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Azolla Liquid Fertilizer *(Azolla pinnata)* And Chicken Manure Fertilizer on the Growth and Yield of Shallots

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ABSTRACT

This study aims to see the effect of giving Azolla liquid organic fertilizer and chicken manure on the growth and yield of shallots. The research method used a factorial Randomized Block Design (RAK) consisting of 2 factors with 16 combinations and 3 blocks. The first factor is the provision of azolla liquid organic fertilizer consisting of 4 levels, namely 0 ml / l water / m2, 200 ml / l water / m2, 400 ml / l water / m2, 600 ml / l water / m2. The second factor is the provision of chicken manure consisting of 4 levels, namely 0 kg / m2, 0.5 kg / m2, 1.0 kg / m2 and 1.5 kg / m2. The provision of azolla liquid organic fertilizer has a significant effect on the parameters of the number of tillers, the number / plant, the wet weight of bulbs / plant, the dry weight of bulbs / plant. The provision of azolla liquid organic fertilizer 600 ml / liter of water / m2 gave the best effect on all observation parameters. The provision of chicken manure gave a significant effect on the parameters of plant height, number of leaves, number of shoots, number of bulbs/ plant, wet weight of bulbs/plant, dry weight of bulbs/plant. The dose of chicken manure of 1.5 kg/m2 showed the best effect for all observation parameters. The interaction between the provision of liquid organic fertilizer azolla and chicken manure did not differ significantly in all treatments.

Keywords: Azolla, Chicken Manure, Red Onion

INTRODUCTION

Horticulture is an important part of the agricultural sector that has great potential to make a significant contribution to economic development. In addition, horticulture also plays an important role as a source of income for farmers, the trade sector, and creating jobs (Janet et al., 2020). Shallots are a horticultural plant that is a primary need as a complementary seasoning in everyday cooking (Ramadhan and Sumarni, 2018). Shallots play an important role in society, both in terms of their high economic value and their nutritional content.

Shallot production can only be carried out in one season which can cause an imbalance between supply and demand over the past five years. Based on 2022 data, North Sumatra Province is ranked sixth as one of the largest shallot producers in Indonesia. This province contributes 3.03% to the total national production, with a production volume reaching 65,585 tons (Central Statistics Agency, 2023).

Fertilizer is a crucial production factor for farmers. This is because fertilizer is a supplier of nutrients so that plant growth can be optimal so that the harvest yields are maximized. However, currently the amount of subsidized fertilizer is limited. It is recorded that the allocation of subsidized

fertilizer in 2022 is only around 37-42% of the total needs of farmers in Indonesia. On the other hand, the price of non-subsidized fertilizer is also considered expensive. As a result, of course, it will increase production costs for farmers. The soaring prices of various world commodities including gas and oil due to the pandemic, the energy crisis in Europe, the export ban policy, and the war between Russia and Ukraine have caused disruptions in fertilizer supply and soaring prices that have spread to inflation. The raw materials for NPK fertilizer are mostly imported from countries affected by the crisis, such as Russia and Belarus. The two countries contribute to 30 percent of the world's phosphate supply which is the raw material for NPK fertilizer.

LITERATURE REVIEW

Attention to agricultural biomass waste is still lacking. This plant biomass can be utilized and processed into new products that increase agricultural productivity. One of the aquatic plants that can be used as organic fertilizer is azolla (Azolla pinnata). Azolla is a type of aquatic fern that lives floating in aquatic environments and has a fairly wide distribution and is able to bind N2 from the air as a source of nitrogen nutrients (Suryati, 2014). Research by Andi *et al*., (2021) stated that liquid organic fertilizer azolla with a treatment of 15 ml/liter of water can increase plant height and fresh weight of green mustard (*Brassica juncea L*.). The administration of 250 ml/plant of liquid organic fertilizer azolla had a significant effect on plant height, number of fruits and weight of red chili fruit (Fathin, 2021). Nur's research (2023) stated that by giving 200 kg/ha of NPK fertilizer and 80 ml/liter of azolla liquid organic fertilizer, it had a significant effect on plant height, number of primary branches of jack beans (*Canavalia ensiformis)*

Valensa's research (2022) stated that the combination of Rhizobium and azolla liquid organic fertilizer had a significant effect on plant height, flowering age, net assimilation rate, stem growth rate, number of active root nodules, weight of 100 wet seeds, weight of 100 dry soybean seeds. The best treatment was at a dose of 20 g Rhizobium/kg of seed and 130 ml/1 water of azolla liquid organic fertilizer. Abdurahman's research (2019) giving azolla compost at a dose of 19.5 g/plant showed plant height, number of leaves, wet weight of bulbs and dry weight of shallot bulbs.

The increase in the need for chicken meat in recent years has caused the number of chicken farms to increase. According to BPS (2021), the population of broiler chickens is 2,960,493,660. The average chicken manure produced is 0.075 kg/head so that the amount of chicken manure produced is abundant but if not utilized it will be wasted and pollute the environment. Sajar (2021) stated that the results of soil analysis in the Glugur Rimbun area are soil with low fertility, rather low soil pH (5.59), poor in organic matter and nutrients N, P, K, Ca, Mg Ca, Na. Soil acidity and low macronutrient content are limiting factors for plant growth and high Al saturation can poison plants. After the application of chicken manure and chicken egg shells to the soil incubated for 2 weeks showed an increase in pH (6.39) and an increase in organic C, Ca, and soil phosphorus content.

One type of manure commonly used by farmers is chicken manure. Sajar (2023) stated that organic materials in the form of agricultural waste from chicken manure, chicken egg shells, and tofu industry waste can be used in organic soybean cultivation as a substitute for inorganic fertilizers, although the nutrients are low, they can improve the physical, chemical and biological properties of the soil. so that nutrients can be available in the soil. Generally, farmers prefer chicken manure because the N, P, K and Ca content is higher than other livestock manure (Setyorini, 2006). The results of the analysis of chicken manure by Balittan (2014) stated that the nutrient composition contained in chicken manure includes N (1.50%), P (1.30%), K (0.8%), Ca (4.0%), Mg C/N ratio 9-11% (Balittan, 2014). Meanwhile, the results of

Sajar's research (2022) stated that the results of the analysis of chicken manure contained 1.73% Nitrogen (N), 1.45% Phosphorus (P), 1.12% Potassium (K), and 18.15% Organic C. The N, P, and K content in chicken manure has a fairly high nutrient content so that chicken farm waste in the form of chicken manure and chicken egg shells can be used as soil conditioners to improve the physical, chemical and biological properties of the soil to increase the availability of nutrients in the soil.

