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Biocompost Application *Trichoderma* spp. and NPK Fertilization on the Growth and Yield of Shallots (Allium *ascalonicum* L.)

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Abstract. Shallots (Allium ascalonicum L.) are plants that are needed as a kitchen spice. Production decreases along with decreasing planting area and land fertility levels, so a solution is required to increase land fertility using biocompost. They should also require large amounts of N, P and K for their growth and development. This research aims to determine the effect of *Trichoderma* spp. biocompost application and NPK fertilisation on the growth and yield of shallot plants. The experiment used a completely randomised factorial design consisting of two factors, namely biocompost dosage (b), which consists of four levels: 1) without biocompost (b0), 2) 1.25 t/ha (b1), 3) 2.50 t/ha (b2), 4) 3.75 t/ha (b3), and the NPK dose factor (n) has four levels, namely: 1) 400 kg/ha (n1), 2) 300 kg/ha (n2), 3) 200 kg/ha (n3), 4).100 kg/ha (n4). The research results show the following. Application of *Trichoderma* spp. biocompost had a significant effect on the number of tillers at 6 WAP, number of tubers per hill, wet tuber weight, dry tuber weight, tissue P and K nutrient uptake values and had no significant effect on plant height, number of leaves and tissue N nutrient uptake values. Various doses of NPK fertiliser substantially affected the number of tillers at 6 WAP, number of tubers per hill, wet weight of tubers per hill, dry weight of tubers and tissue N, P and K nutrient uptake values. It had no significant effect on plant height and number of leaves. Secondly, there is an interaction effect of the two treatments on tissue N and P nutrient uptake values, with the highest N uptake value obtained in a combination of 2.50 t/ha (b2) of biocompost with a 300 kg/ha (n2) (b2n2) NPK fertiliser dose. In contrast, the highest P uptake value was obtained in a combination of 3.75 t/ha (b3) of biocompost with an NPK fertiliser dose of 200 kg/ha (n3). The best yield tendency was obtained in a combination of 2.5 t/ha (b2) of biocompost with a 300 kg/ha (n2) NPK fertiliser dose (b2n2).

Keywords: Shallots; Biocompost Trichoderma spp., NPK Fertilizer Dosage.

INTRODUCTION

Shallots (Allium *ascalonicum* L.) are a horticultural commodity cultivated intensively by farmers, and their presence is always needed as a household flavouring (kitchen spice). Demand for shallot commodities continues to increase along with the increase in population, so to meet this, production must be increased [1]. The government has designated shallots as one of the program commodities in a national strategic plan focused on supporting food security through a unique program to increase rice, corn, soybeans, onions and chillies to increase production to meet national needs.

Shallot production in NTB since 2018 has decreased from 212,885 t to 188,741 t in 2020 [2], which aligns with the decline in planting and harvest areas. Apart from that, land fertility is one of the determining factors in the production of shallot crops. Authors [20] believe the leading cause of the decline in shallot productivity is soil fertility due to excessive and continuous application of inorganic fertilisers.

Efforts to increase shallot production continue to be made through improving cultivation techniques such as using superior seeds, improving planting media, using balanced fertiliser, regulating water needs, and protecting against pest and disease attacks. They are increasing shallot production by providing optimal and balanced fertiliser by applying organic and inorganic fertilisers. Providing organic fertiliser is very good for improving soil's physical, chemical, and biological properties, increasing the activity of soil microorganisms, and making it more environmentally friendly.

According to [3], one of the obstacles in the application of organic compost fertiliser in shallot cultivation is the reluctance of shallot farmers to use organic materials such as manure/compost because the effect is felt to be slow, so the application of organic fertiliser is directed at the use of liquid organic fertiliser (POC) which is expected to provide a good effect quickly and directly on the growth and yield of shallots.

The use of biocompost organic fertiliser is an alternative that can be done to overcome land degradation quickly. According to [4], the use of one of the functional microorganisms known as soil biological fertiliser *Trichoderma* spp. can help plant growth because it can degrade organic matter and produce nutrients for plants, acts as a growth regulating compound and can inhibit pathogens that are harmful to plants. This is to the report by [5] that in greenhouse experiments using a combination of AMF and bioactivators containing the fungus T. Harzianum isolate Sapro-07 and T. Koningii isolate Endo-02 could suppress Fusarium wilt disease and increase the growth and yield of shallot plants. The simultaneous application of bioactivators and biocompost containing *Trichoderma* spp. and AMF in shallot plants can improve soil health and stimulate the growth and development of shallot plants.

