needs to be evaluated and identified tolerance levels to abiotic stress to obtain new potential genes that are resistant to abiotic stress and have high yields. One of the main problem of rice production are limited water. Drought stress are one of abiotic stresses that can lead to decrease of the yield and quality of rice [2; 3].

Furthermore, rice cultivation in various region of Indonesia having deficiency of sufficient irrigation facilities which leads to a decrease in rice crop production [4]. [1] said that abiotic stresses have negatif effect to survival, biomass production, and crop yield. Drought stress is a serious threat to plant productivity.

Long lasting drought stress could increase cuticle thickness and disturb plant metabolism. The thickness of cuticle can make the cuticle permeable less to water. Thus condition causes delays in growth of stems and leaves especially in vegetative stage [5].
Through the result of research on drought tolerance test on several Aceh local rice genotypes, it will be obtained information that can be useful in breeding programs in order to increase rice production especially in Aceh. This research aims to determine the drought tolerance of several potential genotypes of local rice in West-South Region Aceh as parents (P1) in order to become the basic population in creating the new high yielding varieties that were resistant to drought.

2. Materials and Methods
This study was conducted at experimental farm in Agriculture faculty Teuku umar university form October to December 2019. The research materials used was seeds of West-south Aceh local rice genotypes which had potential to drought tolerance (Sigupai, Sirende, Pade Manggend, Pade Geudok, Sambai, Tinggong, Sikleng, Arias, Sijane, Rangan Lango, Borayek, Rasi Singki, Ramos and Inpago 5 as a control), soil, Fertilizer (Urea, SP-36, KCL), and plant’s pot. , This study was carried out in Randomized Block Design (RDB) with 3 replications. The observed variables were: Plant height and Number of tiller per clumps at 10, 20, 30 and 40 days after planting, root length, number of roots, wet and dry weight of roots at days 40 after planting

2.1. Seed treatment and planting
The seeds used are soaked in clean water for 24 hours, seeds are germinated for 48 hours by wrapping them with a damp cloth. After germination, the seeds are transferred to the prepared nursery container. The planting medium used in this study was alluvial soil and manure with a ratio of (2:1) then put in a pot size of 8 kg/pot and given water, then stirred by hand until evenly distributed.

Planting is done when the seedlings are 12 days after sowing (HSS) as much as 1 (one) seed per pot. The fertilizers given were Urea 300 kg ha-1 (1.2 g pot-1), SP-36 200 kg ha-1 (0.8 g pot-1) and KCl 150 kg ha-1 (0.6 g pot-1).

2.2. Drought stress treatment
Drought stress applied three weeks after planting, at the age 7 DAP, then regularly irrigated for a week to see the level of tolerance. As a control carried out at optimum conditions where water were available in sufficient quantities.

3. Result and Discussion
3.1. Plant height
The results showed that several local rice genotypes from South West Aceh had a very significant effect on plant height at 40 DAP. Significant effect on plant height at 30 DAP, but no significant effect on plant height at 10 and 20 DAP. The average plant height of several local rice genotypes at the age of 10, 20, 30 and 40 DAP after the LSD0.05 Test Showed in Table 1.

Based on LSD test showed that the highest plant height was found at Rangan Lango Genotypes (62.83 cm) at 10 and 20 DAP, although statistically did not show a significant difference. The highest plant height also found in Rangan lango Genotypes at 30 (91.50 cm) DAP but had not significant difference with sigupai (85.33 cm), rasi singki (82.83 cm), pinang geudok (81.83 cm), Sijane (81.67 cm) and Sambai Genotype (76.67cm), but had significant difference with others genotypes. Besides, the highest plant height at 40 DAP also showed in Rangan Lango (104.33 cm) did not show significant difference with Rasi Singki (100.83 cm) and Sigupai (96.83 cm), but had significant difference with other genotypes.
Table 1. Average plant height at 10,20,30,40 DAP on several rice local genotypes from West-South Aceh Region

