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The Effect Of Planting Spatial And Eco Enzyme Concentration On The Growth And Production Of Shallots (*Allium cepa* L.)

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Abstract*. The research aims to determine red onion plants' growth and production response (Allium cepa L.) on Planting Distance Treatment and Eco enzyme Concentration. This study used a Randomized Block Design (RBD) with two treatment factors. The first factor is the Planting Distance treatment consisting of 3 levels, namely J1 = 15 cm x 15 cm, J2 = 20 cm x 15 cm, and J3 = 25 cm x 15 cm. The second factor is the Eco enzyme Concentration, consisting of 3 levels, namely E1 = 0.8 ml ee / 240 ml water, E2 = 1.6 ml ee / 240 ml water, and E3 = 2.4 ml ee / 240 ml water. The study results showed that the Planting Distance treatment significantly affected root length and tuber diameter per sample. However, they had no significant effect on fresh tuber weight on the growth and production of shallots. The Eco enzyme concentration treatment had no significant effect on all observation treatments. The interaction between Planting Distance and the Eco enzyme concentration had no significant effect on all observation treatments.*

Keywords*: Eco Enzyme Concentration, Planting Distance, Shallots.*

1. INTRODUCTION

Shallots (Allium cepa L.) are one of the leading commodities in several regions of Indonesia. They are used as cooking spices and have beneficial health content. Based on research results, shallots contain calcium, phosphorus, iron, carbohydrates, and vitamins such as A and C (Lana et al., 2019).

Indonesian shallot production in 2018 was 59,200,533.72 tons with a harvest area of 11,377,934.44 ha and a productivity of 52.03 kwha-1. In 2019, the production of shallots decreased to 54,604,033.34 tons with a harvest area of 10,677,887.15 ha and a productivity of 51.14 kwha-1. This requires special efforts to increase domestic shallot production to reduce import dependence. According to BPS 2018 data, national shallot production reached 1.5 million tons.

Organic farming can increase the productivity of shallots, help increase community income, and also help improve soil conditions sustainably (Wangiyana et al., 2019). Therefore, organic fertilizer is one alternative to increase the productivity of shallots and carry out organic farming sustainably. The use of organic fertilizer has many benefits if applied to the soil, namely, it can improve the physical, chemical, and biological properties of the soil, increase the activity of soil microorganisms, and be more environmentally friendly (Ramadhan & Sumarni, 2018).

Planting distance is an important factor that determines the quality and quantity of production results; planting distance is an effort to increase the production of shallots by

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increasing the plant population. Different planting distance arrangements are one of the efforts that can be made to obtain an optimal population for shallots, planting distance arrangements with a specific density aim to provide growing space for each plant, planting distance will affect the density and efficiency of light use, competition between plants in the use of water and nutrients so that it will affect plant production (Pithaloka et al., 2015).

Organic waste management by recycling it can reduce the amount of waste and the percentage of waste burned in Indonesia. One way to recycle organic waste is by making eco-enzymes; the main ingredient of eco-enzymes is agricultural waste or household waste. Eco-enzymes are a solution resulting from the fermentation of household waste by adding water and brown sugar cane/palm sugar. Organic waste such as apple peels, oranges, pears or vegetables that do not have hard skin are put into a bottle or container that has a lid, the waste can be chopped first to speed up the fermentation process, then water and brown sugar are added to the container, the fermentation process takes a long time, around 3 months and requires regular checking. The benefits of eco-enzymes are not only in agriculture but also in helping clean the body, polluted water, and anti-fungal, anti-bacterial, and insecticidal agents (Vama & Cherekar, 2020).

Based on the description above, research was conducted on the response of growth and production of shallots to planting distance and eco-enzyme concentration.

2. LITERATURE REVIEW

Planting Distance

Distance planting is an effort to increase the production of shallots by increasing the plant population. Arranging different planting distances is one of the efforts that can be made to obtain an optimal population for shallots. Arranging planting distances with a specific density aims to provide growing space for each plant. Planting distance will affect the density and efficiency of light use, competition between plants in the use of water and nutrients, so that it will affect plant production (Pithaloka et al., 2015).

According to (Mahmudi et al., 2017), the planting distance of 25 cm x 20 cm produces the highest number of bulbs per clump, which is thought to be caused by the widest planting distance causing no competition between plants. Low competition has a positive impact on shallot production, so that it can be optimal. Shallots require sufficient nutrients for bulb formation.

