The Potential Yield of Some Superior Breeding Lines of Upland Rice of Southeast Sulawesi Indonesia

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Demand for rice as a source of food in Indonesia continues to increase in line with the growth of population, while the capacity to produce paddy rice increasingly limited. One of the efforts is to develop upland rice that tolerant to drought and high production potential the hybridization. The study was conducted at the experimental field of the Faculty of Agriculture Halu Oleo University. Production characters were observed and assessments are tillers number, a number of productive tillers, panicle length, number of filled grain/panicle and weight 1,000 seed grains. The results showed that there is eight promising progeny of upland rice that are tolerant to drought and high potential yield.

Key words*:* Upland rice, Progeny, Hybridization, Drought, Mineral stress.

Rice has become dominant and important staple food in Indonesia [1]. The rice demand continues to increase in line with population growth, while the production rice capacity to increase is very limited. An effort to increase rice production continuously is facing severe challenges, due to the high rate of population growth at one side and at the other side; there is a reduction in the productive wetland area. So that role of upland rice to support rice production and strengthen food security is needed more increasing.

Indonesia has more than 50 million hectares of dryland but that are suitable for development food crops only reached 35 million hectares [2], including marginal dry land for developing upland rice. As a result, the potential upland rice production that can be achieved is still low. The low productivity of upland rice is due to the severity constraints on upland rice cultivation, as compared with the constraints on rice production on the wetland. These constraints partly because upland rice grown on the acid soils, which have low nutrients, especially N, P, K, Ca, Mg and Mo [3-5]. Soil acidity has become a limiting factor for growth and increase rice production on dry land. In the acid soil, the toxicity of aluminum is a major factor constraining crop performance [3,6-9], and low availability of phosphor will be a problem in upland rice production [10-12]. Water holding capacity on the dry land also very low and soil easily eroded. Aluminum (Al) affect primarily on the root system, causing inhibition the elongation root. As a result, the fertilizer effectiveness and water absorption will reduce [13]. The high Al also can inhibit the transport of nutrients from the roots to the top of the plant [13-14]. Increased concentrations of Al also reduce the absorption of micronutrients [15] in rice plants [16]. Al toxicity occurred since the beginning of Al induces instability of cellular membranes [17-19] and toxic the metabolic activity [20].

One of the efforts to increase the upland rice production in acid soil is to create the tolerant cultivars through crossing [21]. Upland rice has a

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great diversity against Al and the tolerant cultivar only showed a small decrease in growth[22]. Rice plants have the genetic variability tolerant to Al toxicity and have the ability to use the different nutrient potassium[23].

Each type of plant and each different growth phases has a different water needs. Water has an important role in the transportation and translocation of nutrients[24], opening and closing of stomata[25]. According to a response of plants to drought stress is differentiated to tolerant and sensitive[26]. Tolerant plants are able to accumulate large amounts of dissolved compounds, whereas sensitive crops not able to accumulate the dissolved compounds. Genetic improvement through plant breeding is an effort to overcome some constraint on the upland rice production. The development of upland rice lines that tolerant to abiotic and biotic stress is a cheaper and easier approach to using at the farm level.

MATERIALAND METHODS

Preparation of sample

Research was conducted in Agriculture Farm Department of Agrotechnology Faculty of Agriculture Universitas Halu Oleo Kendari. Soil analysis conducted in the soil laboratory Faculty of Agriculture Universitas Halu Oleo.

Field arrangement

The research was arranged in randomized completely block design consist of eight progeny i.e., V_1 (GS12-2), V_2(GS44-2), V_3(GS16-2), V_4(GS11-2), V_5 (GS44-1), V_6 (GS16-1), V_7 (GS12-1) and V_8 (GS11-1). Production characters were observed and assessments (1) number of tillers at harvest, (2) number of productive tillers, (3) panicle length (cm), (4) number of filled grain /panicle and weight of 1000 grains of seeds.

RESULTS AND DISCUSSIONS

Number of tillers

Based on number tillers character appears that the progeny V_2 (GS44-2) has the highest number of tillers. Followed by the progeny V_5 (GS44-1) and V_4 (GS11-2). While the progeny V_3 (GS16-2) has the lowest number of tillers (Table 1).

