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Application of ameliorant on the growth and product of pakchong (*Pennisetum purpureum* cv Thailand) in post-tin mining land

Aplikasi amelioran terhadap pertumbuhan hasil rumput pakchong (*Pennisetum purpureum cv Thailand*) *di lahan pasca tambang timah*

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ABSTRAK

Aktivitas penambangan timah di Pulau Bangka menyebabkan lahan menjadi miskin hara. Pemanfaatan lahan pasca tambang timah dilakukan dengan menambahkan amelioran pada budidaya rumput pakchong. Penelitian ini bertujuan untuk melihat pertumbuhan dan hasil rumput pakchong di lahan pasca tambang timah dengan pemberian mikoriza, biosaka dan pupuk NPK. Penelitian ini dilaksanakan di lahan pasca tambang timah Desa Dwi Makmur, Kecamatan Merawang, Kabupaten Bangka mulai dari Maret 2023 hingga Juli 2023. Penelitian ini menggunakan Rancangan Acak Kelompok Faktorial (RAKF) yang terdiri dari 2 faktor perlakuan. Faktor pertama yaitu pemberian Mikoriza (B1) dan Tanpa Mikoriza (B2). Faktor kedua yaitu NPK 100% (P1), NPK 75% + Biosaka (P2) dan NPK 50% + Biosaka (P3). Hasil analisis ragam menunjukkan perlakuan mikoriza berpengaruh nyata terhadap jumlah daun, jumlah anakan dan berpengaruh tidak nyata terhadap perlakuan lainnya. Pemberian perlakuan NPK + biosaka berpengaruh sangat nyata terhadap jumlah daun dan berpengaruh tidak nyata terhadap perlakuan lainnya. Pemberian mikoriza pada tanaman pakchong lebih baik pertumbuhannya dibandingkan tanpa pemberian mikoriza. Pemberian pupuk NPK 75% + Biosaka (P2) berpengaruh tidak nyata terhadap perlakuan NPK 100% (P1). Pemberian mikoriza + NPK 75% (B1P2) memiliki tinggi tanaman, jumlah daun yang lebih tinggi dibandingkan perlakuan lainnya.

Kata kunci: Biosaka, Mikoriza, NPK, pakchong, lahan pasca tambang timah

ABSTRACT

Tin mining activities on Bangka Island cause the land to become nutrient-poor. Post-tin mining land use was done by adding ameliorant and cultivating pakchong grass. This research aimed to see the growth and yield of pakchong grass in post-tin mining land by applying mycorrhiza, biosaka and NPK fertilizer. This research was carried out on post-tin mining land in Dwi Makmur Village, Merawang District, Bangka Regency from March 2023 to July 2023. This research used a Randomized Group Factorial Design (RAKF) consisting of 2 treatment factors. The first factor was giving Mycorrhiza (B1) and Without Mycorrhiza (B2). The second factor was NPK 100% (P1), NPK 75% + Biosaka (P2) and NPK 50% + Biosaka (P3). The analysis of variance showed that mycorrhizal treatment had a significant effect on the number of leaves and tillers and had no significant effect on other treatments. Giving NPK + Biosaka treatment had a very significant effect on the number of leaves and had no significant effect on other treatments. The mycorrhiza to pakchong plants grows better than without giving mycorrhiza. Giving a fertilizer to the 75% NPK + Biosaka (P2) treatment

had no significant effect on the 100% NPK (P1) treatment. Giving mycorrhiza + NPK 75% (B1P2) results in higher plant height and leaf number compared to other treatments.

Keywords: Biosaka, Mycorrhiza, NPK, pakchong, post-tin mining land

INTRODUCTION

The Bangka Belitung Islands Province is one of the largest tin-producing provinces in Indonesia. According to Nurtjahya and Agustina (2015), continuous tin mining can cause a decrease in the quality of soil properties, namely the soil texture changes from 70% to 97% sand fraction. According to Lestari et al. (2021) tin mining can cause soil damage due to leaching of top soil. Post-tin mining land is dominated by sand tailings with low microbial content, very low cation exchange capacity (CEC), soil pH value and low macro nutrient content (Asmarhansyah, 2017; Inonu et al., 2020). One of the tin mining areas in Dwi Makmur Merawang village, Bangka Regency has a soil C-organic content of 0.097% (very low), N-total 0.001% (very low), CEC 10.88 cmolkg-1 (very low) and a sandy texture. 51.78%, dust 40.69%, and clay 7.53% (Oktaviani et al., 2020).

