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THE EFFECT OF GROWTH REGULATORS SHALLOT EXTRACT AND BIOFERTILIZER ON THE GROWTH AND YIELD OF CORN (*Zea mays* L.)

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ABSTRACT

Corn planting can be optimized if the parameters that influence plant growth and development, such as fertilizer and the use of growth regulators, are met. The purpose of this study is to assess the influence of the concentrations of shallot extract ZPT and biological fertilizer (M-Bio) on maize growth and yield. The experimental design used was a factorial randomized group design (RAK) with 2 factors and 3 replications. Factor I four levels of shallot extract ZPT dosage (k), namely k0 = control (without ZPT), k1 = ZPT concentration 100 ml/Lwater, k2 = ZPT concentration 200 ml/Lwater, k3 = ZPT concentration 300 ml/Lwater. Factor II four levels of biofertilizer concentration (h), namely h0 = control (without biofertilizer), h1 = concentration of 10 ml/Lwater, h2 = concentration of 20 ml/Lwater, h3 = concentration of 30 ml/Lwater. The findings revealed an interaction between the ZPT concentration of shallot extract and the concentration of biofertilizer (M-Bio) on Leaf Area Index (ILD), Net Assimilation Rate (NAR), dry seed weight per ear, and corn yield per hectare (t/ha). The findings of interaction tracking showed that the application of a growth regulator concentration of 300 ml/Lof shallot extract, along with the addition of up to 30 ml/Lof biofertilizer, resulted in a 4.73 t/ha increase in corn yield.

Keywords : *Biofertilizer; ZPT shallot extract; Zea mays L;*

INTRODUCTION

Maize in Indonesia is not only used as food and the main ingredient for flour, but also as animal feed. As a feed ingredient, corn is the main raw material with a portion reaching 51%. The growth of the feed mill industry continues to grow rapidly with an average growth of 10% per year and continues to grow. In 2014, the total demand for maize for the feed mill industry was 7.5 million tons. As a consequence of this growth, it is estimated that in the next five years the demand for maize for the animal feed industry will double from today's level to around 15 million tons (Deptan 2015).

Optimization of maize planting and agricultural intensification can be achieved if the factors that affect plant growth and development can be fulfilled, namely from external and internal factors. External factors include nutrients, water, temperature, humidity, oxygen and light, while internal factors are genes and hormones. Some external and internal factors can be controlled by humans, namely fertilization and the addition of growth regulators from outside (Wiratmaja 2017). One of the efforts that can be made to increase and accelerate the growth of corn plants is by utilizing growth regulators (ZPT). Growth regulators are hormones that

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can affect plant growth, which are organic compounds that are not active nutrients in low concentrations whose activities regulate catabolic reactions. These growth regulators can be synthetic or natural derived from the plant itself (Lindung 2014).

Shallot extract (Allium cepa L.) contains nicotinic acid, Thiamin, vitamin B1, riboflavin, and also has rhizocalin and auxin content that can affect plant development and growth, especially in the roots, so that the absorption of water and plant nutrients is fulfilled (Tarigan et al. 2017). The results of research by Siskawati et al. (2013), showed that the content of vitamin B1 and auxin in shallots proved to be able to trigger or stimulate the growth of shoots and roots of Jatropha curcas L. stem cuttings. In research conducted by Siregar et al. (2015), the provision of natural ZPT from shallot extract at a concentration of 2% and 1.5% can increase the growth of agarwood seedlings, in plant height, number of leaves, leaf area, stem circumference, wet weight and dry weight of agarwood seedlings.

Growth regulators (ZPT) function well if supported by nutrients that can be absorbed by plants. To fulfill this, it is necessary to make an effort to prepare a lot of nutrients from the soil. One alternative to add nutrients other than using organic and inorganic fertilizers is with biological fertilizers. According to Saraswati (2012), biofertilizer can be defined as an inoculant made from living organisms that function to add certain nutrients or facilitate the soil nutrients for plants. Biofertilizers are used as a collective for all functional groups of soil microbes. Soil microbial functional groups consist of bacteria, fungi, and algae that function as nutrient providers in the soil through changes in organic matter in the soil so that it can be available to plants.

The content of organic matter, apart from that in the soil, can also be provided through organic matter fertilization. However, the organic matter to be available nutrients must be degraded / broken down first by microbes. For this reason, with the presence of these beneficial functional microbial groups, the application of biofertilizers is expected to increase nutrients in the soil and can reduce and streamline the use of inorganic fertilizer doses so as to increase crop yields in a more environmentally friendly manner.