The provision of 10 tons of chicken manure/ha can increase vegetative growth and organic soybean production. 2. Green manure Calopogonium mucunoides up to a dose of 15 kg of seeds/ha can increase vegetative growth of plants but has no effect on organic soybean production. 3. The interaction of manure doses and green manure doses affects the wet weight of root nodules and the wet weight of 100 grains. The highest wet weight of 100 grains was achieved by giving 15 kg of green manure seeds/ha or 10 tons of chicken manure/ha. Yadi and Sabarudiddin (2012) stated that organic chicken manure fertilizer had a significant effect on fruit length with the highest average obtained in the 20 ton/ha treatment, namely 22.36 cm, fruit weight (g fruit^{-1}) 382.78 g fruit^{-1} with the highest production of 48.23 t ha Firdany's (2021) research showed that a dose of 10 tons/ha of chicken manure fertilizer combined with 3.3 tons/ha of dolomite was able to improve the chemical properties of ultisol soil, namely soil pH, electrical conductivity, soil organic C and available P and had a good effect on the growth of caisim Based on the explanation above, the purpose of this study was to test Azolla sp as a liquid organic fertilizer and chicken manure on the growth and yield of shallots.

MATERIALS & METHODS

Research Location

This research was conducted in Sampecita Village, Kutalimbaru District, Deli Serdang Regency at an altitude of +/- 30 meters above sea level. February to May 2024.

Materials and Tools

Materials and tools used in this study are azolla sp plants, chicken manure, molasses, tarpaulin, buckets, hoes, burlap, machetes, ropes, meters, handsprayer, shovels, bamboo, calculators, scales and fertilizers, rulers, notebooks, watering cans and other tools that support the study

Type and Scope of Research

This study is an experimental study using a Factorial Randomized Block Design (RAK) consisting of 2 treatment factors and 3 blocks. Factor I. Liquid Organic Fertilizer Azolla (A) consisting of 4 treatment levels, namely:

A0 = No treatment (0 ml/l water/m2)
A1 = 200 ml/l water/m2
A2 = 400 ml/l water/m2
A3 = 600 ml/l water/m2

Factor II. Chicken Manure Fermented Mol Fertilizer consisting of 4 treatment levels, namely:

D0 = 0 kg/m2
D1 = 0.5 kg/m2
D2 = 1.0 kg/m2
D3 = 1.5 kg/m2

Research Procedure

The land for the study was cleared of weeds and fenced to prevent damage to plants from animal disturbances around the study location. This study was conducted with 3 replications, a distance between replications of 50 cm, 48 experimental plots measuring 100 cm x 100 cm and a distance between experimental plots of 50 cm. The distance between shallot plants used in this study was 20 cm x 20 cm, with the number of plants per plot 16 plants, the number of sample plants 8 plants, the total number of sample plants 384 plants, and the total number of plants as many as 768 plants.

Making Liquid Organic Azolla Fertilizer

Azolla sp that has been dried under the sun is put into a bucket containing water, EM4 and molasses. Next, stir until evenly mixed, the bucket is tightly closed and stored in a shady place so that it is not exposed to direct sunlight. The fermentation process is carried out for 14 days, during the fermentation process, stirring is carried out

once a day. The criteria for finished fertilizer is that it has an aroma like tape. Then the results of the fermentation of liquid organic fertilizer for water ferns are filtered to separate the dregs and liquid, and the filtered liquid is stored in a closed place and is ready to be used directly on plants.

Making Chicken Manure

The materials used are chicken manure collected from chicken farms, rice husks, rice molasses, 200 ml of molasses. Mix the molasses into 2 liters of water and the rice molasses is stirred until evenly mixed. Then spray it on the chicken manure that has been mixed with rice husks until the chicken manure is moist enough, covered with a tarpaulin so that humidity can be maintained. Every week the chicken manure mixture is turned over and stored in a shady place. After 3 weeks, the organic fertilizer made from chicken manure is ready to be used by air drying for one day.

Planting

The application of chicken manure is carried out 2 weeks before planting by stirring until evenly mixed with the soil according to the treatment. The soil is ready to be used to see its effect on the growth and production of shallots (indicator plants).

Planting shallots with bulbs is done in the afternoon. The soil is made into a hole with a depth of 3-5 cm with a planting distance of 20 x 20 cm. The bulbs are cut at the top and then the bulbs are placed in the hole and then the surface is covered with thin soil. The insertion of shallot plants is done one week after planting, if there are dead plants in the experimental plot. Dead plants are removed, collected and discarded and then replaced with new plants. Liquid organic fertilizer for water ferns is given in the 2nd, 4th, and 6th weeks after planting. Application is done by watering directly around the plant stem according to the specified treatment.

Watering is done every day in the morning and evening. Weeding is done once a week depending on the growth of weeds in each plot and research area. This is done manually by pulling out the weeds directly and loosening the soil. Shallots can be harvested after they are old enough, usually at the age of 60-70 days. The shallot plants are harvested after signs such as 60% soft stem neck, fallen plants and yellowing leaves are seen. Harvesting should be carried out in dry soil conditions and sunny weather to prevent attacks of bulb rot disease.

All data were analyzed using analysis of variance at a test level of 5% to determine the difference in the effect of treatments that can be seen in the significance of the F count. For variables with a calculated F that shows significance at a test level of 5%, a real difference test is carried out based on the Duncan Multiple Range Test at a level of α 5% to determine the difference between treatments

RESULT

Shallot Growth

Table 1 shows the effect of administering liquid organic fertilizer azolla and chicken manure on the growth of shallots. The administration of liquid organic fertilizer azolla did not have a significant effect between treatments on plant height at 6 weeks after planting. The highest height of shallots at 6 weeks after planting was obtained in the treatment of 600 ml/liter of liquid organic fertilizer azolla (29.14 cm) which was not significantly different from 400 ml/liter of liquid organic fertilizer azolla (28.55 cm), 200 ml/liter of liquid organic fertilizer azolla (27.42 cm), 0 ml/liter of water (27.41 cm).

