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Morphological Responses of Bawang Dayak (*Eleutherine palmifolia* (L.) Merr.) to Plant Growth Promoting Rhizobacteria Application

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ABSTRACT

Bawang dayak is one of the important medicinal plant that need to be developed in cultivation techniques and production. The use of Plant Growth Promoting Rhizobacteria (PGPR) recently known to be effective to increase plant growth and yield. This research aimed to determine the optimal concentration and immersion time of PGPR on the growth and yield of bawang dayak. The experiment was arranged in complete randomized block design, consisting of two factors. The first factor is the concentration of PGPR with 4 levels namely K_0 = 0 g L^{-1}, K_1 = 5 g L^{-1}, K_2 = 10 g L^{-1} and K_3 = 15 g L^{-1}. The second factor is immersion time of seed, namely P_1 = 10 minutes, P_2 = 20 minutes, P_3 = 30 minutes and P_4 = 40 minutes. The results showed that there was an interaction between concentration and immersion time of PGPR on the number of leaves and the number of tillers. The immersion time of PGPR for 10 minutes with a concentration of 15 g L^{-1} produced the highest number of leaves (58 leaves) and produced the highest number of tillers (27.67 tillers). The treatment of PGPR concentration or immersion time of PGPR singly did not affect all observed variables of growth and yield of bawang dayak.

INTRODUCTION

Bawang dayak is a medicinal plants typical of the forests of Central Kalimantan, originating from Tropical America. Bawang dayak is beneficial to reduce hypertension, cholesterol, boils, diabetes, colon cancer, stomach pain after childbirth and also can prevent strokes (Galingging, 2007). According to Heyne (1987) bawang dayak bulbs contain alkaloids, glycosides, flavonoids, phenolics, quinones, steroids, tannins and essential oils. The leaves and roots contain polyphenols and flavonoids.

In Indonesia, bawang dayak are not yet widely cultivated intensively. Cultivation techniques of bawang dayak are also not yet developed. Efforts to improve bawang dayak production should be done with environmentally friendly cultivation techniques. One of them is by providing plant growth promoting rhizobacteria (PGPR) applied to bawang dayak seeds. PGPR is a group of beneficial bacteria that can stimulate plant growth, increase crop yields and soil fertility (Rahni, 2012). Bacteria in PGPR are *Pseudomonas sp, Bacillus sp, Azobacter* sp and, *Azospiriumsp,* and fungi *Aspergilussp* (Saraswati and Sumarsono, 2015). According to Sayuti (2018) the administration of PGPR has a significant effect on the number of bulbs per clump in shallot (70 HST) due to the presence of phytohormone in PGPR such as auxin and gibberellins.

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MATERIALS AND METHODS

The experiment was conducted in January to May 2019 in Kandang Limun, Bengkulu City, with an altitude of 25 m above sea level.

The experiment was arranged in complete randomized block design, consisting of two factors. The first factor is the concentration of PGPR (K) with 4 levels namely K_0 = 0 g L^{-1}, K_1 = 5 g L^{-1}, K_2 = 10 g L^{-1} and K_3 = 15 g L^{-1}. The second factor is immersion time of seed (P), namely P1 = 10 minutes, P_2 = 20 minutes, P_3 = 30 minutes and P_4 = 40 minutes.

Fertilizers used are nitrogen (Urea of 200 kg ha^{-1}), phosphorous (SP36 of 150 kg ha^{-1})and potassium (KCl of 150 kg ha^{-1}). Nitrogen fertilizer (urea) was applied twice, at the time of tillage (100 kg ha^{-1}) and in 30 days after planting (100 kg ha^{-1}) in subsequent fertilization. Pest and disease control was carried out manually by pulling out the weeds that grow around the plant. Harvesting is done manually by tearing the polybags then separating the soil and the roots after by spraying water gently. Bawang dayak were harvested when the flower of 70% were began to fall at about 4 months after planting.

Variables investigated were plant height, number of leaves, level of greenness of leaves, number of tillers, floweringtime, fresh bulbs weight, number of bulbs per clump, diameter of bulbs, root length, root fresh weight, and total fresh weight. The data were statistically analyzed using analysis of varians (ANAVA) of the F test at 5% and 1% level. The results of the F test which showed the significant effect were further tested by the Orthogonal Polynomial Test.