According to Priyadi (2017), the mixed culture of microorganisms contained in biological fertilizer (M-Bio) works synergistically to ferment organic matter, both those found in nature/soil and organic matter that has been previously provided to meet the nutrient needs of plant growth. Biofertilizer (M-Bio) also contains macro and micro nutrients such as N, P, K, S, Mo, Fe, Mn, and B that are needed by plants.

The results of research reported by Priyadi (2017) showed that soybean cultivar Slamet planted on peat soil with the application of biological fertilizer (M-Bio) was able to produce 1.1 to 3.8 tons/ha, while the control treatment was 0.4 to 0.6 tons/ha. Priyadi (2017) also reported that the yield of peanuts with the application of inoculated biological fertilizer (M-Bio) was higher, which was 3.04 tons/ha compared to without inoculation of biological fertilizer (M-Bio) which was 1.83 tons/ha.

The purpose of this study was to determine the effect of the interaction between shallot extract growth regulator and biological fertilizer in increasing the growth and yield of corn.

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Method

The research was conducted in Cintanagara Village, Jatinagara Subdistrict, Ciamis Regency, West Java Province with an altitude of 300 meters above sea level (masl) from November 2022 to April 2023. The materials used were corn seeds of superior hybrid varieties (Bisi 18), NPK phonska (15:15:15), organic fertilizer (chicken manure), ZPT shallot extract and biological fertilizer (M-Bio). The tools used in this study were hoes, sprayers, stakes, measuring cups, buckets, rulers, stationery, push rulers, and other tools used for corn cultivation.

The experimental design used was factorial randomized group design (RAK) with 2 factors and 3 replications. Factor I four levels of shallot extract ZPT concentration (K), namely k0 = control (no ZPT), k1 = ZPT concentration 100 ml/Lwater, k2 = ZPT concentration 200 ml/Lwater, k3 = ZPT concentration 300 ml/Lwater. Factor II four levels of biofertilizer concentration (H), namely h0 = control (without biofertilizer), h1 = concentration of 10 ml / L water, h2 = concentration of 20 ml / L water, h3 = concentration of 30 ml / L water. Thus, 16 treatment combinations were obtained and repeated 3 times, resulting in 48 experimental plots. Data were analyzed with Anova test and continued with Duncan's Multiple Range Test (DMRT) at 5% level. Then for tracking and testing the interaction effect continued with the Student Newman Keul (SNK) test.

The application of biological fertilizers was carried out as in the research conducted by Suherman et al. (2018) which was applied 3 times at 7, 14, and 21 days after planting (HST), to the soil around the plant after being dissolved adjusted to the concentration of each treatment. While ZPT shallot extract was applied at 23, 25, 27, and 29 days after planting by spraying it onto each leaf.

Preparation of shallot extract, namely shallot bulbs (Allium cepa L.) weighed as much as 1 kg, then the shallots that have been weighed are mashed using a blender and added with 1 liter of water, then filtered using a filter cloth (the filtrate obtained is considered as a 100% concentrated extract). After the filtering process is complete, dilution is carried out using water solvent for concentrations of 100 ml/liter of water, 200 ml/liter of water, and 300 ml/liter of water, respectively.

Variables observed included Leaf Area Index (LAI), Net Assimilation Rate (NAR), Plant Growth Rate (PGR), ear length, ear diameter , dry kernel weight per ear, and corn yield per hectare. In the observation of ear length, ear diameter, weight of dry kernels per plant, using a sample of 2 plants per experimental plot so that in one replication there were 10 plants. Meanwhile, the sampling of corn yield per hectare was 60 plants.

RESULT AND DISCUSSION

Leaf area index (LAI)

According to the findings of the analysis of variance, there is a significant difference between the treatment of ZPT concentration of shallot extract and the concentration of biological fertilizer on leaf area index on the 30th, 34th, 38th, and 42nd day after planting (DAP), as illustrated in Table 1.

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Table 1 Effect of ZPT concentration of shallot extract and biofertilizer concentration on leaf area index (LAI) at 30th, 34th, 38th, and 42nd day after planting.