Plant Red onion requires the input of N, P, and K as an energy source for its growth process. Authors [6] stated that NPK fertiliser needs to be added to complete the macronutrient requirements needed by shallot plants. One type of inorganic fertiliser containing the elements N, P and K, which is widely sold in agricultural kiosks today, is NPK Phonska fertiliser. However, in recent years, NPK fertiliser has often experienced shortages with relatively high prices at the field level (retailers and farmers). Therefore, solutions are needed to overcome the scarcity and high prices of inorganic fertilisers in shallot cultivation.

The research results [7] reported that the use of inorganic fertilisers and biological fertilisers can be done simultaneously to reduce dependence on chemical fertilisers, giving a dose of 3,000 kg/ha of organic fertiliser + 50 kg/ha of biological fertiliser gives the highest dry bulb weight yield of shallots, amounting to 15, 48 t/ha. Furthermore, [8] reported that the recommended fertiliser combination for shallot plants is 250 kg/ha NPK Phonska + 2.5 t/ha organic fertiliser (Petroganik) because it produces the best dry weight. Authors [5] reported that by using 15 g biocompost/plant or the equivalent of 4 t/ha, an average shallot yield of 14 t/ha was obtained. Authors [9] stated that the NPK fertiliser dose of 200 kg/ha consistently provides better growth and yields if we look at shallot plants' growth and production components. This differs from the research results [10] in that Phonska NPK fertiliser treatment can increase vegetative growth and production of shallots. The best dose is 150 kg/ha. Shallot plants show the best vegetative growth and bulb production at this dose.

METHOD

The method used in this research is an experimental design method with experiments in a greenhouse carried out from January to April 2023.

Experimental design

The experiment was designed using a factorial completely randomised design (CRD) with two factors, namely the biocompost factor (b) and the NPK fertiliser dosage factor (n). Biocompost factors consist of four levels, namely: 1) b0 – without Biocompost (0 t/ha); 2) b1 – 5 g/plant (1.25 t/ha); 3) b2 – 10 g/plant (2.50 t/ha); 4) b3 – 15 g/plant (3.75 t/ha).

The second factor is the NPK Phonska dose (n) consisting of 4 levels, namely: 1) n1 – 100% recommendation (400 kg/ha); 2) n2 – 75% of the recommended dose (300 kg/ha); 3) n3 – 50% recommended dose (200 kg/ha); 4) n4 – 25% of the recommended dose (100 kg/ha).

Each treatment level of each factor is combined to obtain 16 treatment combinations, namely: b0n1, b0n2, b0n3, b0n4, b1n1, b1n2, b1n3, b1n4, b2n1, b2n2, b2n3, b2n4, b3n1, bb3n2, b3n3 and b3n4. Each combination was repeated five times to obtain 80 experimental pots.

Research Experiment Preparation

Media Creation Potato Dextrose Agar (PDA). Potatoes are peeled, washed clean, and cut into smaller pieces like dice. 200 g of potato pieces are boiled in 1000 ml of water. After that, the material is filtered, and only the extract (liquid) is taken. Potato extract was put into an Erlenmeyer tube, and 20 g of agar powder and dextrose were added to each tube and then stirred until homogeneous. Next, 50 ppm (0.05 g/l) of the antibiotic chloramphenicol was added and dissolved in 10 ml of absolute ethanol solvent. The Erlenmeyer tube was covered with aluminium foil and cotton, then autoclaved for 30 minutes at 121 °C at a pressure of 1.5 atm.

Preparation of T. Harzianum Sapro-07. The fungal culture used is a collection of mushrooms in pure culture form grown on PDA media. Propagation is carried out by increasing spores and/or mycelia of the fungus T. Harzianum Sapro-07 on stock isolates into new PDA media in Petri dishes that have been prepared. The propagation technique uses a sterile mycelial transfer technique in a Laminar Air Flow cabinet. The fungal mycelia containing spores are taken using an ENT needle and then dipped/scratched/immersed slightly on the surface of the solidified PDA. Then, the culture was wrapped sterilely using plastic wrapping and incubated at room temperature (± 25°C) for seven days until the fungus grew to fill the petri dish and sporulated (green).

Preparation of Trichoderma spp. Suspension. This is done by harvesting spores in mature cultures (culture > seven days). Spore harvesting is carried out in Laminar Air Flow by pouring a small amount of sterile water (± 10 ml) into a petri dish for culturing *Trichoderma* spp. then scratched or brushed using a small soft brush. Next, the suspension was dissolved in 1 litre of sterile water. After that, the spore density was calculated to determine the concentration or density of spores in the suspension.

Spore counting was carried out using a Haemocytometer and observed under a light microscope. The number of spores was counted using a hand counter. The reference for spore density is 106. If the spore density is lower than that, then add fungal spores until it reaches 106. The formula for calculating the density of suspension spores is: Spore density = Average number of spores observed × 2.5 × 105.