RESULTS AND DISCUSSION

The results showed that the treatment of concentration and immersion time of PGPR singly had nonsignificant effect on the growth and yield of bawang dayak. The interaction between PGPR concentration and immersion time had a significantly different effect on the variable number of leaves and number of tillers. The results of the analysis of variance are presented in Table 1.

The results showed that when the bulbs were soaking for 10 minutes in PGPR solution, the higher concentration PGPR caused the more the number of leaves produced (Figure 1). The higher concentration of growth regulators, the faster plant growth, and vice versa the smaller the concentration the slower its growth (Nurlatifah and Setiati, 2016).

Soaking the bulbs for 10 minutes in PGPR solutionwith a concentration of 15 g.L^{-1} produced the highest number of leaves, 58 leaves. But the longer immersion time of PGPR (20-40 minutes) with high concentrations, the slower plant growth (Figure 1).

Soaking the bulbs in a longer time with high concentrations of PGPR solution increases in osmotic pressure which results in dehydration in plant tissue. Factors that influence osmotic dehydration are temperature, solution concentration and soaking time (Jaya, 2012). The decrease in water content will be higher when using high

Table1. Effect of concentration and immersion time of PGPR on growth and yield of bawang dayak

Variable	F value		
	Consentration	Immersion time	Interaction
Plant height	0.869 ns	0.504 ns	1.395 ns
Number of leaf	0.571 ns	0.654 ns	2.603 *
Leaf greenness	0.490 ns	0.263 ns	1.633 ns
Number of tiller	0.757 ns	0.476 ns	2.306 *
Flowering time	2.087 ns	1.177 ns	0.773 ns
Bulbs fresh weight	0.731 ns	0.262 ns	0.643 ns
Number of bulbs	0.757 ns	0.276 ns	1.256 ns
Bulbs diameter	0.554 ns	0.232 ns	1.036 ns
Root height	1.820 ns	0.278 ns	0.940 ns
Root fresh weight	0.494 ns	0.473 ns	0.299 ns
Total fresh weight	0.415 ns	0.421 ns	0.545 ns

Note: * = significant effect, ns = non significant effect.

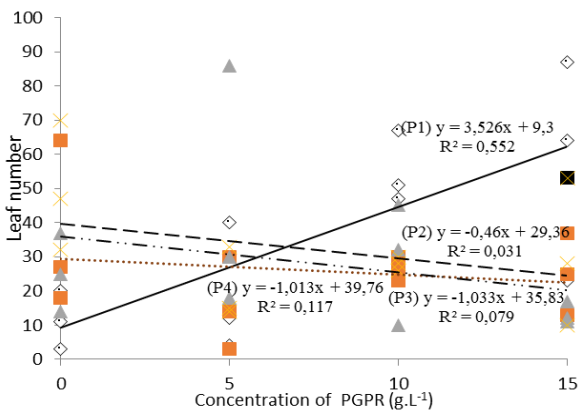

Figure 1. Effect of concentration and immersion time on the number of leaves.

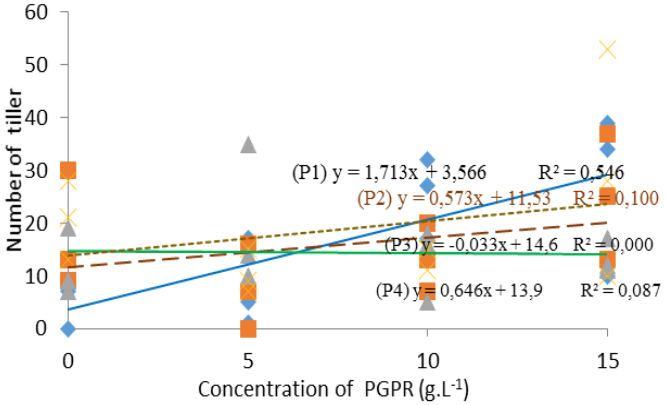

Figure 2. Effect of concentration and immersion time on the number of leaves

concentration of solution (Dwinata, 2013). The value of water loss also increases with increasing concentration used (Sucahyo, *et al*., 2013). Dubois, *et al*. (2018) state that concentrations of growth regulators that are too high for a particular type of plant will encourage the synthesis of ethylene in plants and will then inhibit plant growth. Auxin is a type of hormone that can stimulate plant growth by increasing cell elongation and stem elongation processes as well as cell differentiation (Tarabily, *et al.,* 2003).