Observation time	Biofertilizer concentration (H)	ZPT Concentration of Shallot Extract (K)				Mean
		Control	100 ml/L	200 ml/L	300 ml/Lair	
30th DAP	Control	0,90 a A	1,13 ab B	1,37 a B	1,44 a B	1,21 a
	10 ml/L	1,28 b A	1,31 b A	1,32 a A	1,39 a A	1,33 b
	20 ml/L	1,28 b AB	1,06 a A	1,34 a B	1,48 a B	1,29 ab
	30 ml/L	1,43 b A	1,49 bc A	1,49 a A	1,55 a A	1,49 c
	Mean	1,22 A	1,25 AB	1,38 C	1,46 C	
34th DAP	Control	1,30 a A	1,65 ab B	1,86 a B	1,84 a B	1,66 a
	10 ml/L	1,76 b A	1,84 bc A	1,84 a A	1,91 ab A	1,84 b
	20 ml/L	1,83 b A	1,50 a B	1,80 a B	2,03 ab B	1,79 ab
	30 ml/L	1,95 b A	2,07 c A	2,06 a A	2,15 b A	2,06 c
	Mean	1,71 A	1,76 AB	1,89 BC	1,98 C	
38th DAP	Control	1,86 a A	2,08 ab AB	2,40 a B	2,45 a B	2,20 a
	10 ml/L	2,26 b A	2,47 bc A	2,34 a A	2,62 a A	2,42 b
	20 ml/L	2,43 b A	2,00 a B	2,56 a B	2,63 a B	2,41 b
	30 ml/L	2,60 b A	2,65 c A	2,72 a A	2,80 a A	2,69 c
	Mean	2,29 A	2,30 AB	2,50 C	2,63 C	
42th DAP	Control	2,55 a A	2,74 ab AB	3,12 a C	3,17 a C	2,90 a
	10 ml/L	2,87 b A	3,19 c AB	3,13 ab AB	3,57 bc C	3,19 b
	20 ml/L	3,36 c B	2,62 a A	3,44 bc B	3,46 ab B	3,22 b
	30 ml/L	3,37 c A	3,45 c AB	3,71 c AB	3,83 c B	3,59 c
	Mean	3,04 AB	3,00 A	3,35 C	3,51 C	

Describes : Numbers followed by the same uppercase letter horizontally and the same lowercase letter vertically are not statistically different according to Duncan's Multiple Range test at the 5% real level. DAP: Days After Planting.

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Shallots contain the hormones auxin and gibberellin, so that shallot extract can help germination and growth of plant roots and shoots. The growth phase will stimulate cell division and enlargement, seed germination, can control the active growth of plants and can spur an increase in leaf area. The increase in leaf area will increase the chlorophyll content in it. The wider the leaf size, the more chlorophyll content until the maximum leaf development, but the older the leaf, the chlorophyll content decreases (Setyawati et al. 2022).

Based on Table 2 above, it shows that at the age of 34 DAP the concentration of biofertilizer (H) 30 ml/L(h3) spurred an increase in Leaf Area Index (ILD) of 0.57 higher than the concentration of biofertilizer 20 ml/L(h2) at the concentration of ZPT shallot extract 100 ml/L(k1), at the concentration of ZPT shallot extract 200 ml/L(k2) increased ILD of 0.26 and with the concentration of ZPT shallot extract 0 ml/L(k0) only increased ILD of 0.12. At the age of 38 DAP, the concentration of biofertilizer (H) 20 ml/L(h2) spurred an increase in leaf area index (ILD) of 0.22 higher than the concentration of biofertilizer 10 ml/L(h1) at a ZPT concentration of shallot extract 200 ml/L(k2), at a ZPT concentration of shallot extract 0 ml/L(k0) increased ILD by 0.17 and with a ZPT concentration of shallot extract 100 ml/L(k1) decreased ILD by 0.47.

Table 2 The results of tracking the interaction effect of the biofertilizer concentration factor (H) with the ZPT concentration of shallot extract (K) on Leaf Area Index (ILD) at 30th, 34th, 38th, and 42th and day after planting.

Observation Time	M-Bio biofertilizer concentration (H) ml/L	Variation of shallot extract zpt concentration (K) ml/L		
		k0 (0)	k1 (100)	k2 (200)
30th DAP	-	-	-	-
34th DAP	$h_3 - h_2$ (20-30)	0,12	0,57	0,26
38th DAP	$h_2 - h_1$ (10-20)	0,17	-0,47	0,22
	$h_3 - h_2$ (20-30)	0,17	0,65	0,16
42th DAP	$h_2 - h_1$ (10-20)	0,49	-0,57	0,31

Concentration variations h3 and h2 display almost the same variation as h2-h1, namely the concentration of biofertilizer (H) 30 ml/L(h3) spurred an increase in leaf area index (ILD) of 0.65 higher than the concentration of biofertilizer 20 ml/L(h2) at a ZPT concentration of shallot extract of 100 ml/L(k1), at a zpt concentration of shallot extract of 0 ml/L(k0) increased ILD of 0.17 and with a zpt concentration of shallot extract of 100 ml/L(k1) only increased ILD of 0.16.