Observation results: the spore density was 6.65 x 106

After the suspension reached the desired spore density, 20 g/l glucose was added. The addition of glucose is helpful as a source of nutrition for *Trichoderma* spp.

Making Biocompost. A bioactivator solution containing the fungus T. Harzianum isolate Sapro-07 was added as a decomposer to speed up the composting process. Biocompost is dissolved with 25 ml of bioactivation and diluted with 250 ml of water to make 100 kg of biocompost. The dilute bioactivator solution is then sprinkled liberally on the biocompost material stacked on a plastic tarpaulin basis. After the bioactivator solution is poured evenly over the biocompost material, fermentation is carried out by covering the pile of biocompost material tightly (an-aerobic conditions) with a plastic tarp and then opening it once a week to turn the biocompost material over and water it again with the bioactivator solution. After turning twice, the biocompost is mature with the following characteristics (laboratory analysis): black biocompost, odourless biocompost, pH 6.0; C-organic 1.52; CEC 17.98 cmo kg-1 ; C/N ratio 12.5; *Trichoderma* fungal population 45 x 10 propagules/g biocompost, free of soil-borne pathogens [11].

Planting Media Preparation. The planting medium used is air-dried soil sieved with a sieve diameter of 2 mm. Each polybag measuring 40 x 40 cm was then filled with 8.8 kg of soil, watered and left for a week.

Seed Preparation. The shallot seeds used in this research were the Bali rubber variety. The condition of the tubers used as seeds is fresh, without defects, and clean from dry skin, dirt, pests, and diseases.

Implementation Research Experiment

The application of biocompost is carried out at planting time according to the treatment dose by digging it next to the plant to a depth of around 3 cm. Phonska NPK fertiliser (15-15-15) is adjusted to the recommended dose (400 kg/ha) and given three times, namely at planting time, 2 WAP, and 4 WAP, each at a third of the treatment dose.

Seed tubers are planted as many as two seeds per polybag measuring 40 x 40 cm. Planting is carried out at a depth of 3 cm. Shallots cut off at the ends and dried are placed in the hole with the ends at the top flush with the soil's surface. After planting, water is saturated and left until the water stops dripping. After that, the polybag is weighed to determine the initial weight when planting.

Maintenance carried out includes irrigation/watering, weeding and pest control. Maintenance procedures follow the Technical Instructions for Shallot Cultivation [11]:

a) Irrigation is carried out every morning and evening to maintain moisture levels in the planting medium. The amount of water added is the difference between the weight of the polybag at the beginning of planting and the weight of the polybag at the time of observation.

b) Weeding by removing grass/weeds around the plant-growing environment to reduce competition for nutrients during the plant-growth phase.

c) OPT control using chemical pesticides is only a last resort. Several actions taken against pests that attack shallots in research trials include: Aphid attacks were controlled using the insecticide Curacron 500EC-100 ml. The Curacron pesticide is to dissolve 1 ml of Curacron 500EC in 1 litre of water, put it in a sprayer/spray tube and spray it on the desired part of the plant (affected by pest attacks). Fusarium wilt disease was found, removed, and destroyed to prevent it from spreading. To avoid transmission, control is carried out with Nordox 56WP brand fungicide at a dose of 1 gram per litre of water. Harvesting shallots is carried out after the shallot plants are 62 days old, which is characterised by the colour of the leaves starting to turn yellow and maximum bulb enlargement.

Observation

Variable what is observed is: a) Soil chemical properties include soil pH, organic C content, total N, available P, K, and soil CEC; b) Shallot plant growth variables include parameters: plant height, number of leaves and number of tillers; c) Plant yield variables include parameters: number of tubers per cluster, tuber weight per cluster, and dry stem weight; d) Nutrient uptake variables (NP and K). All observational data were analysed using Variety Analysis (ANOVA).

The analysis of variance (ANOVA) results were significantly different, followed by an honest significant difference test (BNJ) at the 5% level.

RESULTS AND DISCUSSION

Results Analysis of Soil Characteristics Before and After Planting. Based on Table 1, it can be seen that after treatment, all components of the observation parameters experienced an increase except that in the b1n2, b2n2, b2n3, b2n4, b3n2, b3n3 and b3n4 treatments, there was a decrease in N levels. The increase was thought to be caused by the addition of biocompost and NPK fertiliser, which the shallot plants had not absorbed. This is by the statement of [12]. The soil's N, P, and K nutrient content increased after the experiment. The increase in soil N, P, and K nutrient content can come from the residue of N, P, and K fertiliser applied and the results of the decomposition of organic fertiliser (compost) provided as essential fertiliser. Authors [21] stated that fertilising with organic materials plus NPK compound fertiliser can increase the availability of nitrogen, phosphorus and potassium in the soil, which plants can absorb directly. Furthermore, authors [14] stated that applying compost and NPK fertiliser can increase the CEC of the soil, affecting the cation adsorption capacity, which can improve the availability of nutrients.

