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Response of Growth and Yield of Sweet Corn (Zea mays saccharata Sturt) to Giving Tofu Liquid Waste and Chicken Manure Fertilizer

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ABSTRACT

This study aims to determine the response of growth and yield of Sweet corn crops (Zea mays saccharata Sturt) on the provision of liquid waste tofu and chicken manure. This research was arranged by using Randomized Block Design with treatments, namely: Control (P0), liquid waste tofu 300 ml (P1), liquid waste tofu 600 ml (P2), chicken manure (P3), liquid waste tofu 300 ml + chicken manure (P4), liquid waste tofu 600 ml + chicken manure (P5) with 4 replications. The variables observed in this study consist of; plant height, number of leaves, number of cobs, cob weight and wet weight of the plant. Data were analyzed by using variance test (Anova) followed by Duncan 5% test. The results showed that the liquid waste treatment of 600 ml + chicken manure can increase the plant height, the number of leaves, the number of cobs, the weight of the cob and the wet weight of the plant. The best crop yields were found in the treatment of liquid waste of 600 ml + manure (P5) because it was able to increase plant height 61.20%, leaves 40.16%, cobs 79%, cob weight 564,74%, wet weight 163, 83% compared with control treatment (P0).

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1. INTRODUCTION

Corn (Zea mays L.) is a type of grain food plant from the Graminiae family. This plant is one of the important food crops, besides wheat and rice(Nazirah & Marpaung, 2021). Apart from being a source of carbohydrates, corn can be used as animal feed, namely cobs and leaves as forage. The seeds can be made into oil or into corn flour (maizena). Seed flour and cob flour can be used as industrial raw materials. Corn cobs are rich in pentose, which can be used as a raw material for making furfural. Corn that has been genetically modified is now grown as a producer of pharmaceutical ingredients(Setyastiawan et al., 2010).

Maize production in North Kalimantan during the period 2009 to 2013 according to data from the Central Statistics Agency, namely 2009 totaling 12,520 tons, 2010 totaling 11,994 tons, 2011 totaling 7,340 tons, 2012 totaling 9,940 and in 2013 decreased to only around 973 tons (BPS Tarakan, 2016). One effort to increase the production of sweet corn is by applying fertilizer.

Fertilization means adding nutrients to the soil and plants. Fertilization is the act of providing additional nutrient elements to the soil complex, either directly or indirectly, can contribute food to plants(Mansyur et al., 2021). The goal is to improve soil fertility so that plants get enough nutrients to increase the quality and quantity of plant growth.

The use of organic fertilizers can be a solution in reducing the excessive application of inorganic or chemical fertilizers to the soil, this is because organic matter can improve the physical, chemical and biological properties of the soil.(Pranata, 2010). Utilization of various wastes into organic fertilizer is an effort to overcome the problem of environmental pollution, with high organic matter, waste can act as a source of organic food by microbial growth.(Pramushinta & Yulian, 2020). Organic fertilizers can be in the form of solid fertilizers and liquid fertilizers, one of which is tofu liquid waste fertilizer.

Tofu waste is waste generated in the process of making tofu and when washing soybeans. The waste generated is in the form of solid and liquid waste. The impact of the solid waste from the tofu industry has not been felt because the solid waste from the tofu industry can be used as animal feed(Rosalina, 2008).

Tofu waste has a high organic content of protein in tofu liquid waste if it is decomposed by soil microbes it will release N compounds which will eventually be absorbed by plant roots.(Asmoro & Suranto, 2008)so that tofu waste has the potential to be used as organic fertilizer (Rosallina, 2008). The results of Novita's research (2009), showed that watering tofu wastewater with a concentration of 25% produced the best values for all parameters of mustard greens growth by watering it once a week. Study(Marian & Tuhuteru, 2019), adding 20% of tofu waste and 1 kg of soil to Chinese cabbage (Brassica chinensis) can increase Chinese cabbage yield three times.

2. METHOD

2.1 Time and place

This research was carried out at St.Eugenius Gardens (in front of Borneo Tarakan University) from June to August 2017.

2.2 Tools and materials

The materials used in the study were corn seeds of the Bonanza F-1 variety, water, manure (chicken manure), tofu liquid waste, furadan 3 G. The tools used in this research were hoes, tape measure, buckets, dippers, machetes, hammers, gembor, hand sprayer, measuring cup, scissors, analytical balance, oven, raffia rope, pH meter.

