The Vegetative Performance of Two Local Upland Rice Cultivar Under Different Shading of Teak Planting

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Abstract : Abstract: The aim is to analyses the shading effect on the vegetative growth of rice cultivar under the teak stands. This research conducted in an experimental farm, the Faculty of Agriculture, University of Halu Oleo. The research designed in a split-plot design. The main plot was the different levels shade, and the second factor was different of cultivars. The main plot is the difference of shade under teak stands as follows: n_1= 60%-80% shade level; n_2= 40%-60% shade level; n_3= 20%-40% shade level and n4 = 10%-20% shade level. While in subplot is the difference of upland rice cultivar i.e., (v_1) = *Labandiri* and (v_2) = *Jangkobembe.* The research revealed that the shading level has a significant effect on the plant height, leaf number and leaf area of Labandiri cultivar. While on the *Jangkobembe* cultivar, the different shading level only has a significant effect on leaf number parameter. The *Jangkobembe* has the cultivar that could be developed as tolerant cultivar for rice planting under the teak stand.

Index Terms—upland rice, teak plant, shade level, low irradiation, agroforestry.

1 INTRODUCTION

Rice is still a dominant staple food as a source of carbohydrates in Indonesia [1],[2] and rice demand tends to increase every year [3],[4]. There are various continual attempts to increase rice production and achieve conditions of food security. The main program to increase rice production included, improvement seed quality [5],[6], development new rice variety [7],[8] through gamma irradiance [9],[10] and hybridization [11], and also expanding planting areas. Improvement of the cultivation systems and the application of the appropriate technology are also to increase rice production.

Other efforts also include the development of non-rice food sources to decrease level of rice consumption [12]. Although multi attempts have been made to increase rice production, but the grain yield stagnation has been observed [13],[14]. The development of upland rice is one of the promise options. However, the land availability for expanding planting rice is limited [15].

The available choice using is planted in the sub-optimal lands such as land under teak plant stands through intercropping systems in agroforestry system and using rice as an inserted plant on forestry plants [16],[17],[18],[19]. However, some report planting crops under the stand of tree crops will experience the limited solar radiation and could negatively impact on rice growth and production [20],[21],[22],[23]. Therefore, the success of rice-teak intercropping highly depended on the availability of rice cultivars that are tolerant to low light intensity and compatible with teak root exudates that could inhibit rice growth. The study's aim is to analyses the effect of different shading level on vegetative rice growth under teak stands.

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2. MATERIAL AND METHODS

The research was conducted in an experimental garden Faculty of Agriculture, University of Halu Oleo. The research arranged in a split-plot design. The different level shading under the teak plant to rice canopy placed as the main plot and the difference of cultivars placed at subplots. The different level shade treatment are : n_1= 60%-80% of shade level; n_2= 40%-60% of shade level; n_3= 20%-40% of shade level, and n_4 = 10%-20% of shade level. The different type cultivar treatment are : v_1 = *Labandiri* and v_2 = *Jangkobembe*.

The parameters are examined included plant height, leaf number, and leaf area. The analyses data using ANOVA (analyses of variance). Furter test the different mean between treatment using Least Significant Difference (LSD)

3. RESULT AND DISCUSSION

3.1 Results

3.1. 1. Plant Height

The results indicated that the different level of shading has a significant effect on plant height. The higher the shading level, the higher the plant height. The increased level of teak shade could increase plant height (Table 1). The results also indicated that each cultivar gives different responses to the varying levels of shade. The increase in plant height due to the

shading effect of teak occurred in *Labandiri* Cultivar. In the *Labandiri* cultivar, plant height increases significantly due to increases in shade level. While in *Jangkobembe* cultivars, variations in shade levels did not cause significant differences in plant height.

Table 1. Effect of teak shading level on the upland rice plant height

Shade Level	Plant Height (cm)		LSD 0.05
	v_1 (*Labandiri* Cultivar)	v_2 (*Jangkobembe* Cultivar)	
n_1 (60-80%)	82.92 a p	56.52 b pq	7.04
n_2 (40-60%)	53.97 a r	53.95 a pq	
n_3 (20-40%)	48.93 a s	47.77 a q	
n_4 (10-20%)	64.68 a q	57.38 b p	

Remarks : The number at the same row followed by the same index (a,b) and in the same column followed by the same index (p,q,r,s) are not significantly different at LSD Test.

3.1.2. Leaf Number

The results indicated that the different level of shading has a significant effect on leaf number. The increase in the shading level could increase the leaf's number (Table 2). The increase in leaves number due to the shading level of teak occurred in all cultivars tested.

Table 2. Effect of teak shading level on the upland rice leaf numbers

Shade Level	Leaf Numbers		LSD 0.05
	v_1 (*Labandiri* Cultivar)	v_2 (*Jangkobembe* Cultivar)	
n_1 (60-80%)	6.70 a p	6.49 a q	7.04
n_2 (40-60%)	5.30 a r	5.10 a r	
n_3 (20-40%)	5.26 a r	4. 83 b r	
n_4 (10-20%)	5.71 b q	7.00 a p	

Remarks : The number at the same row followed by the same index (a,b) and in the same column followed by the same index (p,q,r,s) are not significantly different at LSD Test.

3.1.3. Leaf Area

The results also indicated that the different level of shading has a significant effect on leaf area. The increase of the shading level of the teak could increase leaf area (Table 3). The leaf area increase due to the shading effect of teak only occurred in *Labandiri* Cultivar. The results indicated that each cultivar gives different responses due to varying levels of shade. In the *Labandiri* cultivar, leaf area increased significantly due to shade differences. While in *Jangkobembe* cultivars, variations in shade levels did not cause significant differences in leaf area.

Table 3. Effect of teak shading level on the upland rice leaf area

Shade Level	Leaf Area (cm^2)		LSD 0.05
	v_1 (*Labandiri* Cultivar)	v_2 (*Jangkobembe* Cultivar)	
n_1 (60-80%)	62.13 a p	35.17 b p	7.25
n_2 (40-60%)	44.06 a q	27.78 b q	
n_3 (20-40%)	38.50 a r	31.93 b p	
n_4 (10-20%)	42.29 a q	33.11 b pq	

Remarks : The number at the same row followed by the same index (a,b) and in the same column followed by the same index (p,q,r,s) are not significantly different at LSD Test.

3.2. Discussion

The results indicated that shade treatment have significant effects on the vegetative growth of rice cultivar that planted under the teak stand. In the *Labandiri* cultivar, the shading treatment have significant effect on the plant height, leaf number and leaf area. While on the *Jangkobembe* cultivar, the different shading level have significant effect only on the leaf number parameter. There is different response of cultivar to the shade level. The higher shading level tends to increase the plant height, leaf number, and leaf area. Low light irradiance will decrease grain yield and quality in rice [14],[15]. An increase in vegetative growth is one of the plant mechanisms in adaptation to the changing light [24]. Base on the result of the vegetative character, the Jankobembe cultivar has more tolerant to low radiation or high level of shading compare to the *Labandiri* cultivar. The *Jangkobembe* cultivar has the candidate of cultivar that could be develop as tolerant cultivar for rice planting under the teak stand.

4 Conclusion

It concluded that the level of shade has a significant effect on the vegetative growth in the parameter, plant height, leaf number, and leaf area of *Labandiri* Cultivar. While on the *Jangkobembe* cultivar, the shading level only has a significant effect on leaf number parameter. The Jankobembe cultivar has more tolerant to low radiation, or high level of shading compare to the *Labandiri* cultivar.

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