Table 1 – Results of Analysis of Soil Chemical Properties of Red Onion Planting Media Before Treatment and After Treatment

Treatment	pH	C-Organic %	N-Total (%)	P-Available (%)	K-Available (%)	CEC cmol/kg
Before Treatment	5.65	1.53	0.10	0.01	0.03	10.20
After Treatment						
b0n1	5.25	1.82	0.11	0.21	0.11	12.20
b0n2	5.45	1.78	0.13	0.21	0.11	12.56
b0n3	5.55	1.76	0.10	0.18	0.11	12.75
b0n4	5.60	1.73	0.12	0.19	0.11	12.78
b1n1	5.55	1.86	0.12	0.23	0.11	13.46
b1n2	5.59	1.87	0.12	0.22	0.12	13.88

Treatment	pH	C-Organic %	N-Total (%)	P-Available (%)	K-Available (%)	CEC cmol/kg
b1n3	5.92	1.86	0.09	0.21	0.11	13.08
b1n4	5.93	1.87	0.12	0.20	0.12	13.07
b2n1	5.65	1.86	0.13	0.21	0.11	13.06
b2n2	5.75	1.90	0.08	0.23	0.12	13.46
b2n3	6.04	1.87	0.08	0.19	0.11	13.87
b2n4	5.91	1.79	0.08	0.19	0.11	13.47
b3n1	5.92	1.88	0.12	0.21	0.11	13.06
b3n2	6.08	1.96	0.08	0.21	0.11	13.50
b3n3	6.12	1.92	0.06	0.17	0.10	13.06
b3n4	6.25	1.96	0.07	0.17	0.10	13.46

Analysis of Biocompost Content. The biocompost carried out at the NTB BPTP Laboratory is black biocompost, pH: 7.58, C-Organic Content 11.46%, N-Total 0.82%, Organic Material 19.75%, CEC 16.37 cmol/kg, P2O5 0.42 %, K_2O 0.60%. Meanwhile, observations of the *Trichoderma* population were carried out at the Microbiology Laboratory, Mataram University, with a population of 2.40 x 105.

Summary of Results of Analysis of Variance (ANOVA) on Observed Variables. From Table 2 above, it can be seen that the biocompost dosage treatment did not significantly affect the parameters of plant height at 6 WAP, number of leaves at 6 WAP and tissue N nutrient uptake values, while the other parameters had a significant effect. Various doses of NPK fertiliser significantly affected shallot yield variables and N, P, and K nutrient uptake values, while growth variables (plant height, number of leaves) had no significant effect. The interaction between biocompost and NPK treatment influences the variable values of tissue N and P nutrient uptake.

Table 2 – Summary of ANOVA Results

No	Observation Variables	Biocompost Dosage	NPK Fertilizer Dosage	Interaction
1	Plant height 6 WAP	ns	ns	ns
2	Number of Leaves 6 WAP	ns	ns	ns
3	Number of Tillers 6 MST	s	s	ns
4	Number of Tubers Per Clump	s	s	ns
5	Wet Tuber Weight	s	s	ns
6	Dry Weight	s	s	ns
7	N Nutrient Uptake Value	ns	s	s
8	P Nutrient Uptake Value	s	s	s
9	Nutrient K Absorption Value	s	s	ns

Note: ns = non-significant, s = significant

Observation of Growth Variables

Plant Height (cm). Based on the analysis of variance (ANOVA) and Table 2, it can be seen that the treatment of providing biocompost and NPK fertiliser significantly increased plant height both independently and in interaction. This is in line with the research results, which state that applying organic and biological fertilisers does not significantly affect the growth of shallot plants but can improve soil structure, increase the nutrients available to plants, and increase the activity and population of soil microbes. Applying Phonska NPK fertiliser did not significantly increase plant height (Table 2). This is thought to be caused by the low nitrogen (N) element in the soil media used in the research experiment, namely 0.10%, resulting in the N element being used by plants for growth becoming unavailable. After giving NPK, the N element increased but was still relatively low. This is thought to be caused by the characteristic nature of N, which is readily leached/lost and evaporated, according to the statement by [12] that the N element can easily be lost or become unavailable to plants.

Number of leaves per clump (piece). From Table 2, it can be seen that based on the results of the analysis of variance (ANOVA), the administration of various doses of biocompost and Phonska NPK fertiliser did not have a significant effect on the formation of the number of shallot plant leaves, either independently or in interaction. These results are in line with the research results [6] that plots with an NPK fertiliser dose of 300 kg/ha had no significant effect on shallot plants due to the higher concentration of the fertiliser dose, root absorption in the soil and physical growth of weak leaves, stunted leaves, and pale and yellowish leaf colour.