Table 1. Effect of Azolla Liquid Organic Fertilizer and Chicken Manure on the Growth of Shallots

Treatment	Plant height		Number of leaves		Number of tillers	
Azolla liquid fertilizer	……cm…….		….leaves ..		……tillers……	
0 ml/liter of water	27.41	a	28.94	a	6.72	a
200 ml/liter of water	27.42	a	28.99	a	7.17	b
400 ml/liter of water	28.55	a	29.47	a	7.21	b

600 ml/liter of water	29.14	a	31.16	a	7.8	c
Chicken manure fertilizer	……cm…….		….leaves ..		……tillers……	
0 kg/m2	26.29	a	27.66	a	7.02	a
0,5 kg/m2	28.52	b	29.56	a	7.02	a
1,0 kg/m2	28.58	b	30.35	b	7.28	a
1,5 kg/m2	29.13	b	30.99	b	7.58	b

Description: Numbers followed by the same letter in the same column indicate no significant difference at the 5% level based on the Duncan Range Test (DMRT).

The provision of chicken manure showed a significant effect between the treatment of 0 kg/m2 chicken manure and other treatments. The highest height of the shallot plant was obtained with the provision of 1.5 kg/m2 chicken manure (29.13 cm) which was not significantly different from the treatment of 1 kgm2 chicken manure (28.58 cm), 0.5 kg/m2 chicken manure (28.52 cm) but significantly different from without chicken manure treatment (0 kg/m2) which was 26.29 cm. Figure 1 shows that chicken manure application is linearly positive with the equation y = 1.7135x + 26.844 with a coefficient of determination of 0.777 or has a close relationship of 0.8815 or 88.15% between chicken manure application and onion plant height at 6 MST and there are still 11.85% other variables that affect plant height. Each increase in chicken manure dose of 0.5 kg/m2 will increase plant height by 1.7135 cm. The constant value of 1.7135x shows that without chicken manure, the plant height is only 26.84 cm. This also shows that the higher the dose of chicken manure given, the height of the onion plant will increase by 1.7135 cm.

The provision of liquid organic azolla fertilizer did not have a significant effect on increasing the number of leaves at 6 MST. However, the provision of 600 ml/l of liquid organic fertilizer azolla water showed the highest number of leaves (31.16 leaves) and the lowest in onion plants without the provision of liquid organic fertilizer (28.94 leaves).

The treatment of chicken manure had a significant effect on increasing the number of leaves. The provision of chicken manure at doses of 0 kg/m2 and 0.5 kg/m2 did not differ significantly on the number of leaves but was significantly different from the treatment of doses of 1.0 kg/m2 and 1.5 kg/m2. The highest number of leaves was at a dose of 1.5 kg/m2 (30.99 leaves) and the least 27.66 leaves (0 kg/m2). The provision with a combination of liquid organic fertilizer azolla and chicken manure did not show a significant effect on increasing the number of red onion leaves.

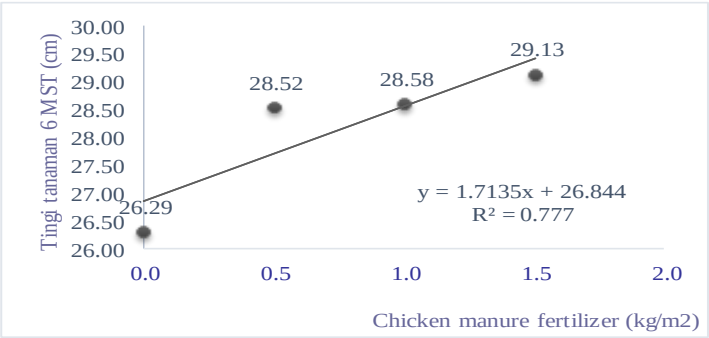

Figure 1. Relationship between chicken manure application and onion plant height at 6 MST

Figure 2 shows that the provision of chicken manure is linearly positive with the equation y = 2.1583x + 28.022 with a coefficient of determination of 0.9303 or has a close relationship of 0.9645 or 96.45% between the provision of chicken manure and the number of shallot leaves at 6 MST and there are still 3.55% other variables that affect the number of shallot leaves.

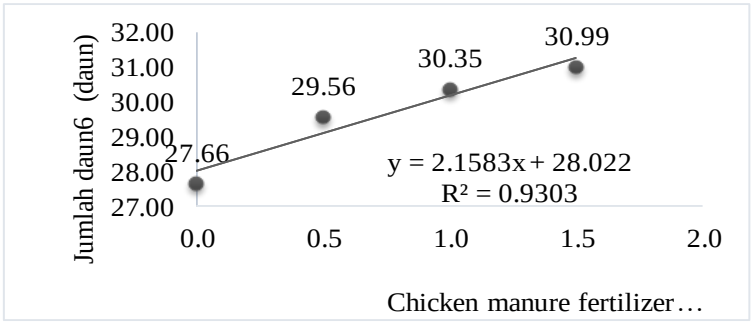

Figure 2. Relationship Between Chicken Manure Application and the Number of Shallot Leaves at 6 MST

Every increase in chicken manure dosage of 0.5 kg/m2 will increase the number of leaves by 2.1583 leaves. The constant value of 2.1583x shows that without chicken manure, the number of leaves is only 28.022 leaves. This also shows that the higher the dose of chicken manure given, the number of shallot leaves will increase by 2.1583 leaves.

Application of liquid organic azolla fertilizer showed a significant effect on the number of shallot shoots. The highest number of shoots was in the 600 ml/l water treatment (7.80 shoots) and the lowest in the treatment without liquid organic azolla fertilizer (6.72 shoots).

The chicken manure treatment had a significant effect on the number of shallot shoots. In the chicken manure treatment with doses of 0 kg/m2 and 0.5 kg/m2 and 1.0 kg/m2, there was no significant difference in the number of shoots but it was significantly different from the 1.5 kg/m2 dose treatment. The highest number of tillers was at a dose of 1.5 kg/m2 (7.58 tillers) and the least was 7.02 tillers (0 kg/m2). The combination of interactions in the treatment of azolla liquid organic fertilizer and chicken manure did not differ significantly from all treatments.