It is also shown in the variable number of tillers. Soaking the bulbs for 10 minutes with a concentration of 15 g L^{-1} produced the highest tillers (27.67 tillers). In immersion time of 10 minutes with the higher the concentration of PGPR solution caused the more number of tillers produced (Figure 2).

The higher the concentration of PGPR, the better the effect on plant growth. The higher concentration of PGPR caused the more concentration of beneficial bacteria maintaining plant growth optimally (Ramadhan and Maghfoer, 2018). PGPR can produce IAA, cytokines, and gibberellins which are important hormones in spurring plant growth (Kloeper and Schroth, 1978). This ability has a clear effect on the parameters observed when it is associated with the function of each hormone. Cytokines and gibberellins both function in stimulating plant growth, especially

Table 2. Effect of PGPR concentration on the growth and yield components of Bawang dayak

Concentration of PGPR (g.L^{-1})	Growth components					Yield components					
	Plant height (cm)	Number of leaf (leaf)	Leaf Greenness (%)	Number of tillers (tillers)	Flowering time (day)	Bulbs fresh weight (g)	Bulbs number (bulb)	Bulbs diameter (cm)	Root length (cm)	Root fresh weight (g)	Total fresh weight (g)
0	24.83	30.66	46.09	13.66	50.00	38.58	18.66	1.13	19.50	11.28	107.05
5	24.08	24.91	47.60	11.33	59.08	31.66	16.75	1.06	15.66	8.60	91.90
10	27.58	34.66	43.96	16.33	61.91	43.53	20.66	1.13	16.08	10.94	112.4
15	27.91	31.66	46.74	15.50	74.00	38.04	19.66	1.11	20.50	11.95	105.92

Table 3. The effect of immersion time of PGPR on the growth and yield components of bawang dayak

Immersion time of PGPR (min)	Growh components					Yield components					
	Plant height (cm)	Number of leaf (leaf)	Leaf Greenness(%)	Number of tillers (tillers)	Flowering time(day)	Bulbs fresh weight (g)	Bulbs number (g)	Bulbs diameter (cm)	Root length (cm)	Root fresh weight (g)	Total fresh weight(g)
10	25.91	35.75	45.45	16.41	54.25	35,15	18.25	1.09	17.25	10.11	96.72
20	24.33	25.91	46.13	12.75	65.16	39.58	19.58	1.10	19.50	10.41	105.06
30	26.25	28.08	45.12	12.83	55.83	35.86	17.91	1.10	17.58	9.50	99.05
40	27.91	32.16	47.68	14.83	69.75	41.21	20.00	1.14	17.41	12.75	116.43

in cell division to form new plant organs and cell extensions so that these two hormones have an effect on the number of onion saplings (Ramadhan and Maghfoer, 2018).

Effect of PGPR concentration on the growth and yield of bawang dayak

The results showed that the concentration of PGPR had a non-significant effect on all observed variables of growth and yield of bawang dayak (Table 1). The growth and yield response of Dayak onions due to PGPR concentrations are presented in Table 2.

The effect of PGPR immersion time on the growth and yield of Bawang dayak

The results showed that the immersion time of PGPR had a significantly different effect on all observed variables of growth and yield of bawang dayak (Table 1). The growth and yield response of Dayak onions due to immersion time of PGPR are presented in Table 3.

CONCLUSION

The optimal concentration and immersion time of PGPR application in bawang dayak have not been obtained. However, 10 minutes immersion of PGPR in higher the concentration (10 - 15 $g.L^{-1}$) were the more effective in increasing the number of leaves and the number of tillers. The immersion time of PGPR for 10 minutes with a concentration of 15 g L^{-1} produced the highest number of leaves (58 leaves) and the highest number of tillers (27.67 tillers). The longer immersion time of PGPR (20 - 40 minutes) reduced plant growth, but may increased the yield components due to providing adequate nutrition and growth regulators may increase plant production and quality.

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