Number of tillers per hill. The provision of biocompost and NPK significantly affected the formation of the number of tillers per cluster of shallot plants. In contrast, the interaction of the two had no significant effect. The average number of tillers formed after the 5% BNJ follow-up test is presented in Table 3.

Table 3 – Average Number of Tillers per Clumps (stems) of Shallots When Providing Various Doses of Biocompost and NPK Fertilizer

Treatment	Number of Saplings Per Clump (stem)				
	2 WAP	3 WAP	4 WAP	5 WAP	6 WAP
Biocompost Dosage					
b0 (Without Biocompost)	3.08	3.98 a	5.35	6.23	5.90 a
b1 (1.25 t/ha = 5 g/plant)	3.40	4.63 ab	5.83	6.83	7.73 b
b2 (2.50 t/ha = 10 g/plant)	3.68	4.85 b	5.90	6.93	7.73 b
b3 (3.75 t/ha = 15 g/plant)	3.58	4.73 b	5.80	6.95	7.70 b
BNJ 5%	-	0.65	-	-	0.66
NPK Fertilizer Dosage					
n1 (400 kg/ha = 1.6 g/plant)	3.58	4.68	5.93 ab	6.45 ab	7.68 b
n2 (300 kg/ha = 1.2 g/plant)	3.60	4.88	6.13 b	6.25 a	7.83 b
n3 (200 kg/ha = 0.8 g/plant)	3.25	4.48	5.60 ab	7.18 b	6.90 a
n4 (100 kg/ha = 0.4 g/plant)	3.30	4.15	5.23 a	7.05 ab	6.65 a
BNJ 5%	-	-	0.76	0.80	0.66

Notes: Numbers followed by the same letter in the same column are not significantly different in the 5% BNJ test

Table 3 shows that the treatment with various doses of biocompost significantly affected the formation of seedlings at the ages of 3 and 6 WAP. The treatment without biocompost (b0) was substantially different from the treatment with 1.25 t/ha (b1), 2.50 t/ha (b2) and 3.75 t/ha of biocompost. The maximum number of tillers occurred at 6 WAP, with the highest number of tillers obtained in the treatment of giving 2.50 t/ha (b2) and 1.25 t/ha (b1) of biocompost with 7.73 tillers and not significantly different from giving biocompost 3.75 t/ha (b3) was 7.70 tillers, the lowest number of tillers was obtained in the treatment without biocompost (b0) at 5.9 tillers and was significantly different from all treatments. This indicates that the provision of biocompost containing *Trichoderma* spp. fungi affects the formation of the number of saplings. According to [5], organic materials affect the number of tillers and the number of bulbs of shallot plants, especially the nitrogen element contained in the organic material.

Furthermore, authors [11] stated that shallot plants treated with the biostimulant mixture of T. Harzianum Sapro-07 and T. Koningii Endo-02 fungi, either with or without PGR BAP, can increase plant height, number of leaves, root length, and improve the number of tillers and the dry weight of harvested shallots. Independently, giving various doses of NPK fertiliser significantly affects the formation of offspring aged 4 WAP, 5 WAP and 6 WAP. The maximum number of tillers was formed at the age of 6 WAP with an average of the highest tillers in the treatment given NPK 300 kg/ha (n2) amounting to 7.83 tillers, not significantly different from the treatment with NPK 400 kg/ha (n1) 7.68 tillers but significantly different with 200 kg/ha NPK treatment (n3) 6.90 tillers and 100 kg/ha NPK treatment 6.64 tillers. Providing NPK fertiliser has a natural effect. This fertiliser is thought to contain essential elements to support plant vegetative growth, including nitrogen. Plants that receive an adequate nitrogen supply will form broad leaves with high chlorophyll content so that plants can assimilate in sufficient quantities to support vegetative growth. Good vegetative growth will increase the number of shallot seedlings. According to [6], nitrogen is a structural component of several important organic compounds, such as Amino acids, proteins, nucleoproteins, various enzymes, purines and pyrimidines, which are needed for cell enlargement and division so that optimum nitrogen application can increase plant vegetative growth.

Observation of Result Variables (Production). The results of analysis of variance (ANOVA) and further tests of 5% BNJ on the application of biocompost and various doses of NPK fertiliser to shallot plants had a significant independent effect on the parameters of several tubers per cluster, wet tuber weight per cluster and dry stem weight. The interaction of the two treatments had no significant impact. The analysis results and further tests for BNJ 5% can be seen in Table 4.