Figure 3 shows that the administration of azolla liquid organic fertilizer is linearly positive with the equation y = 0.0016x + 6.7352 with a coefficient of determination of 0.9119 or has a close relationship of 0.9549 or 95.49% between the administration of azolla liquid organic fertilizer and the number of shallot tillers at 7 MST and there are still 2.28% other variables that affect the number of tillers. shallots. Each increase in the dose of azolla liquid organic fertilizer of 200 ml/liter of water will increase the number of tillers by 0.0016 tillers. The constant value of 0.0016x shows that without azolla liquid organic fertilizer, the number of tillers is only 6.7352 tillers. This also shows that the higher the dose of liquid organic azolla fertilizer given, the height of the shallot plant will increase by 0.0016.

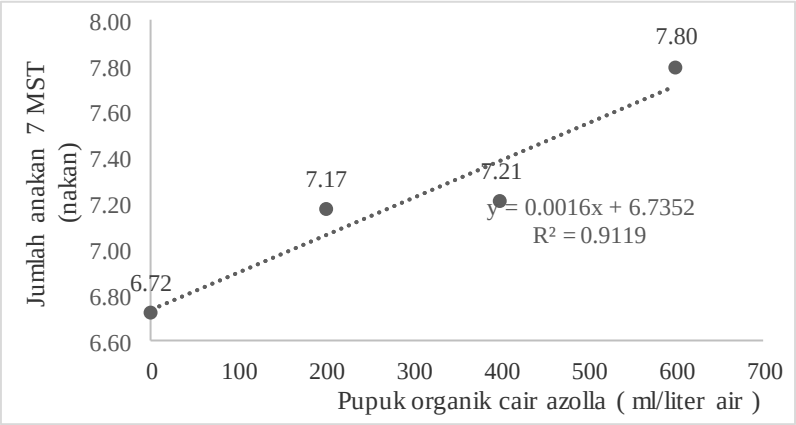

Figure 3. Relationship between the provision of Azolla liquid organic fertilizer and the number of tillers 7 MST

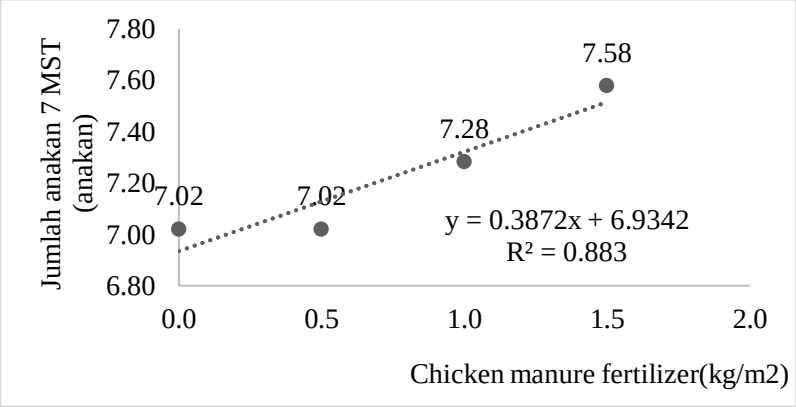

Figure 4. Relationship Between Chicken Manure Provision and the Number of Shallots at 7 MST

Figure 4 shows that the provision of chicken manure is linearly positive with the equation y = 0.3872x + 6.9342 with a coefficient of determination of 0.883 or has a close relationship of 0.9127 or 91.27% between the provision of chicken manure and the number of shallots at 7 MST and there are still 8.73% other variables that affect the number of shallots. Each increase in the dose of chicken manure of 0.5 kg/m2 will increase the number of shallots by 0.3872 leaves. The constant value of 0.3872 x shows that without chicken manure, the number of shallots is only 6.9342. This also shows that the higher the dose of chicken manure given, the number of shallots will increase by 0.3872.

Shallot Production

Table 2 shows the average yield of shallot plants due to the provision of liquid organic fertilizer azolla and chicken manure. The provision of liquid organic fertilizer azolla gave a significant effect between treatments on the number of shallot bulbs. The highest number of shallot bulbs/plant was obtained in the treatment of 600 ml of liquid organic fertilizer azolla (53.33 bulbs, no different from the provision of 400 ml/liter of liquid organic fertilizer water (51.42 bulbs) but significantly different from 200 ml/liter of liquid organic fertilizer azolla (43.75 bulbs) and 0 ml/liter of water (36.92 bulbs).

Table 2. Effect of Provision of Liquid Organic Fertilizer Azolla and Chicken Manure on Shallot Plant Yield

Treatment	**Number bulbs/plant**		**Bulbs wet weight/plant**		**Bulbs kennel weight/plant**	
Azolla liquid fertilizer	…bulbs…….		…….gram….		……gram……	
0 ml/liter of water	36.92	a	31.85	a	18.9	a
200 ml/liter of water	43.75	a	34.54	a	20.3	a
400 ml/liter of water	51.42	b	41.87	b	24.6	b
600 ml/liter of water	53.33	b	44.96	b	31.4	c
Chicken manure fertilizer	…bulbs…….		…….gram….		……gram……	
0 kg/m2	41.08	a	32.56	a	16.9	a
0,5 kg/m2	44.42	a	36.97	a	20.1	a
1,0 kg/m2	49.08	b	40.05	b	26.6	b
1,5 kg/m2	50.83	b	43.66	b	31.7	c

Description: Numbers followed by the same letter in the same column indicate no significant difference at the 5% level based on the Duncan Range Test (DMRT).

Figure 5 shows that the provision of azolla liquid organic fertilizer is linearly positive with the equation y = 0.0285x + 37.817 with a coefficient of determination of 0.9518 or 0.9518 or has a close relationship of 0.9756 or 97.56% between the provision of azolla liquid organic fertilizer and the number of shallot bulbs per plant and there are still 2.44% other variables that affect the number of shallot bulbs.