Shallots contain the hormones auxin and gibberellin, so that shallot extract can help germination and growth of plant roots and shoots. The growth phase will stimulate cell division and enlargement, seed germination, can control the active growth of plants and can spur an increase in leaf area (Setyawati et al. 2022). Corn plant leaf quantity and area increase in direct proportion to cell division, expansion, and differentiation activity. Nitrogen is one factor that has a significant influence on these processes. Nitrogen is the primary ingredient for plant growth, acting as a

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constituent of all proteins and nucleic acids, or as a constituent of protoplasm in general (Widiyawati et al. 2014). Cytokinin functions to stimulate protein synthesis, induce chloroplast synthesis and volume, cause differentiation in shoot and root meristem tissues, and play a role in leaf formation (Setyawati et al. 2022). The biofertilizers used in this study on average contain microbes that are very helpful in plant growth including nitrogen fixing microbes.

According to Suwahyono (2011) nitrogen-fixing biofertilizers contain microbes that are able to bind nitrogen compounds from the air, then by biological processes in the soil the nitrogen compounds can be used by plants. Plants with well-met nitrogen needs will have an optimal leaf chlorophyll content, allowing them to absorb an optimal quantity of light and, as a result, the rate of photosynthesis can be optimized. The photosynthate created during photosynthesis is transferred to the plant's vegetative organs, eventually increasing the number of leaves and leaf area (Syam'un et al., 2012).

Net Assimilation Rate (NAR)

According to the results of the analysis of variance, there is a significant difference between the treatment of ZPT concentration of shallot extract and the concentration of biological fertilizer on the rate of net assimilation at various plant ages. Table 3 shows the influence of shallot extract ZPT and biofertilizer concentrations on net assimilation rate (NAR).

The total leaf area will affect the photosynthesis process and the net assimilation rate. The net assimilation rate is a measure of the ability of photosynthesis to produce plant dry matter. Masabni et al. (2016) stated that leaf area has a close relationship with the net assimilation rate. If the leaves are wider, the net assimilation rate will increase but leaves that are too wide can also reduce the net assimilation rate. From the results of the data, the NAR growth pattern for all treatments showed.

NAR increased from the start of growth until the age of 38 DAP, then declined as the corn grew older. The increase in NAR value in the beginning of growth was assumed to be because at that time the number of leaves and leaf area were still adequate, so that the leaves of the plant did not shade each other. Thus, the interception of solar radiation by the leaves of corn plants is still high, so that the photosynthetic apparatus increases.

Cytokinin is one of the hormones in plants that functions in encouraging division (cytokinesis), increasing the number and size of leaves, and delaying the aging of leaves, flowers and fruit by controlling well the process of deterioration that causes plant cell death (Zein 2016).

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Table 3. Effect of ZPT concentration of shallot extract and concentration of biological fertilizer on net assimilation rate (NAR) ($g/cm^2/day$) at 30-34th, 34-38th and 38-42th day after planting.

Observation time	Biofertilizer concentration (H)	ZPT Concentration of Shallot Extract (K)				
		Control	100 ml/L	200 ml/L	300 ml/L	Mean
30-34th DAP	Control	0,15 a A	0,43 a AB	0,36 a A	0.65 a AB	0.40 a
	10 ml/L	0,37 ab A	0,57 a A	0.59 ab A	0.53 a A	0.52 ab
	20 ml/L	0,49 bc A	0,42 a A	0.29 a A	0.37 a A	0.39 a
	30 ml/L	0,79 c AB	0,67 a AB	0.52 ab A	0.41 a A	0.60 b
	Mean	0,45 A	0,52 A	0.44 A	0.49 A	
34-38th DAP	Control	1.30	1.65	1.86	1.84	1.66 a
	10 ml/L	1.76	1.84	1.84	1.91	1.84 a
	20 ml/L	1.83	1.50	1.80	2.03	1.79 a
	30 ml/L	1.95	2.07	2.06	2.15	2.06 a
	Mean	1.71 A	1.76 A	1.89 A	1.98 A	
38-42th DAP	Control	0.25 a A	0.36 ab A	0.20 a A	0.59 a A	0.56 bc
	10 ml/L	0.76 b A	0.26 a A	0.64 ab A	0.58 a A	0.69 c
	20 ml/L	0.48 ab A	0.83 b A	0.83 ab A	0.61 a A	0.29 a
	30 ml/L	0.25 ab A	0.36 ab A	0.29 b A	0.27 a A	0.35 ab
	Mean	0.44 A	0.45 A	0.49 A	0.51 A	

***Describes** : Numbers followed by the same uppercase letter horizontally and the same lowercase letter vertically are not statistically different according to Duncan's Multiple Range test at the 5% real level. DAP: Days After Planting.