Table 4 – Average Number of Bulbs per Clump, Wet Bulb Weight (ton/ha) and Dry Bulk Weight (g/clump) of Shallots When Applying Various Doses of Biocompost and NPK Fertilizer

Treatment	Number of Tubers Per Clump	Wet Tuber Weight (t/ha)	Dry Weight of Clusters (g/clump)
Biocompost Dosage			
b0 (Without Biocompost)	5.78 a	15.22 a	6.70 a
b1 (1.25 t/ha = 5 g/plant)	6.70 b	16.49 ab	7.26 ab
b2 (2.50 t/ha = 10 g/plant)	7.10 b	18.27 b	8.04 b
b3 (3.75 t/ha = 15 g/plant)	6.93 b	17.73 b	7.80 b
BNJ 5%	0.64	1.95	0.86
NPK Fertilizer Dosage			
n1 (400 kg/ha = 1.6 g/plant)	7.00 b	18.26 b	8.04 b
n2 (300 kg/ha = 1.2 g/plant)	7.10 b	17.96 b	7.90 b
n3 (200 kg/ha = 0.8 g/plant)	6.33 a	16.42 ab	7.22 ab
n4 (100 kg/ha = 0.4 g/plant)	6.08 a	15.07 a	6.63 a
BNJ 5%	0.64	1.95	0.86

Notes: Numbers followed by the same letter in the same column are not significantly different in the 5% BNJ test

Number of Tubers per Clump. Based on Table 4, it can be seen that the application of biocompost and various doses of NPK significantly affect the formation of the number of tubers per hill. Independently, the treatment without biocompost (b0) significantly differed from all treatments, with the lowest number of tubers at 5.78. Most tubers were obtained in the 2.5 ton/ha (b2) biocompost treatment, which was 7.10, which is not significantly different from the b1 and b3 treatments. This indicates that the provision of biocompost containing the fungus *Trichoderma* spp. affects the formation of the number of tubers. The number of tubers produced in this research experiment is directly proportional to the number of seedlings formed. The greater the number of tillers, the greater the number of tubers produced. Independently, the application of NPK fertiliser significantly affects the number of tubers per hill formation. Amount the most tubers were obtained in the 300 kg/ha (n2) NPK treatment with 7.10 tubers, not significantly different from the 400 kg/ha NPK treatment (n1) 7.00 tubers, but substantially different from the 200 kg/ha NPK (n3) treatment, 6.33 tubers and 100 kg/ha NPK treatment 6.08 tubers. These results align with research [14], which states that multiplying shallot bulbs requires 300-400 kg/ha of NPK. Authors [13] noted that the availability of the nutrients N, P and K influences the growth of shallot bulbs where they are given optimal nitrogen, can increase plant growth, increase protein synthesis, and the formation of chlorophyll, which causes the colour of the leaves to become greener and increase the number of shallot leaves. At the same time, element P stimulates root growth, accelerating tuber growth and increasing the number of bulbs.

Wet Tuber Weight per Clump (t/ha). Table 4 shows that the application of biocompost and various doses of NPK fertiliser affect shallots' wet bulb weight parameters; the interaction between the two does not have a significant effect. Independently, giving 2.5 t/ha (b2) of biocompost gave a better effect of 18.27 t/ha, not significantly different from giving 3.75 t/ha (b3) of 17.73 t of biocompost and 1,73 t of biocompost. Twenty-five t/ha (b1) was 16.4 t but was significantly different from the treatment without biocompost (b0), which was 15.22 t. Treatment b0 is not substantially different from treatment b1. This indicates that the provision of biocompost can increase the production of shallot bulbs, presumably because it is influenced by the nutrients contained in the biocompost, which positively responds to bulb growth. The absorbed nutrients are translocated to the leaves to be assimilated in photosynthesis. According to [13, 14], one of the results of photosynthesis is fructan, which is necessary to form tubers. The application of NPK fertiliser affected the wet bulb weight parameters of shallots. The highest tuber yield was obtained in the NPK 400 kg/ha (n1) treatment of 18.26 t/ha, not significantly different from the application of NPK 300 kg/ha (n2) of 17.96 t/ha and giving NPK 200 kg/ha (n3) was 16.42 t/ha, but this was significantly different from giving NPK 100 kg/ha (n4) which was 15.07 t/ha. This indicates that in this research experiment, the higher the amount of NPK given, the higher the weight of the tubers produced, following the statement by [17], that the treatment of providing rice straw compost and NPK fertiliser was able to deliver the nutrient needs for shallot plants so that the photosynthesis process ran well.

Regarding tuber development, the essential elements are N, P and K. According to [14], tuber plants are high absorbers of phosphorus. Phosphorus is necessary for the formation and development of tubers. The potassium element is also crucial to shallot plants, where it plays a role in metabolic processes, nutrient absorption, transpiration, and carbohydrate translocation, activating many enzymes necessary for photosynthesis and respiration.