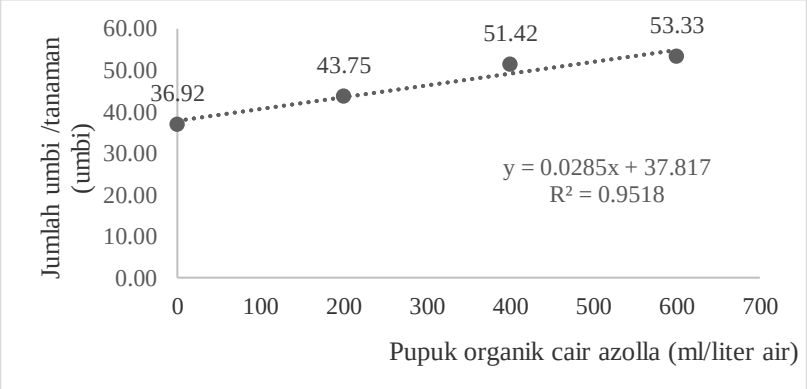

Figure 5. Relationship between the Application of Liquid Organic Fertilizer Azolla and the Number of Bulbs/Shallot Plants

Each increase in the dose of azolla liquid organic fertilizer of 200 ml/liter of water will increase the number of bulbs by 0.0285x. The constant value of 0.0285x shows that without azolla liquid organic fertilizer, the number of bulbs is only 37.817 bulbs. This also shows that the higher the dose of azolla liquid organic fertilizer given, the height of the shallot plant will increase by 0.0285.

The provision of chicken manure showed a significant effect between the treatment of 0 kg/m2 chicken manure and other treatments. The number of bulbs per shallot plant was highest when the chicken manure was given 1.5 kg/m2 (50.83 bulbs) which was not significantly different from the treatment of 1 kgm2 chicken manure (49.08 bulbs), but significantly different from 0.5 kg/m2 chicken manure (44.42 bulbs) and without chicken manure treatment (0 kg/m2) which was 41.08 bulbs.

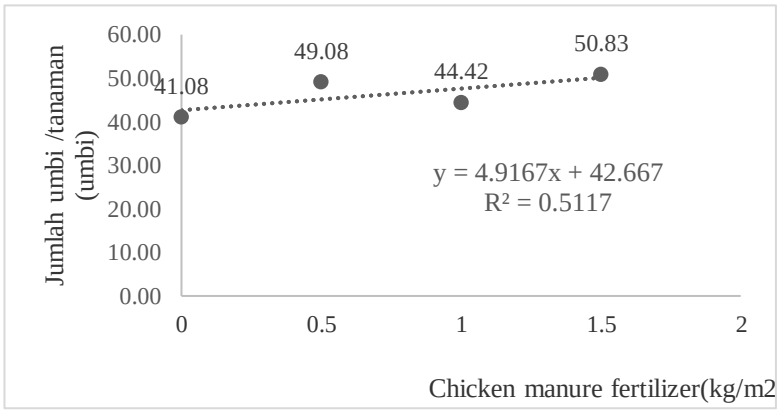

Figure 6. Relationship between Provision of Chicken Coops and the Number of Bulbs/Shallot Plants.

Figure 6 shows that the provision of chicken coops is linearly positive with the equation y = 4.9167x + 42.667 with a coefficient of determination of 0.5117 or has a close relationship of 0.7153 or 71.53% between the provision of chicken coops and the number of bulbs/shallot plants and there are still 28.47% other variables that affect the number of bulbs/shallot plants. Each increase in the dose of chicken coops of 0.5 kg/m2 will increase the number of offspring by 4.9167 bulbs. The constant value of 4.9167 x shows that without chicken coops, the number of bulbs is only 42.667. This also shows that the higher the dose of chicken coops given, the number of shallot bulbs will increase by 4.9167 bulbs.

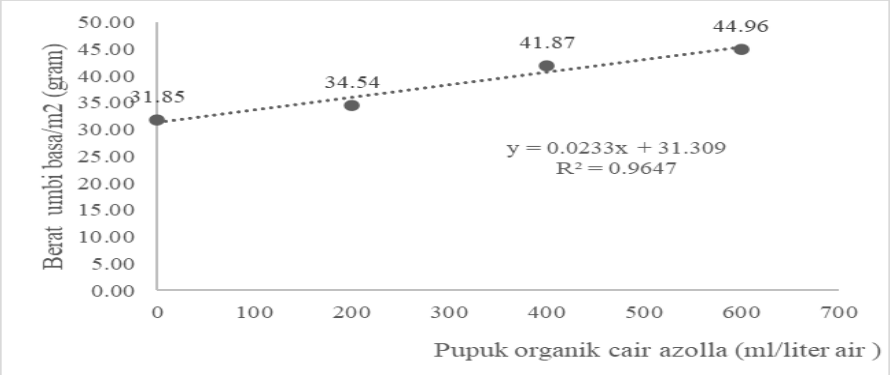

Figure 7. Relationship Between the Application of Liquid Organic Azolla Fertilizer and the Weight of Wet Bulbs per Plant

The provision of chicken manure showed a significant effect on the wet weight of bulbs/plants between the treatment of 0 kg/m2 chicken manure and other treatments. The wet weight of bulbs per plant was highest in the provision of 1.5 kg/m2 chicken manure (43.66 grams) which was not significantly different from the treatment of 1 kgm2 chicken manure (40.95 grams) but significantly different from 0.5 kg/m2 chicken manure (36.97 grams), without chicken manure treatment (32.56 grams). Figure 7 shows that the provision of azolla liquid organic fertilizer is linear positive with the equation y = 0.0233x + 31.309 with a determination coefficient of 0.9647 or has a close relationship of 0.9822 or 98.22% between the provision of azolla liquid organic fertilizer and the wet tuber weight per plant and there are still 1.78% other variables that affect the wet tuber weight/plant. Each increase in the dose of azolla liquid organic fertilizer of 200 ml/liter of water will increase the weight of wet bulbs/plants by 0.0233 grams. The constant value of 0.0233x shows that without azolla liquid organic fertilizer, the weight of wet bulbs/plants is only 31.309 grams. This also shows that the higher the dose of azolla liquid organic fertilizer given, the weight of wet bulbs/shallot plants will increase by 0.0233 grams.