Number of grain

Base on the number of grain on panicle appears that the progeny V_1 (GS12-2) has the highest number of grain, followed by progeny V_3 (GS16-2) and V_4 (GS11-2). While the progeny V_5 (GS44-1) has the lowest number of grain (Figure 1). Based on the character of number of grain, the promising progeny are V_1 (GS12-2) has the highest number of grain, followed by progeny V_3 (GS16-2) and V_4 (GS11-2).

Potential Production

In the character of grain production appears that the progeny V_2 (GS44-2) has the highest grain production, followed by progeny V_1 (GS12-2) and V_5 (GS44-1). While the progeny V_8 (GS11-1) has the lowest grain production (Figure 2). Based on the grain production, the promising progeny is at V_2 (GS44-2), V1 (GS12-2) and V_5 (GS44-1).

Weight of 1000 Grain (WTG)

Based on the weight of thousand grain (WTG) appears that the progeny V_5 (GS44-1) has the highest of WTG, followed by the progeny V_6

Table 1. Different productive characteristic of upland rice progeny

Progeny	Number of tiller (tiller clump $^{-1}$)	Number of grain (seed panicle $^{-1}$)	Production (g clump^{-1})	Weght of 1.000 Grains (gram)
V_1 (GS12-2)	15.1	251.93	57.30	24.16
V_2 (GS44-2)	25.2	178.67	61.61	28.62
V_3 (GS16-2)	12.6	230.00	45.83	26.70
V_4 (GS11-2)	20.1	210.13	48.47	26.49
V_5 (GS44-1)	25.0	164.93	55.89	30.79
V_6 (GS16-1)	14.5	199.40	41.32	27.15
V_7 (GS12-1)	15.1	191.67	38.34	25.67
V_8 (GS11-1)	17.4	170.27	35.92	25.14

(GS16-1) and V_2 (GS44-2). While the progeny V_1 (GS12-2) has the lowest WTG (Figure 3). Based on the WTG characters, the promising progeny is at V_5 (GS44-1) has the highest of WTG, followed by the progeny V_6 (GS16-1) and V_2 (GS44-2).

Based on the productive character that includes the number of tillers, number of grains, grain production and grain weight; it appears that there is a significant differences character between progeny. Therefore, the development and plant breeding programmed must be adjusted to the main objective of the cross itself. When the crossing aims are to obtain progeny that have the highest grains per panicle, the most promising cultivars is the progeny V_1 (GS12-2) that has reached 251.93 grains per panicle. If the purpose of crossbreeding is to obtain the plants with the highest production potential, the most promising progeny is crosses V_2 (GS44-2) with 61.61 grams per panicle that equivalent to 12 ton ha^{-1}. However, if the goal of crossbreeding is to choose the progeny that has the big size of rice grain, the progeny V_5 (GS44-1) has the highest weight of grains.

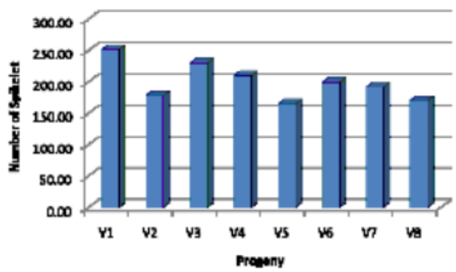

Fig. 1. Effect of different progeny to the number of grain

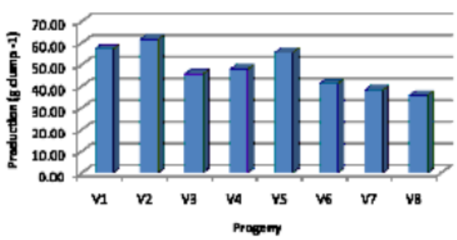

Fig. 2. Effect of different progeny to the rice production

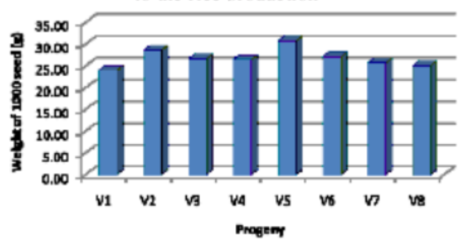

Fig. 3. Effect of different progeny to the weight of thousand grain

CONCLUSION

Based on the research concluded that there are eight promising progeny of upland rice that are tolerant to drought and has a high potential yield, included progeny V_1 (GS12-2), V_2 (GS44-2), V_3 (GS16-2), V_4 (GS11-2), V_5 (GS44-1), V_6 (GS16-1), V_7 (GS12-1) and V_8 (GS11-1).

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