| Genotypes            | Plant Height (cm) |
|----------------------|-------------------|
|                      | 10 DAP | 20 DAP | 30 DAP | 40 DAP |
| Sigupai              | 54.67  | 72.00  | 85.33b | 96.83bc|
| Sirende              | 41.83  | 56.00  | 65.00a | 73.00a |
| Pade Manggeng        | 47.83  | 68.17  | 76.50a | 85.17b |
| Pinang Geudok        | 46.00  | 61.67  | 81.83b | 95.17b |
| Sambai               | 45.50  | 61.67  | 76.67ab| 85.67b |
| Tinggong             | 51.50  | 61.67  | 70.33a | 76.83a |
| Sikleng              | 50.00  | 59.50  | 69.00a | 78.33a |
| Arias                | 55.33  | 65.00  | 76.33a | 80.50a |
| Sijane               | 61.33  | 69.17  | 81.67b | 86.67b |
| Rangan Lango         | 62.83  | 75.67  | 91.50b | 104.33c|
| Bo Rayek             | 60.00  | 70.33  | 75.17a | 81.50ab|
| Rasi Singki          | 56.17  | 67.83  | 82.83b | 100.83c|
| Ramos                | 50.67  | 62.00  | 71.50a | 74.83a |
| Inpago 5             | 43.33  | 54.17  | 62.67a | 71.67a |

LSD<sub>0.05</sub> - 14.50 12.70

Note: The line number followed by the same letter is not significantly different based on the LSD test at the 5% level (LSD<sub>0.05</sub>)

The results showed that, from several genotypes tested, plant height growth was thought to be influenced by genetic traits, where the genotypes had different growth characters. Treated drought stress also affects plant growth, where plants need sufficient water in the process of growth and development. Lack of water in plants can affect vegetative growth [6], in addition, lack of water in plants will affect all metabolic processes in plants and result in disruption of plant growth [6]. Elongation of the crown or plant height is one of the avoidance mechanisms in plants to survive in drought stress, but crown length is not used in the form of being the main selection [7]. High and low plant growth has no effect on production, because high plant growth does not guarantee the greater yields [8]. Plant height is one of the components that affect plant fall. Along with the absorption of N nutrients by plants, the higher the performance of a plant, the higher the the possibility of its fall [9].

3.2. Number of tillers per clump

The results showed that several local rice genotypes from South West Aceh had a very significant effect on the number of tillers in the 30 and 40 DAP groups. Significantly affected the number of tillers aged 20 DAP, but had no effect on the number of tillers at 10 DAP. The average number of tillers of several local rice genotypes at the age of 10, 20, 30 and 40 DAP after the LSD<sub>0.05</sub> test showed in Table 2.

The highest number of tillers at 10 DAP showed on Pade Manggeng Genotype (2.50) but did not show significant different from other genotypes. Meanwhile, the highest number of tillers at 20 DAP showed on Borayek genotype (4.67 tillers), Pade manggeng (4.33 tillers), Arias (4.33 tillers), Sirende (4.17 tillers), and did not show significant difference with Sijane (3.50 tillers) but had significantly different to other genotypes. The highest number of tillers at 30 DAP showed on Sirende (7.00) Arias (7.00), Pade manggeng (5.17) Borayek (5.00), and did not show significant difference with Tinggong (4.33) and Sijane (4.33). Besides, the highest number of tillers at 40 DAP was found on Arias (8.50) and did not show significant difference with Rasi singki (8.00), but had significant difference with other genotypes.
Table 2. Average number of tillers at 10,20,30,40 DAP on several rice local genotypes from West-South Aceh Region