Figure 8 shows that the application of chicken manure is linearly positive with the equation y = 7.2749x + 32.85 with a determination coefficient of 0.9950 or has a close relationship of 0.9975 or 99.75% between the application of chicken manure and the weight of wet bulbs per plant and there are still 0.25% other variables that affect the weight of wet bulbs per shallot plant.

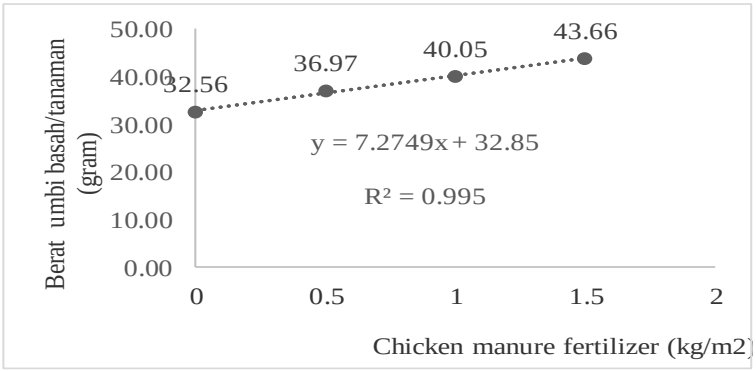

Figure 8. Relationship Between Provision of Chicken Coops and Wet Weight of Bulbs/Plants

Every increase in the dose of chicken manure of 0.5 kg/m2 will increase the wet weight of bulbs by 7.2749 grams. The constant value of 7.2749x shows that without chicken manure, the wet weight of bulbs is only 32.85 grams. This also shows

that the higher the dose of chicken manure given, the wet weight of bulbs per plant will increase by 7.2749 grams.

The results of the study showed that the provision of liquid organic azolla fertilizer had a significant effect between treatments on the dry weight of bulbs/plants. The highest dry weight of shallot bulbs was obtained in the treatment of 600 ml of liquid organic azolla fertilizer (31.44 grams) which was significantly different from 400 ml.liter of water of liquid organic azolla fertilizer (24.57 grams) and 200 ml/liter of water of liquid organic azolla fertilizer (20.33 grams), 0 ml/liter of water (18.85 grams).

The provision of chicken manure showed a significant effect between the treatment of 0 kg/m2 chicken manure and other treatments. The highest dry weight of shallot bulbs was obtained from the provision of 1.5 kg/m2 chicken manure (31.67 grams) which was significantly different from the treatment of 1 kgm2 chicken manure (26.61 grams), 0.5 kg/m2 chicken manure (20.07 grams), without chicken manure treatment (0 kg/m2) which was 16.85 grams.

Figure 9 shows that the provision of chicken manure is linearly positive with the equation y = 10.202x + 16.148 with a coefficient of determination of 0.9849 or has a close relationship of 0.9924 or 99.24% between the provision of chicken manure and the dry weight of bulbs/plants and there are still 0.76% other variables that affect the dry weight of bulbs/plants. Each increase in the dose of chicken manure of 0.5 kg/m2 will increase the dry weight of the bulbs by 10.202 grams. The constant value of 10.202x shows that without chicken manure, the weight of dry bulbs/plants is only 16.148 grams. This also shows that the higher the dose of chicken manure given, the dry weight of bulbs/plants will increase by 16.148 grams.

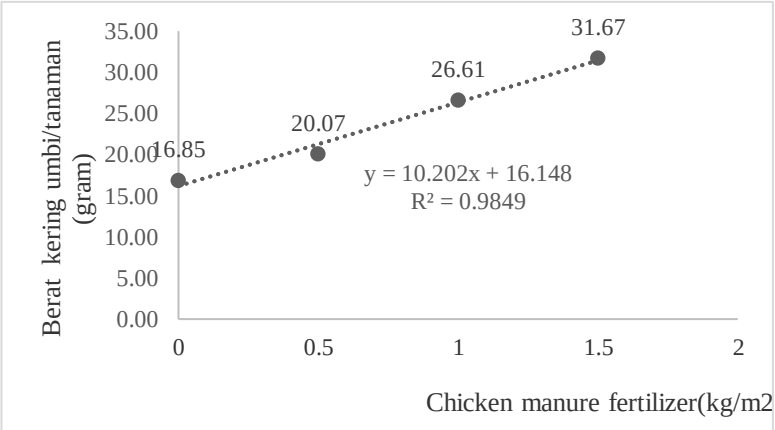

Figure 9. Relationship between the provision of chicken coops and the dry weight of bulbs/plants

Figure 10 shows that the application of liquid organic fertilizer azollaa is linear positive with the equation y = 0.021x + 17.496 with a coefficient of determination of 0.9241 or has a close relationship of 0.9613 or 96.13% between the application of liquid organic fertilizer azolla and the weight of wet bulbs/plants and there are still 1.95% other variables that affect the dry weight of bulbs/plants. Each increase in the dose of liquid organic fertilizer azolla 200 ml/liter of water will increase the dry weight of bulbs/plants by 0.021 grams. The constant value of 0.021x shows that without liquid organic fertilizer azolla, the number of tillers is only 17.496 grams. This also shows that the higher the dose of liquid organic fertilizer azolla given, the dry weight of bulbs/plants will increase by 0.021 grams.

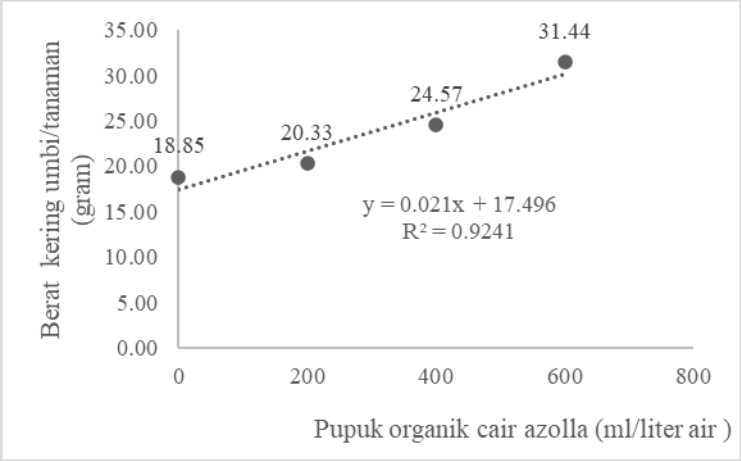

Figure 10. Relationship Between Liquid Organic Fertilizer Azolla and Dry Bulb Weight per Plant

DISCUSSION

Azolla Liquid Organic Fertilizer on the Growth and Production of Shallots

The provision of azolla liquid organic fertilizer did not have a significant effect on the height of shallot plants 6 MST, as well as the number of leaves in observations 6 weeks after planting. However, a real difference was seen in the number of shoots. Observation parameters such as the number of bulbs/plant, wet weight of bulbs/plant, dry weight of bulbs/plant also showed significant differences compared to other treatments.