2.3 Research methods

This research was arranged using a randomized block design (RBD) with 1 factor and 4 replications consisting of 6 treatment levels, namely: P0: Control, P1: 300 ml of tofu liquid waste, P2: 600 ml of tofu liquid waste, P3: Chicken manure fertilizer 10 tons/ha, P4: 300 ml of tofu liquid waste + chicken manure, P5: 600 ml of tofu liquid waste + chicken manure.

2.4 Research Implementation

2.4.1 Research Area Preparation

Soil sampling was carried out by taking soil using a soil drill with a depth of 0-30 cm with 5 points of sampling area, then the soil was put in plastic and then analyzed in the soil science laboratory, Faculty of Agriculture, University of Borneo Tarakan. Land clearing was carried out by measuring the area of the study using a tape measure and then cleaning it from weeds such as roots and other plants growing on it using machetes and hoes. Soil preparation and making of beds is done by making beds using a hoe and a machete and then measuring them using a tape measure, namely 2m x 1m for 24 beds. Application of chicken manure treatment according to the dose of 10 tons/ha, then the land is left for 3 days.

2.4.2 Seed Preparation

The selection of sweet corn seeds used was the Bonanza F-1 variety and the seeds were obtained from seed shops in Tarakan. Before the seeds are planted, the seeds are first soaked in water for 15 minutes so that the corn seeds imbibition process is faster so that they grow faster and it's easier to find good corn seeds to plant.

2.4.3 Planting seeds

Seed planting was carried out using a hammer tool with a depth of 3 - 5 cm at a distance of 60 cm between rows and 30 cm within rows. Each hole is filled with 2 corn seeds and covered again with soil. Plant seeds first soaked in water for 15 minutes. Furadan 3G was sprinkled around the planting hole to prevent the seeds from being eaten by pests. After planting the seeds is complete, the first watering is carried out using gembor evenly.

2.4.4 Maintenance

Routine watering is carried out every day in the morning before 09.00 WITA, especially in the early growth phase, namely 1-2 MST. If it rains at night, watering is not done in the morning; if it rains during the day, watering is not done in the afternoon.

Stitching is done 7 (seven) days after planting (HST) by leaving one plant that is growing well. Embroidery is done if the plants in the planting hole do not grow or die.

Weeding is done to control weeds around the plants. Weeding is done every time there are weeds growing around the cultivated plants. Weeding on young corn plants can be done by hand or small hoe, fork and others. So that weeding does not interfere with plant roots, it is done after the plants are 15 days old.

Pembumbunan intended to strengthen the establishment of plants. Hilling is done simultaneously with the second weeding, namely at the age of 42 days after planting.

Provision of tofu liquid waste and basic fertilizer is given every 2 weeks, starting from plants aged 2 MST, 4 MST, 6 MST and 8 MST. However, before the fertilizer is applied, the tofu liquid waste is fermented for 12 days.

2.4.5 Harvest

Harvesting is done after the plants are 70 days after planting. Sweet corn that is ready for harvest is marked by its hair which is blackish brown, dry and cannot be decomposed, the tip of the cob is fully filled and the color of the seeds is shiny yellow.

2.5 Observation Parameters

The observation component consisted of 2 components, namely growth and yield: Growth components, namely: plant height, number of leaves and yield components, namely: weight of cobs, number of cobs, fresh weight of plants without cobs.

2.6 Data analysis.

The data obtained was tested statistically using the F test ANOVA (5%) to see the difference in effect between treatments. If there is an effect between treatments, continue with Duncan's test at the 5% level. Correlation test is used to determine the relationship between parameters.

3. RESULTS AND DISCUSSION

3.1 Research results

In this study, observations were made regarding the response of growth and yield of corn (Zea mays saccharata. S) to the application of tofu liquid waste and chicken manure fertilizer. The results of this study included plant height, number of leaves, number of cobs, cob weight and plant fresh weight. Data were measured at 8 MST and analyzed using variance (Anova) followed by Duncan's multiple range test at 5% level.

3.1.1 Plant height

Plant height is an indicator of plant vegetative growth. Parameters of sweet corn (Zea mays saccharata Sturt) plant height were measured at 8 WAP. Based on the results of analysis of variance (ANOVA), it was shown that the application of tofu liquid waste and chicken manure had a very significant effect on the height of sweet corn plants. Plant height data on the provision of tofu liquid waste and manure can be seen in Figure 1.