Unutilized post-tin mining land in Bangka Belitung has the potential to be used as agricultural land to meet feed needs and overcome post-mining environmental problems (Asmarhansyah & Hasan, 2020). Efforts to utilize post-tin mining land that can be carried out by planting adaptive plant species. According to Harahap (2016) the selection of plant types to be planted on post-tin mining land is based on adaptability and availability of plant material. A plant that has the potential to be cultivated on post-tin mining land is pakchong grass (*Pennisetum purpureum* cv Thailand). According to Sirait (2018), pakchong grass is tolerant of drought and has wide adaptation to soil acidity (pH) levels. Increasing the adaptability of pakchong grass, cultivation can be improved by combining the use of mycorrhiza.

Mycorrhiza is a mutualistic symbiosis between fungi and plant roots that has the widest distribution and socializes to almost all plant roots. Mycorrhiza on former tin land has benefits for increasing plant growth, including height, shoots, number of leaves, stem diameter and root nodules of Pterocarpus indicus which are better than without mycorrhizal inoculation (Husna et al., 2020). The growth potential and yield of pakchong grass can be increased with a combination of mycorrhiza and biosaka. Biosaka is an extract from pressing healthy plants that grow around the planting area and are able to adapt to the surrounding environment. Using biosaka as an elicitor can make plant growth better. Biosaka as an elicitor can trigger physiological, morphological responses and accumulation of phytoalexins (Reflis & Sumartono, 2023).

Providing biosaka to pakchong plants on post-tin mining land is one of the efforts to reduce the use of chemical fertilizers. It is hoped that providing this treatment can increase the growth of pakchong plants on post-tin mining land. The different types and doses used will provide different responses to the growth of pakchong grass in post-tin mining land. The objectif of this research was to determine the response of pakchong grass growth to the application of ameliorant on post-tin mining land.

MATERIALS AND METHODS

Location and Time

The research activity was carried out from March 2023 to July 2023. The research was carried out on post-tin mining land in Dwi Makmur Village, Merawang District, Bangka Regency. The materials used were pakchong grass seeds, cow dung, NPK fertilizer, mycorrhiza and Biosaka. The research method that will be used was the experimental method. The design that will be used was a Factorial Randomized Block Design with the first treatment namely mycorrhiza (B1) and no mycorrhiza (B2), the second treatment namely NPK 100% (P1), biosaka + NPK 75% (P2), and biosaka + NPK 50% (P3). This treatment was repeated 4 times, so that 24 experimental plots were obtained.

This research was carried out through several stages of activities. This research was carried out through several stages of activities. The land was

cleaned of weeds using a hoe, then plots measuring 2 m x 1 m were formed with a distance between plots of 1 m, then 500 g of cow dung fertilizer was applied per planting hole. Planting Pakchong grass seeds was done by inserting half of the seed segments into the planting hole at a slope of around 45°, then covering it with soil and watering it with sufficient water. The planting distance used was 70 cm x 50 cm.

Making biosaka using babandotan grass leaves around the research area looks fresh green, healthy and not attacked by pests. Put 100 grams of babandotan grass into a bucket, then mix it with 1 liter of water and knead it in the bucket for 15-20 minutes until the water turns green. The biosaka concoction was filtered using a filter and put into a plastic bottle which was then tightly closed and left for 5-7 days to see the success of making the biosaka. Successful biosaka was characterized by the absence of sediment in the bottle, the water does not turn clear and a foul smell does not come out when the bottle cap was opened.

NPK fertilizer was applied twice to plants aged 4 weeks and 8 weeks after planting. Treatment of 100% NPK was 10 g/plant, 75% NPK was 7.5 g/plant and 50% NPK was 5 g/plant. Fertilization was done by sprinkling it around the plants. Biosaka application was carried out by diluting it in water with a Biosaka dose of 40 ml/15 liters of water and stirring until evenly mixed. Biosaka was given by spraying it using a hand sprayer every 14 days at a dose of 30 ml/plant plot. Harvesting Pakchong grass plants could be done when the plants were 4 months after planting (MAP). Harvesting was done by cutting at the base of the plant stem using a machete.

The Data Analysis

Data analysis uses the F test with a confidence level of 95%. Treatments that have a real effect will be further tested using Duncan's Multiple Range Test (DMRT) with a confidence level of 95%.

RESULTS

The results of variance analysis (Table 1) show that mycorrhizal treatment had a significant effect on the number of leaves and number of tillers and had no significant effect on plant height, internode length, internode diameter, canopy wet weight, and yield per plot. Providing NPK + biosaka treatment had a very significant effect on the number of leaves and no significant effect on plant height, number of tillers, internode length, internode diameter, canopy wet weight and yield per plot. The interaction between the application of mycorrhiza and NPK fertilizer with the addition of biosaka had no significant effect on all observed variables.