| Genotypes      | Number of Tillers |
|----------------|-------------------|
|                | 10 DAP | 20 DAP | 30 DAP | 40 DAP |
| Sigupai        | 1,67    | 2,33 a | 2,83 a | 3,67 a |
| Sirende        | 2,17    | 4,17 b | 7,00 b | 8,00 bc |
| Pade Manggeng  | 2,50    | 4,33 b | 5,17 b | 5,67 b |
| Pinang Geudok  | 1,67    | 2,17 a | 2,17 a | 2,50 a |
| Sambai         | 1,17    | 1,67 a | 2,33 a | 2,67 a |
| Tinggong       | 1,83    | 3,17 a | 4,33 ab| 5,67 b |
| Sikleng        | 1,33    | 2,00 a | 3,17 a | 3,67 a |
| Arias          | 2,17    | 4,33 b | 7,00 b | 8,50 c |
| Sijane         | 2,00    | 3,50 ab| 4,33 ab| 4,83 ab|
| Rangan Lango   | 1,67    | 2,67 a | 2,67 a | 3,17 a |
| Bo Rayek       | 1,83    | 4,67 b | 5,00 b | 6,33 b |
| Rasi Singki    | 1,50    | 2,00 a | 2,50 a | 2,67 a |
| Ramos          | 1,33    | 1,67 a | 2,33 a | 3,83 a |
| Inpago 5       | 2,17    | 2,67 a | 4,17 a | 5,50 b |

LSD 0.05 - 2,13 2,40 2,74

Note: The line number followed by the same letter is not significantly different based on the LSD test at the 5% level (LSD 0.05 )

The difference in number of tillers is thought to be due to genetic factors, this is in line with the opinion of [10] which stated that the results of genetic analysis showed that vertical-horizontal type of tiller growth was controlled by a recessive gene la-1, furthermore The dwt1 gene controls the uniformity of rice tillers, these genes can be heredity [11].

Besides from genetics, growth environmental conditions also affect plant growth. Drought during vegetative phase can inhibit the growth of the number of plant tillers, this is in accordance with the opinion of [6], that water plays an important role in the translocation of nutrients from the roots to all parts of the plant, so that lack of water results in inhibition of plant development. The result showed that Arias and Rasi Singki Genotype had a potential resistant to drought. The results showed that genotypes Arias and Rasi Singki were more resistant to stress, which was characterized by a higher number of tillers compared to other genotypes.

3.3. Root length, number of roots, root wet weight, and root dry weight

The study found that several local rice genotypes from West-South Aceh region not too statistically different to root length, number of roots, root wet weight, and root dry weight (Table 3). However, the root length of the Sigupai genotype tends to be longer than other genotypes, and the highest number of roots, root wet weight, and root dry weight tends to be found in Pade manggeng genotype.
Table 3. Average of root length, number of roots, root wet weight, and root dry weight on several rice local genotypes from West-South Aceh Region

| Genotype        | Root System | Root Length | Number of Roots | Root Wet Weight | Root Dry Weight |
|-----------------|-------------|-------------|-----------------|----------------|----------------|
| Sigupai         |             | 46.67       | 93.33           | 12.19          | 7.24           |
| Sirende         |             | 35.33       | 93.33           | 7.77           | 3.41           |
| Pade Manggeng   |             | 40.33       | 156.67          | 19.22          | 12.69          |
| Pinang Geudok   |             | 45.67       | 38.67           | 2.67           | 1.18           |
| Sambai          |             | 38.00       | 26.67           | 1.99           | 0.62           |
| Tinggong        |             | 34.67       | 97.33           | 14.44          | 10.07          |
| Sikleng         |             | 37.33       | 92.33           | 6.21           | 1.19           |
| Arias           |             | 42.00       | 121.33          | 14.77          | 9.59           |
| Sijane          |             | 38.00       | 136.67          | 7.69           | 4.11           |
| Rangan Lango    |             | 42.67       | 88.33           | 9.22           | 5.09           |
| Bo Rayek        |             | 36.67       | 78.67           | 5.06           | 2.85           |
| Rasi Singki     |             | 42.33       | 96.00           | 6.42           | 1.99           |
| Ramos           |             | 35.33       | 56.67           | 2.31           | 0.30           |
| Inpago 5        |             | 35.33       | 58.00           | 2.52           | 0.87           |
| LSD             |             | -           | -               | -              | -              |

Note: The line number followed by the same letter is not significantly different based on the LSD test at the 5% level (LSD_{0.05})

Figure 1. Root Length

Figure 2. Number of root
4. Conclusion
Based on the research results, it can be concluded that there are 3 genotypes of local West-South Aceh region that are potentially resistant to drought stress in the vegetative stage, namely the Lango genotype, Arias genotype and Pade Manggeng genotype.

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