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Growth performance of two superior line of local upland rice (*Oryza sativa* L.) from SE Sulawesi on the low light intensity

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Abstract. Rice (*Oryza sativa* L.) is the main staple food in Indonesia and the demand increase every year. Many programs have been done to increase rice production. One of the promising programs to increase rice production is development upland rice that tolerant to shade. The study aimed was to characterize the new upland rice lines on shade condition. The research conducted at Field Laboratory, Faculty of Agriculture, Halu Oleo University. The research was design in a split plot design with four replications. The main factor was the level of shade that consisted of four levels i.e. $N_0 = 0\%$, $N_1 = 25-50\%$, $N_2 = 50-75\%$ and $N_3 = 75-100\%$. The second factor was the subplot upland rice lines as subplot which consists of two lines, namely lines GS12-1 and GS16-1. The data were analyzed using ANOVA followed by Duncan Multiple Range Test (DMRT). The results showed that shade could increase plant height and leaf area. The shade treatment may decrease the number of leaves and number of tiller. While on the time flowering, the shade tends to prolong the time of flower.

1. Introduction

Rice in Indonesia is the main staple food [1-3], and the demand increasing every year [4-6]. Indonesian governments to reach rice self-sufficiency [7-8], have policies to boost rice production and decreasing rice consumption [9-12]. The potential program to increase rice production is by developing upland to fulfill the national rice needs [4,7,13].

There are many programs in increasing rice production, included increase seed viability [3,14-15] and breeding program [8,16-17]. Another program to decrease level rice consumption while promoting local food [7,18]. The promising programs are increasing upland rice production as alternative system cultivation [4]. Upland rice can be developed in intercropping or patterns [4,19]. Upland rice could be planted under the stand of estate crop or forestry crops [20-22]. The development of upland rice under the stand of other plants will face to the limited solar radiation. It will affect on the growth and production [23-25]. The upland rice productivity under low radiation can be improved by developing rice tolerant through breeding. The study aimed was to characterize the new upland rice lines on shade condition.

2. Materials and Methods

The research conducted at Field Laboratory, Faculty of Agriculture, Halu Oleo University Kendari. The research designed in a split plot with three replications. The first factor as main plot was the shade



level consisting four levels i.e. $N_0 = 0\%$, $N_1 = 25-50\%$, $N_2 = 50-75\%$ and $N_3 = 75-100\%$. The second factor as the subplot was different upland rice lines. Namely lines GS12-1 (A_1) and GS16-1 (A_2). The data were analyzed using ANOVA. The treatment differences were performed using Duncan Multiple Range Test (DMRT).

3. Results and Discussion

3.1. Results

3.1.1. Plant height and number of leaves. The results showed that the shade level have significant effect on the plant height and leaves number. In general, plant height increases with the higher shade levels. But in the higher level of shade, the plant height tends to decrease. While for the parameter number of leaves, there is no specific pattern of leaf numbers due to different shade was obtained (Table 1)

Table 1. The shade effect on plant height and number leaves of upland rice on 77 days after planting

Shade level	Plant height (cm)		Leaf number	
	A_1 (GS121)	A_2 (GS161)	A_1 (GS121)	A_2 (GS161)
N_0 (0-25 %)	59.30 s B	68.00 q a	21.00 p A	22.00 q a
N_1 (25-50 %)	80.93 p A	70.40 p b	16.00 q A	15.67 r a
N_2 (50-75 %)	66.83 r A	69.47 r b	13.67 r B	30.33 p a
N_3 (75-100 %)	71.33 q A	63.60 r b	12.33 r B	21.33 q a

Note : Number followed by the same letter in the same column (p,q,r) and line (a,b) are not significantly different by DMRT

3.1.2. Leaf area and number of tillers. The results of variance analysis showed that shade significantly affected leaf area and the number of tillers. In general, leaf area increases with increasing shade levels. But in the higher level of shade, the leaf area tends to decrease. The pattern of leaf area follows the pattern of plant height. In the number of tillers parameters, there is no specific pattern of the number of tillers due to shade (Table 2).

Table 2. Effect of shade on plant height and number of leaves of upland rice on 77 day after planting

Shade level	Leaf area (cm ²)		Number of tiller	
	A_1 (GS121)	A_2 (GS161)	A_1 (GS121)	A_2 (GS161)
N_0 (0-25 %)	574.11 p A	764.37 p a	5.00 p a	4.67 q a
N_1 (25-50 %)	741.63 p A	562.72 q a	2.67 q a	3.00 q a
N_2 (50-75 %)	385.46 p B	924.32p a	3.33 q b	8.00 p a
N_3 (75-100 %)	440.56 p B	797.53 p a	2.67 r a	3.00 q a

Note : Number followed by the same letter in the same column (p,q,r) and line (a,b) are not significantly different by DMRT

3.1.3. *Time of flowering.* It showed that the shade level has significantly affected the flowering time. In general, the higher the shade level, the longer it reaches the flowering time (Table 3).

Table 3. Effect of shade on time flowering of upland rice

Shade Level	Variety		DMRT 0.05	
	A ₁ (GS121)	A ₂ (GS161)	N to A	A to N
N ₀ (0-25 %)	90.22 q B	94.67 pq a	2=2.974	2=3.923
N ₁ (25-50 %)	89.67 q B	95.44 p a		3=4.079
N ₂ (50-75 %)	90.22 q B	91.56 r a		4=4.176
N ₃ (75-100 %)	99.00 p A	94.00 q b		

Note : Number followed by the same letter in the same column (p, q, r) and line (a, b) are not significantly different by DMRT

3.2. Discussion

In general, it appears that shade has effects on vegetative growth of two types of cultivars tested. In the parameters of plant height and leaf area, it generally increases with the increasing of shade. But at a higher shade level, there was no increase in these two parameters. While in the number of leaf parameters and a number of tillers, generally there was a decrease with the higher shade level, but there is no specific pattern on the leaf number and tillers numbers due to the shade levels. In the flowering time parameter, generally, the flowering time is slower at a higher shade level.

4. Conclusions

It concluded that the shade level could increase plant height and wide leaves. The shade treatment may decrease the leaf number and the tiller number. While on the time of flowering, the shade tends to prolong the time of flower.

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