Table 3 shows the results of the analysis of liquid organic fertilizer azolla based on the results of laboratory analysis of the Food Crops Research Institute (2023) containing N-total of 0.03%, P2O5 of 0.11%, K2O of 0.59%, C-organic of 1.44%, pH of 3.88%, When viewed from the results of the analysis of the content of liquid organic fertilizer azolla N content of 0.03% does not meet the Decree of the Minister of Agriculture No.261 / KPTS / SR.310 / M / 4/2019 concerning the minimum technical requirements for organic fertilizers (minimum requirement 0.5%), P2O5 of 0.11% (minimum requirement 2-6%), K2O of 0.59% (minimum requirement 2-6%), C-organic of 1.44% (minimum requirement 10%), pH of 3.88 (minimum requirement 4-9) (Ministry of Agriculture, 2019).

Table 3. Laboratory Analysis of Liquid Organic Fertilizer Azolla

No	Type of Analys	Value	Methode
1	C org	1.44 %	Spectrofotometri
2	N tot	0.03%	IK 0.3.14.0 (Kjeldahl)
3	P2O5	0.11%	IK 0.3.15.0 (Spectrofotometri)
4	K2O	0.59%	IK 0.3.16.0 (AAS)
5	pH	3.88%	IK 0.3.12.0 (Elektrometri)

Source: results of BPTP laboratory tests 2023

The treatment of liquid organic fertilizer azolla at a dose of 600 ml/liter of water gave the best results for the parameters above, this is thought to be sufficient at this dose to meet the nutrient needs in the soil. This liquid organic fertilizer azolla is easily soluble in the soil and is thought to be able to increase the availability of soil nutrients through changes in the physical, chemical and biological properties of the soil because when viewed from the nutrient content that has been analyzed in the laboratory (Table 3) shows a low nutrient content, but because it contains organic compounds needed by soil microorganisms, it increases the activity of soil microbes in the process of mineralizing nutrients in the soil which will ultimately increase the availability of nutrients in the soil.

Liquid organic fertilizers generally do not damage the soil and plants even if used as often as possible. In addition, liquid organic fertilizers also have a binding agent so that the fertilizer solution given to the soil surface can be used directly by the soil (Lingga and Marsono, 2003). Pangaribuan *et.al (*2017) stated that the combination of liquid organic fertilizer and inorganic fertilizer (Urea, SP-36, and KCl) 20% recommendation can be an alternative fertilizer for sweet corn that is more economical because its growth and production are the same as the recommended inorganic fertilizer. Liquid organic fertilizer (POC) contains nutrients and microbes that are good for plant growth. These microbes include lactic acid bacteria, photosynthetic bacteria, Saccharomyces sp, Actinomycetes, and fermentation fungi. Liquid organic fertilizer can be used to restore nutrients contained in the soil. Liquid organic fertilizer is in liquid form so it is easily dissolved in the soil and carries elements that make the soil fertile. Thus, the provision of liquid organic fertilizer made from azolla can help increase the growth and yield of red chili plants, and when viewed from the content of liquid organic fertilizer made from azolla, it contains macro elements such as nitrogen (N), phosphorus (P), potassium (K) the provision of liquid organic fertilizer made from azolla with the right dose can reduce the dose of NPK fertilizer use. The dosage of 250 ml/plant of azolla liquid organic fertilizer gave better results on the parameters of general plant height at 11 MST, relative growth rate (LPN) at age 5-6 MST. The treatment of 250 ml/plant of azolla liquid organic fertilizer also gave better results on the parameters of the number of fruits per plant, fresh fruit weight per experimental plot and fresh fruit weight per hectare.

The use of organic fertilizer that is more effective and efficient is in the form of liquid fertilizer. Liquid fertilizer is more easily absorbed by plants because the elements in it have been decomposed. Plants not only absorb nutrients through the roots but also through the leaves of the plant. The use of liquid fertilizer is easier to work on and use, in one application of liquid organic fertilizer, 3 types of processes are carried out at once, namely: fertilizing plants, watering plants and treating plants (Pratama, 2008).

The results obtained after conducting research in the field are close to the hypothesis, namely the administration of azolla liquid organic fertilizer with a dose of 250 ml/plant and the use of NPK fertilizer 3/4 of the normal dose can increase the growth and yield of the highest red chili plants. This is thought to be because the provision of liquid organic azolla fertilizer with the highest dose of 250 ml/plant can provide the nutritional needs required by red chili plants during the growth phase. The higher the dose given, the more nutrients are received by red chili plants. According to Wenda et al., (2017) the higher the concentration or dose of fertilizer given, the higher the nutrient content received by the plants, as well as the more frequent the frequency of fertilizer application carried out on plants, the higher the nutrient content. In addition, there are various nutrients in liquid organic azolla fertilizer, both micro and macro elements. One of the macro elements contained in liquid organic azolla fertilizer is nitrogen (N). This element plays a very important role in the vegetative growth process.

According to Bambang (2007) the element K helps the formation of proteins and carbohydrates which play a role in plant growth, pod and seed formation. The micro elements contained in liquid organic azolla fertilizer include Fe. According to Sutedjo (2008), the function of iron (Fe) plays an important role in the formation of carbohydrates, fats, and proteins which have an impact on fruit weight. In the study of Luta et al (2020), it was stated that liquid organic fertilizer made from water fern (Azolla pinata) was able to increase the vegetative growth of oil palm seedlings and suspected that the Nitrogen content in liquid

organic fertilizer was sufficient for plant needs.