At the age of 38-42 DAP (Table 4), the concentration of biofertilizer (H) 20 ml/L(h2) spurred an increase in the Net Assimilation Rate (NAR) of 0.57 $g/cm^2/day$ higher than the concentration of biofertilizer 10 ml/L(h1) at a ZPT concentration of. According to Siaga et al. (2018), plants experience higher net assimilation rates during the early vegetative stage, when certain leaves are exposed to direct sun radiation. This is in accordance with the opinion of Masabni et al. (2016) the net assimilation rate is lower in the generative stage, although the leaf area increases, but is not accompanied by a high photosynthetic rate, the assimilation activity decreases.

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Table 4. Results of tracking the interaction effect of biofertilizer concentration factor (H) with shallot extract ZPT concentration factor (K) on Net Assimilation Rate (NAR) (g/cm^2/day), which is significantly significant at the age of 30-34th and 38-42th day after planting

Observation Time	M-Bio biofertilizer concentration (H) ml/L	Variation of shallot extract zpt concentration (K) ml/L		
		k0 (0)	k1 (100)	k2 (200)
30-34 th DAP	-	-	-	-
38-42 th DAP	$h_2 - h_1$ (10-20)	-0,28	0,57	0,19

The application of biofertilizers can increase the nutrients and water for plants so as to allow the photosynthesis process to take place optimally even though the NAR value is smaller than that required by cultivated plants for maximum dry matter production. The small value of NAR is because almost all corn plants get enough light for photosynthesis.

Plant Growth Rate (PGR)

Plant growth rate can be measured through plant dry weight. The greater the dry weight of the plants produced, the greater the value of the plant growth rate. Based on the results of the analysis of variance, it shows a significant difference between the treatment of ZPT concentration of shallot extract and the concentration of biological fertilizer on the rate of plant growth at various ages of plants. The effect of ZPT concentration of shallot extract and concentration of biological fertilizer on plant growth rate (PGR) can be seen in Table 5.

As also stated by Setyawati et al. (2022) who said that the hormone auxin has a role in cell development and root growth. Here auxin will stimulate cell elongation which will eventually result in shoot elongation. The mixed culture of microorganisms contained in biological fertilizer (M-Bio) works synergistically to ferment organic matter, both those found in nature/soil and organic matter that has been provided previously (in the manufacture of organic fertilizer by fermentation) to meet the nutrient needs of plants for the process of plant growth (Priyadi 2017).

Based on the interaction effect and its tracking at the age of 30-34 DAP and 38-42 DAP, there was no significant interaction between the concentration of shallot extract ZPT and the concentration of biological fertilizer on the rate of plant growth (PGR). Siaga et al. (2018) state that the rate of plant growth (PGR) is faster in the vegetative phase in the early weeks then gradually decreases after the plant reaches the peak of the flowering period.

Villar et al. (2005) reported that PGR is more regulated by physiological activities (photosynthesis and respiration) as also stated by Setyawati et al. (2022) who said that the hormone auxin has a role in cell development and root growth. Here auxin will stimulate cell elongation which will ultimately result in shoot elongation.

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Table 5 Effect of ZPT concentration of shallot extract and concentration of biological fertilizer on Plant Growth Rate (PGR) (g/cm^2/day) at 30-34 th, 34-38 th and 38-42 th day after planting.

Observation time	Biofertilizer concentration (H)	ZPT Concentration of Shallot Extract (K)				
		Control	100 ml/L	200 ml/L	300 ml/L	Mean
30-34 DAP	Control	0.04 a A	0.15 a B	0.12 ab AB	0.13 a AB	0.11a
	10 ml/L	0.12 ab A	0.19 ab A	0.19 b A	0.18 a A	0.17bc
	20 ml/L	0.17 bc A	0.12 a A	0.09 a A	0.13 a A	0.13ab
	30 ml/L	0.17 c AB	0.24 b AB	0.19 b A	0.15 a A	0.19c
	Mean	0.15 A	0.18 A	0.15 A	0.15 A	
34-38 DAP	Control	0.11	0.10	0.28	0.07	0.14a
	10 ml/L	0.16	0.22	0.06	0.38	0.21a
	20 ml/L	0.29	0.33	0.23	0.27	0.28a
	30 ml/L	0.23	0.12	0.32	0.28	0.24a
	Mean	0.20 A	0.19 A	0.22 A	0.25 A	
38-42 DAP	Control	0.11a A	0.16a A	0.08a A	0.26a A	0.15a
	10 ml/L	0.26a A	0.11a A	0.30ab A	0.32a A	0.25ab
	20 ml/L	0.25a A	0.31a A	0.45b A	0.30a A	0.33b
	30 ml/L	0.12a A	0.18a A	0.17a A	0.16a A	0.16a
	Mean	0.19 A	0.19 A	0.25 A	0.26 A	

