The Effect of *Azotobacter* and *Azospirrilum* Application on Nitrogen, Chlorophyll and Anthocyanine Content of Upland Red Rice Cultivar

Muhidin[1], Elkawakib Syam'un[2], Kaimuddin[2], Yunus Musa[2], Gusti Ray Sadimantara[1], Sitti Leomo[1], Dewi Nurhayati Yusuf[1], Tresjia Corina Rakian[1]

[1]*Department of Agrotechnology, Faculty of Agriculture, Halu Oleo University, Kendari, Southeast Sulawesi 93212 Indonesia*
[2]*Department of Agronomy, Faculty of Agriculture, Hasanuddin University, Makassar, South Sulawesi, 90245 Indonesia*

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Abstract: Upland red rice contains anthocyanine that can act as antioxidants. This study aims to analyze the effect of bacterial fixator on nitrogen, chlorophyl and anthocyanine content in upland rice. The results showed that the application of bacterial fixator increased the amount of nitrogen, chlorophyll and anthocyanine content in upland red rice plants.

1 INTRODUCTION

Rice is a very important food and its needs tend to increase along with an increase in human population (Muhidin, 2015). Increased production of red rice always associated with an increase in national rice production (Suliartini *et al.*, 2018). Various programs have been introduced to maintain the sustainability of rice plants, for example through plant breeding programs (Kadidae *et al.*, 2017; Suliartini *et al.*, 2018; Sadimantara *et al.*, 2018a, 2018b, 2018c), alternative farming systems (Muhidin 2018 *et al.*, 2013; 2018a, 2018b) and reduce the amount of rice consumption in the community (Muhidin *et al.*, 2016). One alternative to increase rice production is through the development of upland rice (Sutariati *et al.*, 2017; 2018a, 2018b), but until now its production capacity is still low.

The low productivity of upland rice is caused by its cultivation which is relatively more difficult when compared to rice cultivation. This obstacle is partly due to the growth medium of upland rice which is generally planted in acidic soils (Lubis *et al.*, 2008), while the ability of farmers to apply fertilizer is very limited. At present, fertilization using inorganic fertilizers is the main choice, because the effects of its use are very quickly seen. However, the use of inorganic fertilizers in large quantities and continuously can cause a decrease in soil fertility (Havlin et al., 2005). Another option for safer fertilizer is to use organic fertilizer. Non-symbiotic biological fertilizer application using *Azotobacter* sp. and *Azospirillum* sp. as Nitrogen fixers can reduce the use of inorganic fertilizers and prevent the decline of soil organic matter and reduce pollution (Syaiful *et al.*, 2013; Nurmas *et al*., 2018a, 2018b).

2 MATERIAL AND METHOD

This research was carried out in a split plot design. The main plot was a different dose of bacterial fixator, consisting of 3 levels: (b_0) = without bacterial fixator, (b_1) = Azotobacter 2.5 L ha^{-1} + Azospirillum 2.5 L ha^{-1} and (b_2) = Azotobacter 5.0 L ha^{-1} + Azospirillum 5.0 L ha^{-1}. Whereas in subplots were different types of upland red rice: (V_1) = La Bandiri, (V_2) = Jangkobembe, (V_3) = Ranggohitam and (V_4) = Paedara.

3 RESULT AND DISCUSSION

3.1 The Bacterial Effect on Nitrogen Content

The results showed that the application of bacterial fixator could increase the nitrogen content in plant tissues (Table 1).

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Table 1: Effect of bacterial fixator on nitrogen content

	Nitrogen content in plant tissue (mg/100g)				
Bacterial Treatment	v_1	v_2	v_3	v_4	Average
b_0	2.92	2.67	3.04	2.82	2.86
b_1	3.12	2.62	3.05	2.77	2.89
b_2	2.95	2.76	3.05	2.83	2.90
Average	3.00	2.68	3.05	2.81	2.88

Remarks :
v_1 = Labandiri Cultivar
v_2 = Jangkobembe Cultivar
v_3 = Ranggohitam Cultivar
v_4 = Paedara Cultivar
b_0 = Without bacterial fixator
b_1 = *Azotobacter* 2.5 L ha^{-1} + *Azospirillum* 2.5 L ha^{-1}
b_2 = *Azotobacter* 5.0 L ha^{-1} + *Azospirillum* 5.0 L ha^{-1}