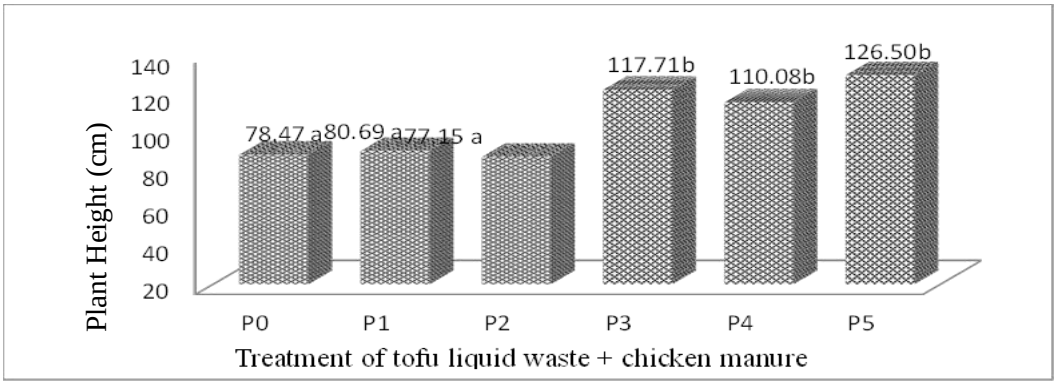

Figure 1. Diagram of the effect of tofu liquid waste organic fertilizer and chicken manure on plant height at 8 WAP.

Information:
P0: Control (Without manure)
P1: 300 ml of tofu waste
P2: 600 ml of tofu waste
P3: Chicken manure fertilizer
P4: 300 ml of tofu waste + chicken manure
P5: 600 ml of tofu waste + chicken manure

Figure 1 shows the treatment of tofu liquid waste and chicken manure had a very significant effect on the height of sweet corn plants. At 8 WAP, the application of tofu liquid waste and chicken manure treatment P5 produced plants with a height of 126.50 cm and this was the highest value compared to other treatments. The results of Duncan's advanced test at the 5% level showed that P5 was significantly different from treatments P0 (78.47), P1 (80.69) and P2 (77.15) but not significantly different from treatments P3 (117.71) and P4 (110). , 08).

As described by (Rossalina, 2008) that tofu liquid waste has a high organic content, the protein in tofu liquid waste if decomposed by soil microbes will release N compounds which will eventually be absorbed by plant roots so that tofu liquid waste fertilizer has the potential to be used as fertilizer. organic in plants. So this is reinforced by research (Desiana, 2013) on the effect of liquid organic fertilizer of cow urine and tofu liquid waste on the growth of cocoa seedlings (Theobramae cacao) stating that 80 ml/kg of tofu liquid waste media soil can have a high effect on cocoa plants.

3.1.2 Number of Leaves.

The number of leaves was counted on leaves that had opened perfectly, the number of leaves was counted to determine the vegetative growth of sweet corn plants. Leaves are plant organs that are used to synthesize food. The more leaves, the more places for food synthesis and the yield will also be more, so that it will affect plant growth. In Figure 2, data on the effect of tofu liquid waste on the number of sweet corn leaves is presented.

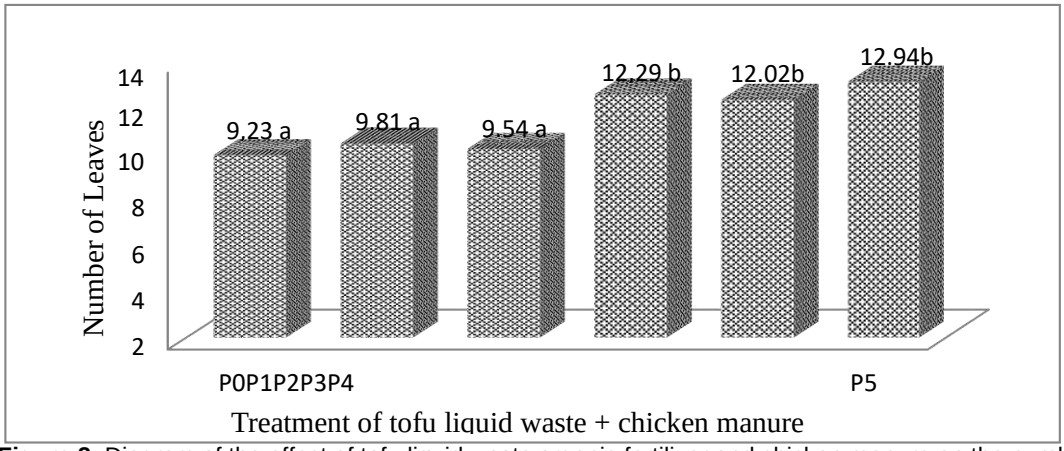

Figure 2. Diagram of the effect of tofu liquid waste organic fertilizer and chicken manure on the number of leaves at 8 WAP.