***Describes** : Numbers followed by the same uppercase letter horizontally and the same lowercase letter vertically are not statistically different according to Duncan's Multiple Range test at the 5% real level. DAP: Days After Planting.

The mixed culture of microorganisms contained in biological fertilizer (M-Bio) works synergistically to ferment organic matter, both those found in nature/soil and organic matter that has been provided previously (in the manufacture of organic fertilizer by fermentation) to meet the nutrient needs of plants for the process of plant growth (Priyadi 2017).

Based on the interaction effect and its tracking at the age of 30-34 DAP and 38-42 DAP, there was no significant interaction between the concentration of shallot extract ZPT and the concentration of biological fertilizer on the rate of plant growth (PGR). Siaga et al. (2018) state that the rate of plant growth rate (PGR) is faster in the vegetative phase in the early weeks then gradually decreases after the plant reaches

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the peak of the flowering period. Villar et al. (2005) reported that PGR is mostly regulated by physiological activities (photosynthesis and respiration).

Ear Length

The analysis of variance revealed no significant difference in ear length between ZPT concentration of shalot extract and biological fertilizer. The concentration of biological fertilizer and ZPT in shallot extract did not significantly affect ear length.

The length of the ear per plant showed the same results or not significantly different in the treatment of biofertilizer concentration and ZPT concentration of shallot extract. However, the concentration of shallot extract ZPT 300 ml/Land the concentration of biological fertilizer 30 ml/L showed a greater number than the other treatments, namely 18.46 cm. It is suspected that the treatment of biological fertilizer concentration (H) and ZPT concentration of shallot extract at various levels is sufficient to meet the needs of corn plant nutrients and hormones in the formation of ear length. According to Saraswati (2012), phosphate is needed by plants during ear formation, activating ear filling and accelerating seed ripening.

Table 6 Effect of ZPT of shallot extract and concentration of biofertilizer on average ear length.

Biofertilizer concentration (H)	ZPT Concentration of Shallot Extract (K)				Mean
	Control	100 ml/L	200 ml/L	300 ml/L	
Control	15.33	16.67	17.50	17.50	16.75a
10 ml/L	16.83	17.33	17.67	17.83	17.42a
20 ml/L	16.83	17.50	18.33	19.33	18.00a
30 ml/L	17.67	17.50	19.50	19.17	18.46a
Mean	16.67 A	17.25 A	18.25 A	18.46 A	

***Describes** : Numbers followed by the same uppercase letter horizontally and the same lowercase letter vertically are not statistically different according to Duncan's Multiple Range test at the 5% real level. DAP: Days After Planting.

Phosphate-releasing biofertilizers contain microbes that are able to leach phosphate elements bound in the soil as organic compounds or mineral rocks. In order to be absorbed by plants, the decay mechanism is different. As with nitrogen-fixing microbes, there are symbiotic and non-symbiotic phosphate-degrading microbes. In principle, these microbes will release organic acid compounds and release phosphate bonds so that they can be absorbed by plants. It is reported that microbial inoculants can contribute about 20-25% of phosphate requirements for plants (Suwahyono 2011).

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Ear diameter

Based on the analysis of variance, there was an interaction between the treatment of shallot extract concentration and biofertilizer concentration on ear diameter as shown in Table 7.

Table 7 Effect of ZPT shallot extract and biofertilizer concentration on average ear diameter (cm)

Biofertilizer concentration (H)	ZPT Concentration of Shallot Extract (K)				Mean
	Control	100 ml/L	200 ml/L	300 ml/L	
Control	4,50 a A	4,67 a B	4,73 a B	4,77 a B	4,67 a
10 ml/L	4,67 b A	4,73 a A	4,77 a A	4,77 ab A	4,73 b
20 ml/L	4,67 b A	4,77 a AB	4,83 ab BC	4,93 c C	4,80 c
30 ml/L	4,77 b A	4,77 a AB	4,93 b C	4,93 c C	4,85 c
Mean	4,65 A	4,73 B	4,82 C	4,85 C	

***Describes** : Numbers followed by the same uppercase letter horizontally and the same lowercase letter vertically are not statistically different according to Duncan's Multiple Range test at the 5% real level. DAP: Days After Planting.