Eco Enzyme Concentration

The manufacture of Eco-enzymes from organic waste of fruit peels and vegetable waste is increasingly popular and widely developed because it is convenient, economical, and environmentally friendly. The use of fruit peels to make Eco-enzymes is an evolution of science through anaerobic fermentation which is very profitable, Eco-enzymes contain various functional enzymes such as amylase, lipase, caseinase, protease, and cellulase, as well as secondary metabolites such as flavonoids, quinones, saponins, alkaloids, and cardioglycosides (Vama & Cherekar, 2020).

Waste fruit skin fermented with sugar and water produces Eco-enzyme which is rich in medical benefits, In addition, Eco-enzyme can also be used as an environmentally friendly cleaner, has aromatherapy, and can reduce environmental toxic levels, and various other benefits, enzymes are produced through fermentation of a mixture of brown sugar, water, kitchen waste or fresh vegetables or fruit waste, During fermentation carbohydrates are converted into volatile acids and in addition, organic acids in the waste material also dissolve into the fermentation solution because the pH of the waste enzyme is acidic, in the fermentation process glucose is broken down to produce pyruvic acid. Pyruvic acid in anaerobic conditions will be decomposed by pyruvate decarboxylase into acetaldehyde, then acetaldehyde is converted by alcohol dehydrogenase into ethanol and carbon dioxide, where Acetobacter bacteria will convert alcohol into acetaldehyde and water, and then acetaldehyde will be converted into acetic acid (Rochyatun & Kaisupy, 2006).

One of the technologies for managing and processing organic waste based on sources is Eco-enzyme, enzymes have been researched for more than 30 years by a founder of the Thai organic farming association named Dr. Rosukon Poompanvong. Dr. Joean Oon, a Naturopath from Penang, Malaysia, introduced this Eco-enzyme to the public. Organic waste in the form of fruit peels, unused fruit flesh, and vegetable scraps is collected in a container/barrel and mixed with molasses/brown sugar and water in specific proportions. The recommended proportion for the ratio of molasses: organic waste: water is 1:3:10 (Eco Enzyme Nusantara, 2021)

The following process is left for 90 days / 3 months as fermentation to produce beneficial enzymes in people's daily lives. There are characteristics of Eco-enzyme that are good for application, namely, 1.) has a fresh aroma typical of fermentation, acidity level (pH) below 4.0, and is generally brownish. Eco-enzyme as an environmentally friendly organic enzyme is very useful not only for everyday life such as floor cleaning fluid, clothes cleaner, dish cleaner, toilet cleaner, home air purifier (humidifier), natural organic fertilizer, rat repellent, flies and cockroaches and can be used as a hand sanitizer and natural disinfectant which is very useful during the current Covid-19 pandemic,

The benefits of Eco-enzyme in agriculture, based on an article by (Ramadani et al., 2019), concluded that the use of pineapple peel eco-enzyme has a good effect on the growth of chilies, which is indicated by plant height, stem diameter, and broader and greener leaves without eco-enzyme fertilizer (Nusantara.Eco Enzyme, Nusantara. 2020). Empowerment of Puhrejo Hamlet Farmer Groups in Processing Pineapple Peel Organic Waste as Eco-enzyme Liquid Fertilizer Proceedings of the 7th HAYATI National Seminar in 2019.

Households produce organic waste such as leftover food, fruit, and vegetables, and inorganic waste such as plastic and bottles. The waste is thrown into the trash without being sorted. Fruit and vegetable waste can be used to make eco-enzyme products. Eco-enzyme is a solution of complex organic substances produced from the fermentation process of organic waste, sugar, and water. This eco-enzyme liquid is dark brown and has a strong sour/fresh aroma. This multipurpose liquid can be used for cleaning the house, as a detergent, and as a poison for agricultural pests (Ramli & Hamzah, 2017).

3. RESEARCH METHODS

This research was conducted at UPT.BI. Palawija, Tanjung Selamat, Tanjung Anom Village, Pancur Batu District, Deli Serdang Regency, Medan, North Sumatra. With an altitude of ± 30 meters above sea level. The study aims to determine the response of growth and production of shallot plants (*Allium cepa* L.) to planting distance treatment and eco-enzyme concentration. This study used a Randomized Complete Block Design (RBD) with two treatment factors. The first factor is the Planting Distance treatment consisting of 3 levels, namely J1 = 15 cm x 15 cm, J2 = 20 cm x 15 cm, and J3 = 25 cm x 15 cm. The second factor is the Eco enzyme Concentration, consisting of 3 levels, namely E1 = 0.8 ml ee / 240 ml water, E2 = 1.6 ml ee / 240 ml water, and E3 = 2.4 ml ee / 240 ml water. The observed variables of this study were root length, tuber diameter per sample, and fresh tuber weight. Data analysis was carried out using variance analysis and Duncan's test.