The results of DMRT (Duncan's Multiple Range Test) (Table 2) show that the mycorrhizal treatment (B1) was significantly different from that without mycorrhizal (B2) in the parameters of number of leaves and number of length and was not significantly different in the parameters of plant height, internode length, internode diameter, canopy wet weight, and yield per plot.

Table 1. Results of various applications of mycorrhiza, NPK, and Biosaka fertilizers on pakchong grass

Parameter	Mikoriza		NPK + Biosaka		Interaction		KK
	F hit	Pr>F	F hit	Pr>F	F hit	Pr>F	
Plant height (cm)	1.59	0.2255^{tn}	1.08	0.3621^{tn}	0.47	5.9430^{tn}	6.72 %
Number of leaves	5.43	0.0288*	9.38	0.0022**	1.06	0.3699^{tn}	9.64 %
Number of length	4.48	0.0438*	2.88	0.0873^{tn}	1.42	0.2714^{tn}	22.12 %
Internode length (cm)	2.17	0.1612^{tn}	1.80	0.1981^{tn}	1.68	0.2195^{tn}	8.48 %
Internode diameter (mm)	0.30	0.5903^{tn}	0.77	0.4780^{tn}	0.46	0.6347^{tn}	10.82 %
Canopy wet weight (g)	1.01	0.3286^{tn}	0.87	0.4363^{tn}	0.32	0.7299^{tn}	19.12 %
Yield per plot (kg/petak)	0.93	0.3487^{tn}	0.91	0.4212^{tn}	0.36	0.7012^{tn}	19.15 %

Source: F hit (F calculated), Pr > F (probability value), *(significant), **(very significant), tn (No significant), KK (coefficient of variation)

Table 2. DMRT test results for mycorrhiza administration

Parameter	Treatment Organic Material	
	Mikoriza (B1)	Without Mikoriza (B2)
Plant height (cm)	179.69	173.56
Number of leaves	45.25_a	41.14_b
Number of length	7.93_a	6.50_b
Internode length (cm)	8.80	8.36
Internode diameter (mm)	10.73	10.99
Canopy wet weight (g)	1100.83	1017.33
Yield per plot (kg/plot)	5.48	5.08

Source: numbers followed by the same letter in the same column indicate that the results were not significantly different in the DMRT test

Table 3. DMRT test results for NPK fertilizer and Biosaka

Parameter	NPK fertilizer + Biosaka		
	NPK 100% (P1)	NPK 75 % + Biosaka (P2)	NPK 50 % + Biosaka (P3)
Plant height (cm)	180.30	177.79	171.77
Number of leaves	44.61_a	44.61_a	38.14_b
Number of length	8.30	6.82	6.51
Internode length (cm)	11.24	10.84	10.51
Internode diameter (mm)	8.89	8.65	8.20
Canopy wet weight (g)	1136,25	1015	1026
Yield per plot (kg/plot)	5.68	5.10	5.07

Source: numbers followed by the same letter in the same column indicate that the results were not significantly different in the DMRT test

The results of DMRT (Duncan's Multiple Range Test) (Table 2) show that the average growth of pakchong plant height shows that the highest plant height results were in the mycorrhiza treatment, namely 179.69 cm and treatment without mycorrhiza namely 173.56 cm. The average yield pakchong per plot shows that the highest results were in mycorrhiza treatment, namely 5.48 kg/plot and treatment without mycorrhiza namely 5.08 kg/plot.

The results of DMRT (Duncan's Multiple Range Test) (Table 3) showed that the NPK 100% (P1) treatment was not significantly different from NPK 75% + Biosaka (P2) but was significantly different from NPK 50% + Biosaka (P3) in the number of leaves parameter. The treatments of NPK 100% (P1), NPK 75% + Biosaka (P2) and NPK 50% + Biosaka (P3) showed no significant differences in the parameters of plant height, number of tillers, length of internodes, diameter of internodes, wet weight of shoots and yield.

The results of DMRT (Duncan's Multiple Range Test) (Table 3) show that the average growth of pakchong plant height shows that the highest plant height results were in the NPK 100% (P1) treatment, namely 180.30 cm and other that treatment NPK 75%+Biosaka (P2) namely 177.79 cm and treatment NPK 50%+Biosaka (P3) namely 171.77 cm. The average yield pakchong per plot shows that the highest results were in the NPK 100% (P1) treatment, namely 5.68 kg/plot and other that treatment NPK 75%+Biosaka (P2) namely 5.10 kg/plot and treatment NPK 50%+Biosaka (P3) namely 5.07 kg/plot.