Dry Bulk Weight per Clump (g). Table 4 shows that the application of biocompost and various doses of NPK fertiliser significantly affected shallots' dry fruit weight parameters. The analysis and further tests of BNJ 5% showed the same results as the wet tuber weight parameters per hill. This indicates that the dry weight of the stover is related to the fresh weight of the stover. If the fresh weight result is high, then the dry weight of the stover will also be high. Dry weight is an accumulation of photosynthesis results, where, with high photosynthetic activity, you will get a wet and dry tuber weight. Authors [10] stated that the accumulation of organic matter reflected in plant weight per hill was consistent with the results observed in tubers' fresh weight and dry weight per hill. Likewise, the growth of shallots (plant height and number of leaves) tends to support the results obtained (plant weight, fresh weight and dry weight of tubers per hill). Authors [3] stated that the availability of N, P and K nutrients absorbed by plant roots could determine the high and low dry weight of plants in line with the report [10] that there was an increase in shallot yield (plant weight, fresh weight and dry weight of tubers per hill) in the treatment of *Trichoderma* together with manure due to the sufficient nutrition required by shallot plants, especially during the active synthesis of organic matter for the formation of enough biomass. Accumulated in plants (reflected in the weight of the plant per hill) and stored in storage organs (reflected in the fresh weight of the tubers and the dry weight of the tubers per hill).

Analysis of NP and K Tissue Nutrient Uptake Values

N Nutrient Uptake Value. N uptake is the concentration of the nutrient N in the plant (%) multiplied by the dry weight of the plant (g). The analysis of variance (ANOVA) showed that the treatment of giving various doses of biocompost did not affect the value of tissue N nutrient uptake. In contrast, the treatment of providing multiple doses of NPK fertiliser had a significant effect. The interaction of the two treatments showed a natural impact on the tissue N nutrient uptake value.

Table 5 – Interaction of Giving Various Doses of Biocompost and NPK Fertilizer on Nutrient N Uptake Values of Shallot Plants

Biocompost	NPK			
	n1	n2	n3	n4
b0	0.19 def	0.18 cdef	0.14 abcd	0.12 abc
b1	0.21 eph	0.18 cdef	0.16 bcde	0.09 a
b2	0.11 ab	0.23 f	0.13 abcd	0.15 abcd
b3	0.16 bcde	0.15 abcde	0.19 def	0.13 abcd
BNJ 5% = 0.06				

Notes: Numbers followed by the same letter in the same column and row are not significantly different in the 5% BNJ test

In Table 5, the interaction of biocompost application (b) with NPK dosage (n) on the N nutrient uptake value can be seen with the highest N uptake value obtained in the b2n2 treatment combination (Biocompost 2.50 t/ha + NPK 300 kg/ha) of 0, 23 g is not significantly different from b0n1, b0n2, b1n1 and b1n2. In contrast, the other combination treatments are significantly different, with the lowest uptake value obtained in the b1n4 treatment combination (1.25 ton/ha biocompost + 100 Kg/ha NPK) of 0.09 g, so It can be stated that the best treatment combination for the N nutrient uptake value parameter is the provision of 2.5 t/ha (b2) of biocompost with the application of 300 kg/ha (n2) of NPK (b2n2). These results align with the research [19], where the recommended 75% compound NPK fertiliser treatment shows that the treatment provides the highest N uptake results compared to other treatments. Furthermore, authors [15] reported that the fertiliser combination for shallot plants was 250 kg/ha NPK Phonska + 2.5 t/ha organic fertiliser (Petroganik) because it produced the best dry weight. The author [18] said that the increase in N uptake by shallot plants is related to improved plant growth and development and increased N concentration in plant tissue, so the higher the concentration of compost extract given, the greater the N availability in the soil and the better the plant growth and development, which in turn, the higher the N uptake.

P Nutrient Uptake Value. Based on the variance analysis (ANOVA) results, the application of biocompost and the dose of NPK fertiliser significantly affected the value of P nutrient uptake, both independently and in interaction. Data from the analysis of the interaction effect of biocompost application (b) and NPK dosage (n) on P nutrient uptake values can be seen in Table 6.