Based on the interaction effect and its tracking at the age of 30-34 DAP and 38-42 DAP, there was no significant interaction between the concentration of shallot extract ZPT and the concentration of biological fertilizer on ear diameter. It is suspected that at these concentrations shallot extract has been able to stimulate the formation of plant cells so as to cause maximum stem diameter increase.

Gibberellin in shallots stimulates the formation of xylem and phloem by the cambium, maintains the elasticity of cell walls and forms primary cell walls (cell walls that are first formed) in plants.

Auxin works with Gibberellin in triggering the growth of vessel tissue and encouraging cell division in the cambium of the vessels which causes the diameter of the stem of a plant to increase (Asra et al. 2020). It is also suspected that the treatment of biofertilizer concentration (H) at various levels is sufficient to meet the nutrient needs of corn plants in the formation of corn ear diameter.

Weight of dry small seeds per ear

Table 8 shows significant variations in the weight of dry tiny seeds per ear across treatments with different concentrations of shallot extract and biofertilizer, as determined by analysis of variance.

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Table 8 Effect of ZPT of shallot extract and concentration of biofertilizer on average weight of dry small seeds per ear (g)

Biofertilizer concentration (H)	ZPT Concentration of Shallot Extract (K)				Mean
	Control	100 ml/L	200 ml/L	300 ml/L	
Control	71,33 a A	91,33 a B	108,67 a B	102,33 a B	93,42 a
10 ml/L	91,00 b A	122,67 b B	116,33 ab B	116,33 ab B	111,58 b
20 ml/L	100,67 bc A	118,00 b AB	128,00 bc BC	140,00 c C	121,67 c
30 ml/L	108,33 c A	118,33 b AB	141,33 c C	162,00 d D	132,50 d
Mean	92,83 A	112,58 B	123,58 C	130,17 C	

*__Describes__ : Numbers followed by the same uppercase letter horizontally and the same lowercase letter vertically are not statistically different according to Duncan's Multiple Range test at the 5% real level. DAP: Days After Planting.

Table 8 shows that the treatment of independent effect of ZPT concentration of shallot extract 300 ml/Lis significantly different compared to other treatments. Likewise, the treatment of ZPT concentration of shallot extract 100 ml/Land 200 ml/Lis significantly different, but the treatment of ZPT concentration of shallot extract 200 ml/Land 300 ml/Lis not significantly different. In the independent effect treatment, the concentration of biological fertilizer 30 ml/Lwas significantly different compared to the other treatments.

Likewise, the treatment of 10 ml/Land 20 ml/Lbiofertilizer concentration was significantly different, and the treatment of 20 ml/Land 30 ml/Lbiofertilizer concentration was significantly different. The treatment of 30 ml/Lbiofertilizer gave the highest effect on the average weight of dry small seeds per ear which was 132.50 grams.

Table 9 The results of tracking the interaction effect of the biofertilizer concentration factor (H) with the ZPT concentration factor of shallot extract (K) on the weight of dry small seeds per ear (g), which is significantly significant.

M-Bio biofertilizer concentration (H) ml/L	**Variation of shallot extract zpt concentration (K) ml/L**		
	k1 (100)	**k2 (200)**	**k3 (300)**
$h_3 - h_1$ (10-30)	-4,34	25,00	45,67

Based on Table 9 above, it shows that the concentration of biofertilizer (H) 30 ml/L(h3) spurred an increase in the weight of dry small seeds per ear weighing 45.67 g higher than the concentration of biofertilizer 10 ml/L(h1) at the concentration of ZPT shallot extract 300 ml/L(k3), at the concentration of ZPT shallot extract 200 ml/L(k2) increased the weight of dry small seeds per ear by 25.00 g and with the concentration of ZPT shallot extract 100 ml/L(k1) decreased the weight of dry small

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seeds per ear by 4.34 g. Fruit weight increases due to soil nutrient availability, microorganism spread, and activation of hormones like auxin and cytokinin. According to Setiawan et al. (2016), gibberellin tissue promotes optimal plant growth and nutrient absorption, while higher fruit weight impacts plant productivity.

Corn Yield Per Hectare (t/ha)

Based on the analysis of variance, there was a significant difference between the treatments of shallot extract concentration and biofertilizer concentration on corn yield per hectare (t/ha) as shown in Table 10.