Table 2: The effect application bacterial fixator on chlorophyll content of upland red rice

Bacterial Treatment	Cholorophyll content (mg / 100g)				
	Cholorophyll a				
	v_1	v_2	v_3	v_4	Average
b_0	6.08	6.27	3.96	6.27	5.64
b_1	4.34	3.40	3.89	4.26	3.97
b_2	5.84	5.11	6.53	5.43	5.73
Average	5.42	4.92	4.79	5.32	5.11
	Cholorophyll b				
	v_1	v_2	v_3	v_4	Average
b_0	24.47	24.57	23.57	24.61	24.31
b_1	23.68	24.39	23.49	23.64	23.80
b_2	24.48	23.95	24.11	24.25	24.20
Average	24.21	24.30	23.72	24.17	24.10
	Total Cholorophyll				
	v_1	v_2	v_3	v_4	Average
b_0	30.51	30.80	27.50	30.84	29.91
b_1	27.99	30.20	27.35	27.55	28.27
b_2	30.28	29.04	29.30	29.64	29.56
Average	29.59	30.02	28.05	29.34	29.25

Remarks :
v_1 = Labandiri Cultivar
v_2 = Jangkobembe Cultivar
v_3 = Ranggohitam Cultivar
v_4 = Paedara Cultivar
b_0 = Without bacterial fixator
b_1 = *Azotobacter* 2.5 L ha^{-1} + *Azospirillum* 2.5 L ha^{-1}
b_2 = *Azotobacter* 5.0 L ha^{-1} + *Azospirillum* 5.0 L ha^{-1}

3.2 Chlorophyll Content

The results showed that the application of bacterial fixator and differentiation of cultivars did not significantly influence the chlorophyll content, both for chlorophyll a, chlorophyll b and total chlorophyll content. The application of bacterial fixator only increases the levels of leaf chlorophyll in Ranggohitam cultivar especially for the total chlorophyll and chlorophyll content. In the other three cultivars (Labandiri, Jangkobembe and Paedara), the application of bacterial fixator did not increase the chlorophyll content (Table 2).

Table 3: The interaction of cultivars and bacteria fixator on anthocyanine content of upland red rice

Bacterial Treatment	Anthocyanine content (mg g^{-1})								Duncan 0.05 between V
	v_1		v_2		v_3		v_4		
b_0	4.93	a	0.05	a	2.73	a	0.17	a	
	p		q		r		r		2=0.042
b_1	0.13	b	0.06	a	4.46	a	0.15	a	
	p		q		r		p		3=0.044
b_2	0.11	b	0.17	b	4.22	c	0.13	a	
	p		q		r		qr		4=0.045
Duncan 0.05 between B			2=0.041				3=0.044		

Remarks : Number followed by the same index in the same row, are not significantly different at Duncan's multiple Range Test (DMRT).

v_1 = Labandiri Cultivar
v_2 = Jangkobembe Cultivar
v_3 = Ranggohitam Cultivar
v_4 = Paedara Cultivar

b_0 = Without bacterial fixator
b_1 = *Azotobacter* 2.5 L ha^{-1} + *Azospirillum* 2.5 L ha^{-1}
b_2 = *Azotobacter* 5.0 L ha^{-1} + *Azospirillum* 5.0 L ha^{-1}

3.3 Anthocyanine Content

The results showed that the application of bacterial fixator could increase the anthocyanine content of rice (Table 3). An increase in anthocyanine levels occurred in Jangkobembe and Ranggohitam cultivars, while in Labandiri and Paedara cultivars, there was no increase in anthocyanine levels.

As a result of the comparison of anthocyanine levels in each cultivar (V_1, V_2, V_3 and V_4) with controls on cultivars without bacterial fixator application (b_0), it appears that the highest increase in anthocyanine levels due to bacterial fixation application occurs in Jangkobembe cultivars, while anthocyanine levels decrease because bacterial fixation application occurred in Labandiri cultivars (Table 3).

4 CONCLUSION

Bacterial fixator has an effect on nitrogen, chlorophyll and anthocyanine content.

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