Table 6 – Interaction of Giving Various Doses of Biocompost and NPK Fertilizer on S-Values Application of Nutrient P in Shallot Plant Tissue

Biocompost	NPK			
	n1	n2	n3	n4
b0	0.024 abc	0.022 abc	0.018 a	0.017 a
b1	0.030 c	0.027 bc	0.023 abc	0.020 ab
b2	0.024 abc	0.026 abc	0.024 abc	0.025 abc
b3	0.021 abc	0.020 ab	0.030 c	0.021 ab
BNJ 5% = 0.008				

Notes: Numbers followed by the same letter in the same column and row are not significantly different in the 5% BNJ test

Based on Table 6, it can be seen that the highest P nutrient uptake interaction value was obtained in the combination of 1.25 ton/ha (b1) biocompost treatment with 400 kg/ha (n1) NPK (b1n1) and the b3n3 treatment combination of 0.030 g was not significantly different from almost all treatment combinations except for the b0n3 combination treatment, the absorption value was 0.017 g and b0n4 was 0.018 g. Providing biocompost to shallot plants can increase P nutrient uptake. According to [18], increasing P uptake is closely related to the supply of P nutrients in compost extract, improving the availability of P elements for plants. The P content of compost can directly contribute P elements to the soil. Adding compost can also enhance the soil's physical, chemical and biological conditions so that plant roots grow and develop better. Furthermore, authors [1] said that organic matter could increase soil pH through its ability to bind positively charged oxide minerals and cations, primarily reactive Al and Fe, causing soil P fixation to be neutralised. The presence of organic acids resulting from the decomposition of organic materials can dissolve P and other elements from the binder, resulting in increased availability and fertilisation efficiency of P and other nutrients.

Nutrient K Absorption Value. Based on the analysis of variance (ANOVA), the application of biocompost and NPK fertiliser had a significant effect on tissue K nutrient uptake values, and there was no interaction effect between the two treatments. The results of analysis and further tests for BNJ 5% can be seen in Table.

Table 7 – Nutrient K Uptake Value of Shallot Plant Tissues When Applying Various Doses of Biocompost and NPK Fertilizer

Treatment	Nutrient K Absorption Value (g)
Biocompost Dosage	
b0 (Without Biocompost)	0.102 a
b1 (1.25 t/ha = 5 g/plant)	0.109 ab
b2 (2.50 t/ha = 10 g/plant)	0.120 b
b3 (3.75 t/ha = 15 g/plant)	0.116 b
BNJ 5%	0.0130
NPK Fertilizer Dosage	
n1 (400 kg/ha = 1.6 g/plant)	0.120 b
n2 (300 kg/ha = 1.2 g/plant)	0.118 b
n3 (200 kg/ha = 0.8 g/plant)	0.108 ab
n4 (100 kg/ha = 0.4 g/plant)	0.099 a
BNJ 5%	0.013

Notes: Numbers followed by the same letter in the same column are not significantly different in the 5% BNJ test

Independently, the treatment without biocompost (b0) with an absorption value of 0.102 g was not significantly different from the 1.25 t/ha biocompost treatment (b1) of 0.109 g but was substantially different from the 2.5 t/ha biocompost treatment (b2) of 0.120 g and 3.75 t/ha biocompost (b3) of 0.116 g. This result is thought to occur due to the role of organic fertiliser in increasing the growth and development of shallot plants, which influences the K nutrient uptake value, according to research results [18], which shows that the application of fermented organic market waste compost extract can increase the K uptake of shallot plants. The K uptake values analysis showed that giving doses of NPK fertiliser had a significant effect. The highest uptake value was obtained when giving NPK 400 kg/ha (n1) at 0.120 g, not significantly different from giving NPK 300 kg/ha (n2) at 0.118 g and when giving NPK 200 kg/ha (n3) at 0.108 g, however significantly different from giving NPK 100 kg/ha (n4) of 0.099 g. Potassium (K) is an essential element and plays a role in the translocation and availability of plant assimilate or photosynthate. K plays a critical role in root development in shallots, which can further improve shallot plants' quality in bulb production and resistance to disease [12].

CONCLUSIONS

Based on the results and discussion, it is concluded that:

1) Application of *Trichoderma* spp. biocompost had a significant effect on the number of tillers at 6 WAP, number of bulbs per cluster, wet weight of tubers, dry weight of tubers, P and K nutrient uptake values of shallot plant tissue and had no significant effect on plant height, number of leaves and tissue N nutrient uptake values. Application of various doses of NPK fertiliser had a substantial impact on the number of tillers at 6 WAP, number of tubers per hill, wet weight of tubers per hill, dry weight of tubers and tissue NPK nutrient uptake values and had no significant effect on plant height and number of leaves.

2) There is an interaction effect when applying *Trichoderma* spp. biocompost with various doses of NPK fertiliser on tissue N and P nutrient uptake values with the highest N uptake value obtained from a combination of 2.50 t/ha (b2) of biocompost with an NPK fertiliser dose of 300 kg/ha (n2) (b2n2). In comparison, the highest was obtained from a combination of 3.75 t/ha (b3) of biocompost with an NPK fertiliser dose of 200 kg/ha (n3) (b3n3). The best combination tendency was obtained in a combination of 2.5 t/ha (b2) of biocompost with an NPK fertiliser dose of 300 kg/ha (n2) (b2n2).

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