DISCUSSION

Post-tin mining land is critical land that needs improvement. The results of research by Oktaviani et al. (2020) on post-tin mining land in Air Jangkang Merawang District. Bangka has a sand texture of 66.11%, dust 29.08%, clay 4.81%, pH H_2O 6.10%, C-organic 0.16%, N-Total 0.09%, P-Total 6.53 Me/100 grams, K-Total 3.18 Me/100 grams, CEC 1.04, K-dd 0.01 Mol (+)/Kg, Nadd 0.05 Mol (+)/Kg, Ca-dd 0.17 Mol (+)/Kg, and Mgdd 0.16 Mol (+)/Kg. Efforts to improve post-tin mining land can be made by providing ameliorant materials such as mycorrhiza, biosaka and NPK fertilizer. The addition of ameliorant or soil conditioner can improve the physical, chemical and biological properties of the soil. Improving critical land can be done by providing mycorrhiza which can form a symbiotic relationship with all types of plants (Nurbaity et al., 2017).

Mycorrhizal treatment had a significant effect on the number of leaves and number of tillers. Applying mycorrhiza to pakchong grass plants on post-mining land can provide the best results compared to treatment without mycorrhiza. This is because the condition of the former tin mining soil, which is dominated by sand, has a low capacity to hold air and nutrients so the provision of mycorrhiza can help plants accelerate the absorption of nutrients in the soil. Providing a combination of NPK + biosaka fertilizer means that the availability of nutrients can be utilized optimally and efficiently. According to Nainggolan et al. (2020) mycorrhiza has the ability to help plant roots to absorb the nutrient N so that plants will grow and develop well. Mycorrhiza can explore the roots to absorb nutrient elements including the elements N, P and K (Silalahi et al., 2020). The absorption of nutrient elements in mycorrhiza will increase both macro and micro nutrient elements (Nurhalimah et al., 2014). So that plants given mycorrhiza can meet plant nutritional needs such as phosphate, zinc, nitrate, ammonium, potassium and iron (Hastuti et al., 2018).

The 100% NPK (P1) treatment was not significantly different from 75% NPK + Biosaka (P2) but was significantly different from 50% NPK + Biosaka (P3) in the leaf number parameter. The treatments of NPK 100% (P1), NPK 75% + Biosaka (P2), and NPK 50% + Biosaka (P3) were not significantly different in the parameters of plant height, number of tillers, internode length, internode diameter, wet crown weight and yield per plot. The nutrients N and P are the main components in preparing organic materials. There is no doubt that N and P have a role in the formation of new cells in plants, especially in increasing the number of leaves. The results of research by Budiman & Nurjaya (2021) show that the application of NPK fertilizer has a significant effect on the variables of plant height, number of leaf stalks per plant, stem weight and leaf weight of Moringa plants. The nutrient content of NPK fertilizer can increase the growth rate, especially in tall plants (Khodijah et al., 2019). Rosalina & Nirwanto (2021) added that the nutrient P can stimulate root formation and increase the number of plant samplings. Nitrogen has an important role in carrying out the photosynthesis process, the results of which will be used for the growth of plant organs. The provision of N elements needs to be supplemented with P and K elements because P elements play a role in helping transfer energy from the nutrient N in the soil for the formation of chlorophyll through the photosynthesis (Suwardi et al., 2021).

The fertilizer NPK 75% + Biosaka (P2) treatment had tall plants, and a higher number of leaves compared to other treatments. The addition of biosaka is able to match plant growth in the 100% NPK treatment, so that the addition of biosaka can reduce the use of NPK fertilizer by as much as 25% on post-tin mining land. This is thought to be because using the appropriate dose of NPK fertilizer combined with biosaka can still be absorbed well by plants. According to Reflis & Sumartono (2023) biosaka is a material made from environmental plants or grass that can protect plants from pests and disease. The use of biosaka has a good effect and can reduce the use of NPK fertilizer on pakchong plants on post-tin mining land. Abror et al. (2023) stated that biosaka is able to reduce fertilizer use by up to 50%.

CONCLUSION

The growth and yield of pakchong plants in post-tin mining land is better if given mycorrhiza compared to without mycorrhiza. The treatment fertilizer NPK 100% has the best effect on the growth and yield of pakchong plants in post-tin mining land.

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