Chicken Manure on the Growth and Production of Shallots

The provision of chicken manure since the beginning of growth gives a real difference in the parameters of plant height, number of leaves, number of shoots, number of bulbs per plant, wet weight of bulbs per plant, dry weight of bulbs per plant. The dose of chicken manure 1.5 kg/m2 showed the best effect for all observation parameters. It is suspected that the nutrient content of chicken manure is able to meet the nutrient needs of shallot plants. Based on laboratory analysis, BPTP (2024) stated that chicken manure contains 1.73% Nitrogen (N), 1.45% Phospor (P), 1.12% Potassium (K), and 18.15% C-Organic. The N, P, and K content contained in chicken manure has a high nutrient content (Hartatik and Widowati, 2006). This is in accordance with the opinion of Mayadewi (2007) that chicken manure can increase the availability of nutrients for plants that can be absorbed from the soil. The production of one plant is the result of photosynthesis, decreased assimilates due to respiration and translocation of dry matter into the plant's yield. The high production of shallots given chicken manure with the right dose cannot be separated from the influence of the net results of plant growth and development.

Chicken manure contains nitrogen which acts as the main component in the formation of chlorophyll, and functions as an activator of protein synthesis enzymes and carbohydrate metabolism. In addition, this fertilizer also contains phosphorus which plays an important role in energy transfer in plant cells, and magnesium which acts as a component of chlorophyll formation and helps the movement of phosphorus in plants. Increasing chlorophyll, the photosynthate formed will be greater and encourage cell division and cell differentiation, where cell division is closely related to the growth of plant organs. Furthermore, according to Sudaryono and Heri (2011), that in acidic soil has a low level of fertility caused by poor macronutrients (N, P, K, Ca, Mg, S), micronutrients (Zn, Mo, Cu, B), and low levels of organic matter. At low pH, it causes high levels of Al, Fe, and Mn dissolved in the soil so that it can poison plants. High P fixation rates, soil properties that are sensitive to erosion, and poor in microorganisms. According to Sutedjo (2008), a deficiency of one or more nutrients will cause plant growth to be abnormal.

Nitrogen functions to increase the rate of photosynthesis by stimulating protein synthesis in plant cells, especially in the formation of bulbs. The mechanism of action of nitrogen also plays a role in the formation of larger leaf layers, which occurs through the formation of nucleic acids. Nucleic acids play an important role in the cell nucleus in the cell division process, which allows for the formation of optimal leaf layers and good development of shallot bulbs (Zamriyeti *et. al,* 2021). The treatment that produces the most optimal growth and production is obtained in the treatment of chicken manure at a dose of 1.5 kg/m2. The higher the dose of fertilizer, the higher the amount of nutrients (such as P, K, and organic matter) that affect soil characteristics, allowing for an increase in soil pH (Tufaila et al., 2014).

In general, the research on the treatment of liquid organic fertilizer azolla and chicken manure in terms of production in the field is lower than the potential production of the Bima Brebes variety, this is because during the research there was often rain with quite high intensity. The land used was a rice field that was watery when it rained and caused the land to be flooded for quite a long time. Pest attacks in the research area were quite high due to the presence of armyworm pests (Spodoptera litura) which attacked when the plants were 40-50 days old. Pests and diseases that attack at the age of 40-50 days. The success of shallot cultivation can be seen from the ability of

the plants to produce bulbs. Rahmah (2013) stated that chicken manure with a dose of 30 tons/ha on shallots was able to increase the data on wet weight and dry weight of plants compared to the control because it provided the elements needed for division and extension of plant cells. Potassium is an important element in the process of bulb formation. This element is highly absorbed by plants because plants can only absorb nutrients in the form of cations (K +). Potassium plays a role in the formation of sugar and starch, as well as in protein synthesis. In addition, potassium also functions as a catalyst in enzymatic reactions, helps neutralize organic acids, and plays a role in the growth of meristem tissue. Potassium is a macronutrient that influences the formation of plant organs in the form of bulbs, leaves and meristem tissue. Potassium acts as an enzymatic catalyst in metabolism and the formation of sugar and starch in protein synthesis, thus helping the formation and enlargement of plant organs (Budianto and Madauna, 2015).

The application of organic fertilizers can increase pH, C-Organic, CEC and N-Total of the soil Luta *et al* (2020). Organic fertilizers have a significant role in improving the physical characteristics of the soil, including structure, consistency, porosity, water retention capacity, and preventing soil erosion. In addition, organic fertilizers also contain growth hormones such as auxins and gibberellins which have the ability to stimulate plant growth from the germination stage to fruit formation (Purba *et al.*, 2018). The use of organic fertilizers has advantages, including complete macro and micro nutrient content, maintaining the life of organisms in the soil, the release of organic nutrients that occurs slowly to prevent excessive nutrient supply, the ability to mobilize nutrients that are already in the soil so that they are easily absorbed by plants, and the ability to improve the chemical properties of the soil

Interaction of Chicken Manure and Azolla sp Liquid Organic Fertilizer on the Growth and Production of Shallots

Based on statistical data analysis, there is no significant difference in all observation parameters due to the combination of azolla liquid organic fertilizer with chicken manure on the growth and production of shallots (A. ascalonicum L). From the average data on all observation parameters, there is a tendency for increased growth and production of shallots, although the analysis of variance is not significantly different.

Discuss findings of your study with relevant reasoning along with proper citations/references.

CONCLUSION

1. Application of liquid organic fertilizer azolla on the growth and yield of shallot plants has a significant effect on the parameters of the number of tillers, the number of bulbs per plant, the wet weight of bulbs per plant, the dry weight of bulbs per plant. Application of liquid organic fertilizer azolla 600 ml/liter of water/m2 has the best effect on all observation parameters.
2. Application of chicken manure on the growth and yield of shallot plants has a significant effect on the parameters of plant height, number of leaves, number of tillers, number of bulbs per plant, the wet weight of bulbs per plant, the dry weight of bulbs per plant and the dose of chicken manure 1.5 kg/m2 shows the best effect for all observation parameters.
3. The interaction of application of liquid organic fertilizer azolla and chicken manure is not significantly different in all treatments

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