Table 10 Effect of ZPT of shallot extract and concentration of biofertilizer on maize yield per hectare (t/ha)

Biofertilizer concentration (H)	ZPT Concentration of Shallot Extract (K)				Mean
	Control	100 ml/L	200 ml/L	300 ml/L	
Control	4,80 a A	6,10 a B	7,30 a B	6,90 a B	6,30 a
10 ml/L	6,10 b A	8,30 b B	7,90 ab B	7,90 ab B	7,50 b
20 ml/L	6,80 b A	8,00 b B	8,60 bc BC	9,40 c C	8,20 c
30 ml/L	7,30 b A	8,00 b AB	9,50 c C	10,90 c D	8,90 d
Mean	6,30 A	7,60 B	8,30 C	8,80 C	

Describes : Numbers followed by the same uppercase letter horizontally and the same lowercase letter vertically are not statistically different according to Duncan's Multiple Range test at the 5% real level. DAP: Days After Planting.

Table 10 shows that the treatment of independent effect of ZPT concentration of shallot extract 300 ml/L is significantly different compared to other treatments. The treatment of ZPT concentration in shallot extract at 100 and 200 ml/L differs significantly, but not at 200 and 300 ml/L.

In the independent effect treatment, the concentration of biological fertilizer 30 ml/Lwas significantly different compared to the other treatments. Likewise, the treatment of 10 ml/Land 20 ml/Lbiofertilizer concentration was significantly different, and the treatment of 20 ml/Land 30 ml/Lbiofertilizer concentration was significantly different. The treatment of 30 ml/Lbiofertilizer gives the highest effect on corn yield per hectare, which is 8.90 t/hectare.

Based on Table 11, it shows that the concentration of biological fertilizer (H) 30 ml/L(h3) spurred an increase in yield of 4.73 t/ha higher than the concentration of biological fertilizer 10 ml/L(h1) at the concentration of ZPT shallot extract 300 ml/L(k3), at the concentration of ZPT shallot extract 200 ml/L(k2) increased the yield by 2.33 t/ha and with the concentration of ZPT shallot extract 100 ml/L(k1) decreased the yield by 0.67 t/ha. From the above, it can be stated that the application of biological fertilizer (H) with a concentration of 30 ml/Lplus ZPT shallot extract (K)

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as much as 300 ml/Lof water can significantly increase corn yield. The application of biofertilizer can increase maize yield compared with no biofertilizer

Table 11 Results of tracking the interaction effect of biofertilizer concentration factor (H) with shallot extract ZPT concentration factor (K) on maize yield per hectare (t/ha), which is significantly significant.

M-Bio biofertilizer concentration (H) ml/L	Variation of shallot extract zpt concentration (K) ml/L		
	k1 (100)	k2 (200)	k3 (300)
$h_3 - h_1$ (10-30)	-0,67	2,33	4,73

According to Waskito et al. (2018), soil or organic fertilizer treated with microbiactivators can boost maize plant yields. The presence of microorganisms that act as biofertilizers is critical for the nutrition and solubility of nutrients required by plants for development and higher output.

Organic matter that is already nutrient-rich in the soil and then treated with biofertilizer can expedite the process of breakdown or decomposition, allowing nutrients to be taken more easily by plants, loosening the soil and improving plant development. According to Yeni and Mulyani (2014) in the production phase, gibberellins will stimulate and increase the percentage of flowers and fruits. This is because gibberellins can stimulate flowering and can reduce premature fruit fall, so as to increase plant production.

CONCLUSION

Based on the study's findings, it is possible to conclude that there is an interaction between the concentration of growth regulator in shallot extract and the concentration of biological fertilizer (M-Bio) on Leaf Area Index, Net Assimilation Rate, dry seed weight per ear, and corn yield per ha. The results of interaction tracing showed that when the concentration of growth regulator of shallot extract was 100 ml/l, then the addition of biofertilizer as much as 30 ml/Lspurred an increase in Leaf Area Index of 0.57 and 0.65, while the concentration of growth regulator of shallot extract was 100 ml/Land the addition of biofertilizer as much as 20 ml/Lcould spur an increase in Net Assimilation Rate of 0.57 g/cm^2/day. The use of 300 ml/Lof shallot extract as a growth regulator, along with 30 ml/Lof biofertilizer, resulted in 44.67 g of dry seed weight per ear and a corn yield of 4.73 t/ha.

RECOMMENDATION

Based on the results of research and discussion, it can be suggested that to increase the growth and yield of corn, biofertilizer 30 ml/Land zpt shallot extract 300 ml/Lcan be given.

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