4. RESULT AND DISCUSSION

Tuber Diameter Per Sample (mm)

Observation data of bulb diameter per shallot sample due to planting distance and eco-enzyme concentration treatments. The analysis of variance list shows that the planting distance treatment significantly affects bulb diameter per sample. In contrast, eco-enzyme concentration and the interaction between the two treatments have no significant effect on bulb diameter per shallot sample. Due to planting distance and eco-enzyme concentration treatments, the average bulb diameter per shallot sample can be seen in Table 1.

Table 1. Average Bulb Diameter Per Sample (mm) of Shallots Due to Planting Distance and Eco Enzyme Concentration Treatment.

Treatment	E1	E2	E3	Average J
J1	29.01	31.84	28.93	29.92 ab
J2	34.27	30.21	28.81	31.10 b
J3	34.99	35.03	33.45	34.49 a
Average E	32.76	32.36	30.40	

Description: numbers followed by the same letter in the same column and group mean that they are not significantly different based on the Duncan test at the 5% test level.

In Table 1, it can be seen that the planting distance treatment has a significant effect on the bulb diameter per sample in shallot plants; the highest bulb diameter was found in treatment J3 (34.49), which was significantly different from J2 (31.10) but not significantly different from J1 (29.92). In Table 2, it can also be seen that the eco enzyme concentration treatment had no significant effect on the bulb diameter per sample in shallot plants; the highest bulb diameter was found in treatment E1 (32.76), and the lowest was found in treatment E3 (30.40).

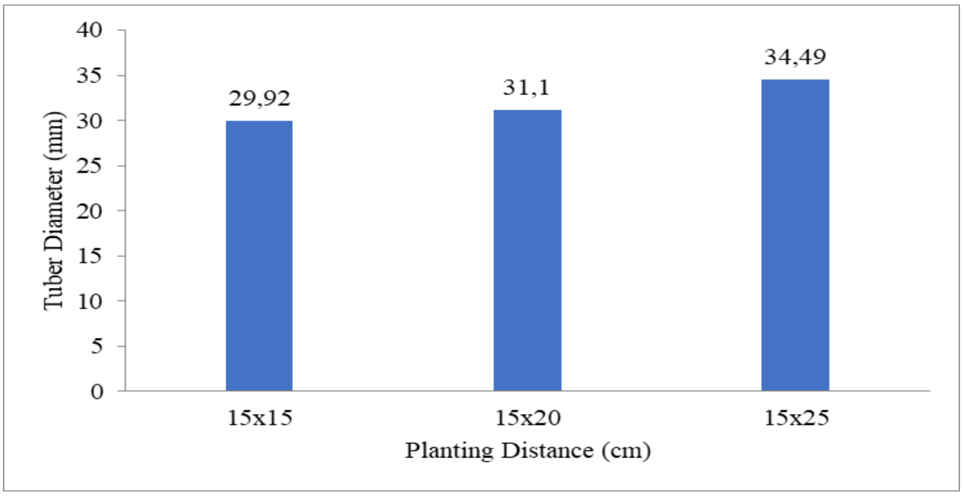

Figure 1. Response of Shallot Bulb Diameter to Planting Distance Treatment.

Figure 1 shows that the bulb diameter response per sample in shallot plants to the widest planting distance treatment was in treatment J3, followed by J2 and J1.

Root Length Per Sample (cm)

Observation data of root length per shallot sample due to planting distance and eco enzyme concentration treatments. The analysis of variance list shows that the planting distance treatment significantly affects bulb diameter per sample. In contrast, the eco enzyme concentration and the interaction between the two treatments do not significantly affect root length per shallot sample. The average root length per shallot sample due to planting distance and eco enzyme concentration treatments can be seen in Table 2.

Table 2. Average Root Length Per Sample (mm) of Shallots Due to Planting Distance and Eco Enzyme Concentration Treatment.

Treatment	E1	E2	E3	Average J
J1	5.46	6.56	7.36	6.21 ab
J2	7.22	8.14	8.86	7.93 b
J3	9.37	8.22	7.94	8.36 a
Average E	7.83	8.02	8.05	

Description: numbers followed by the same letter in the same column and group mean that they are not significantly different based on the Duncan test at the 5% test level.

In Table 2, it can be seen that the planting distance treatment has a significant effect on the root length per sample in shallot plants; the highest root length was found in treatment J3 (8.38), which was significantly different from J2 (7.93) but not significantly different from J1 (6.21). In Table 7, it can also be seen that the eco enzyme concentration treatment had no significant effect on the bulb diameter per sample in shallot plants; the highest bulb diameter was found in treatment E3 (8.05), and the lowest was found in treatment E1 (7.83).

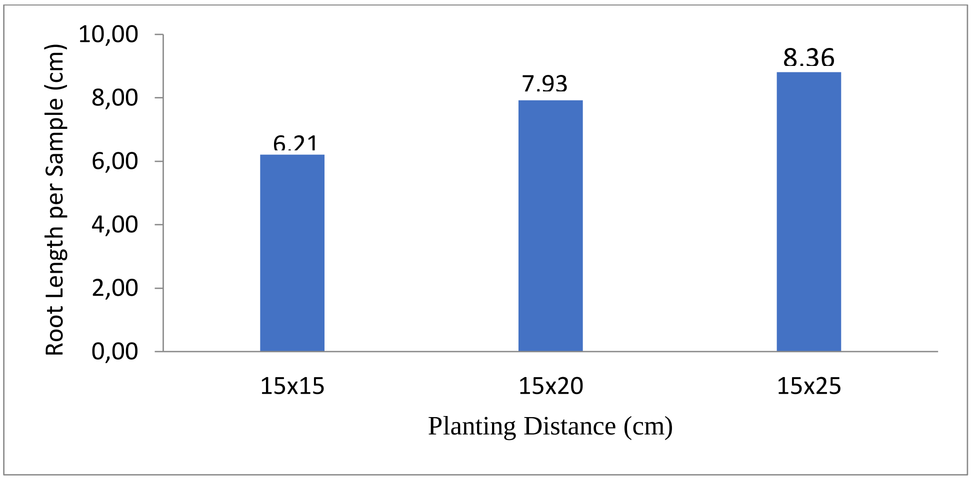

Figure 2. Response of Shallot Root Length to Treatment Planting Distance.

The effect of planting distance on the root length per shallot sample can be seen in Figure 2. Figure 2 shows that the response of root length per shallot sample to the longest planting distance treatment was in treatment J3, followed by J2 and J1.

Fresh Weight of Tubers Per Sample (g)

Observation data of fresh weight of bulbs per sample of shallot plants due to treatment of planting distance and eco enzyme concentration. The list of variance analyses shows that the treatment of planting distance and eco enzyme concentration, as well as the interaction between the two treatments, have no significant effect on the fresh weight of bulbs per sample of shallot plants. The average fresh weight of bulbs per sample of shallots due to treatment of planting distance and eco enzyme concentration can be seen in Table 3.

Table 3. Average fresh weight of red onion bulbs per sample (g) due to Planting Distance and Eco Enzyme Concentration Treatment.

Treatment	E1	E2	E3	Average J
J1	68.71	62.81	69.87	67.13
J2	75.19	62.93	72.26	70.13
J3	77.70	56.98	72.89	69.19
Average E	73.87	60.91	71.67	

In Table 3, it can be seen that the treatment of planting distance has no significant effect on the fresh weight of bulbs per sample in shallot plants; the highest average fresh weight of bulbs is in treatment J2 (70.13), and the lowest average is in treatment J1 (67.13). In Table 5, it can also be seen that the treatment of eco enzyme concentration has no significant effect on the fresh weight of bulbs per sample in shallot plants; the highest average fresh weight is in treatment E1 (73.87), and the lowest average is in treatment E2 (60.91).

Discussion

Effect of Planting Distance Treatment on the Growth and Production of Red Onions

Based on the analysis of variance test, it was shown that the planting distance treatment had no significant effect on the fresh weight of the bulbs but had a significant effect on the diameter of the bulbs and the length of the roots of the shallot plants.

The results of the study showed that the treatment of planting distance had a significant effect on the diameter of the bulbs per sample, the highest planting distance was in treatment J3 = 15 cm x 25 cm (34.49 mm) and the lowest was in treatment J1 = 15 cm x 15 cm (29.92 mm), it is suspected that vast planting distances allow plants to obtain more sunlight to all parts of the plant. In addition, competition in absorbing nutrients and water from the soil becomes smaller because the plant roots are not close together. Such conditions allow plants to absorb elements in sufficient quantities for optimal production. According to (Azad et al., 2020; Heyduk et al., 2019; Zheng et al., 2023), loose plant density allows light to enter all plant parts, which can be helpful in photosynthesis. The more light received by all parts of the plant, the higher the rate of photosynthesis, and the energy produced can then be stored in the bulbs. This will increase the diameter of the shallot bulbs.

The results of the study showed that the treatment of planting distance had a significant effect on the length of roots per sample, the highest planting distance was in treatment J3 = 15 cm x 25 cm (8.36 cm) and the lowest was in treatment J1 = 15 cm x 15 cm (6.21 cm), it is suspected that at a denser planting distance the shallot plants will shade each other so that the sunlight that is needed in the photosynthesis process is not obtained properly. This is in line with the opinion of (Beja, 2020), who stated that planting distance with a specific density aims to provide growing space for each plant to grow well. Plant spacing will affect the density and efficiency of light use, as well as competition between plants for water and nutrients, and thus, it will affect plant production.

Planting distance affects the level of competition between plants; the wider the planting distance, the smaller the competition. According to (Haque & Sakimin, 2022), planting distance affects plant competition in obtaining water, nutrients, and sunlight, which are helpful in photosynthesis. A low level of competition allows the available elements to be absorbed by plants in sufficient quantities. If there is competition, then these elements will be used simultaneously. If the available elements are limited in number, then each plant cannot meet the elements it needs. This causes plant growth to be less than optimal.

Effect of Eco Enzyme Concentration on the Growth and Production of Red Onions

The analysis of variance test results show that the eco enzyme concentration treatment had no significant effect on all observation treatments.

This aligns with research by (Nasihah, 2017), which states that plants watered with vinegar grow abnormally, are somewhat stunted, and cannot grow optimally. The wax layer on the leaves is damaged so that nutrients disappear, causing the plant to be intolerant of cold conditions, fungi, and insects. Root growth slows so fewer nutrients can be taken up, and important minerals are lost. However, the plant can still absorb the nutrients provided through the leaves; this is proven by the eco-enzyme treatment, which produces longer plant length due to the nitrogen content, an important nutrient in plant growth.

In eco enzymes, nitrogen, phosphorus, and potassium nutrients play a role in producing plant biomass. (Arifin et al., 2019) state that potassium plays a role in increasing photosynthesis activity so that photosynthate accumulation can be translocated to generative organs, especially shallot bulbs. This is in line with the research of (Rahnama et al., 2017), who tested various fertilizer application methods (without fertilizer, application through the soil, fertigation, foliar spray, a combination of foliar spray and application through the soil) in oil palm nurseries. In their study, fertilizer absorption through leaves (foliar spray) showed vegetative growth that was not as optimal as fertilizer application with fertigation and a combination of application through the soil and leaves. The primary vegetative parameters that differed significantly were plant height, stem diameter, number of leaves, leaf length, and chlorophyll index. Based on the descriptions above, it can be suspected that applying eco-enzyme potassium sources through leaves damages plant tissue due to low pH and results in less than optimal nutrient absorption compared to application through the soil.

The Effect of Interaction between Planting Distance and Eco Enzyme Concentration on the Growth and Production of Red Onions

Based on the results of the analysis of variance test, it shows that the interaction between planting distance and eco enzyme concentration has no significant effect on all observation treatments of leaf length, number of leaves, number of bulbs, fresh bulb weight, dry bulb weight, root volume and sprouting age, bulb diameter and root length per sample on the growth and yield of shallots.

The results of the study showed that there was no interaction between plant distance and eco enzyme on all observations, allegedly because both treatments gave their respective responses as single factors without any interaction, if the simple effects of a different factor are greater than those that chance factors can cause, this difference in response is called interaction between the two factors. If the interaction is not significant, then it can be concluded that the factors act independently of each other; the simple effect of a factor is the same at all levels of other factors within the limits of random variation.

It is suspected that the difference in varieties and the low pH in the eco enzyme treatment are important factors in determining the results obtained, in addition to low nutrient absorption through the leaves, causing insignificant results. Each variety has different yield potential and characteristics. In addition to the influence of pH, the lower nitrogen nutrient content causes the photosynthesis process to be less than optimal, thus affecting the translocation of assimilates into the tubers. This is according to the opinion of (Irawan et al., 2017), which states that one of the functions of nitrogen nutrients is as a chlorophyll former, which is a photosynthetic filament to produce photosynthate, which will be translocated to the tubers.

5. CONCLUSION AND SUGGESTIONS

Conclusion : Planting distance treatment J1 = (15cm x15cm), J2 = (15cm x20cm), J3 = (15cm x25cm) significantly affected the root length and bulb diameter per sample. However, it did not significantly affect the fresh weight of bulbs from shallot production. Eco enzyme concentration treatment with levels E1 = (0.8 ml ee / 240 ml water), E2 = (1.6 ml ee / 240 ml water), and E3 = (2.4 ml ee / 240 ml water) did not significantly affect all observation treatments. The interaction between planting distance and eco enzyme concentration did not significantly affect all observation treatments. Suggestion: Further research is needed to obtain the maximum planting distance and the eco-enzyme concentration treatment.

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