Figure 2 shows that the treatment of tofu liquid waste fertilizer and chicken manure had very significantly different results in the P5 treatment (12.94 strands) which was the highest value compared to the other treatments. Duncan's advanced test results at 5% level showed that P5 was significantly different from treatment P0 (9.23 strands), P1 (9.81 strands) and P2 (9.54 strands) but not significantly different from treatment P3 (12.29 strands). and P4 (12.02 strands).

This was disclosed (Ngaisah 2014) states that plant growth is stimulated by Nitrogen. Nitrogen plays a role in the overall growth of stems and leaves, besides that N plays a role in the process of photosynthesis.

3.1.3 Number of Cobs

The number of cobs was counted at the time of harvesting the sweet corn plant, namely at the age of 70 days after planting, the number of cobs was counted to determine the yield of sweet corn (Zea mays saccharata Sturt). Based on the results of the ANOVA variance, there was an effect on the growth response and yield of sweet corn (Zea mays saccharata Sturt) on the application of tofu liquid waste fertilizer and manure, then continued with the Duncan test at 5% level. Data on the

number of cobs of sweet corn plants on the application of tofu liquid waste fertilizer can be seen in Figure 3.

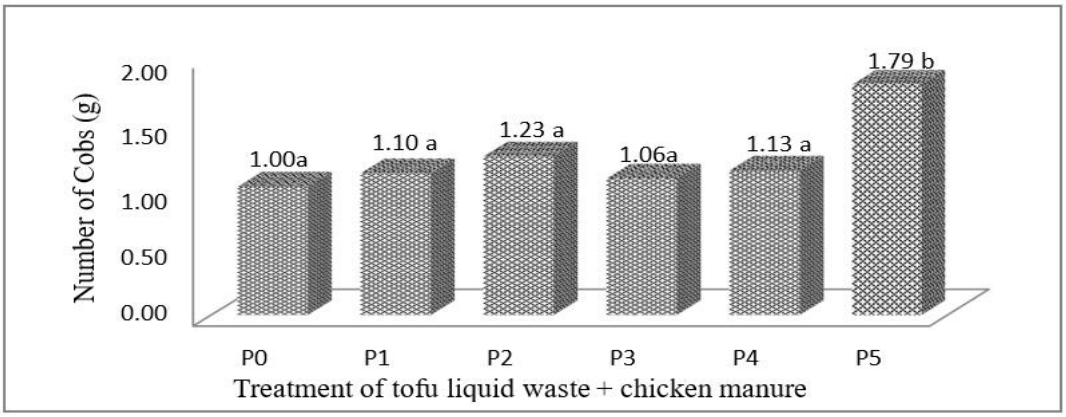

Figure 3. Diagram of the effect of organic fertilizer from tofu liquid waste and chicken manure on the number of plant cobs.

Information:
P0: Control (Without manure)
P1: 300 ml of tofu waste
P2: 600 ml of tofu waste
P3: Chicken manure fertilizer
P4: 300 ml of tofu waste + chicken manure
P5: 600 ml of tofu waste + chicken manure

The results of variance showed that tofu liquid waste and manure had a significant effect on the number of plant cobs. Figure 3 shows that the P5 treatment (1.79 fruit) was the treatment with the highest score of all treatments. Duncan's advanced test results at the 5% level showed that P5 was very significantly different from the treatments P0 (1.00 pieces), P1 (1.10 pieces), P2 (1.23 pieces), P3 (1.06 pieces) and P4 (1,13 pieces).

The increase in the average number of cobs in sweet corn plants occurred due to the provision of sufficient tofu liquid waste for corn plant nutrients and the presence of N, P, K chicken manure which helps add nutrients to sweet corn plants. As described by Efrida (2013) that the application of tofu liquid waste fertilizer and Urea can increase the number of pods of soybean plants.

3.1.4 Cob Weight

Cob weight is a parameter that is carried out on the generative growth of sweet corn plants, corn that has been harvested is then weighed. The results of the average cob weight were seen from the ANOVA results and then continued with the Duncan test at 5% level. The average weight yield of sweet corn cobs is presented in Figure 4.

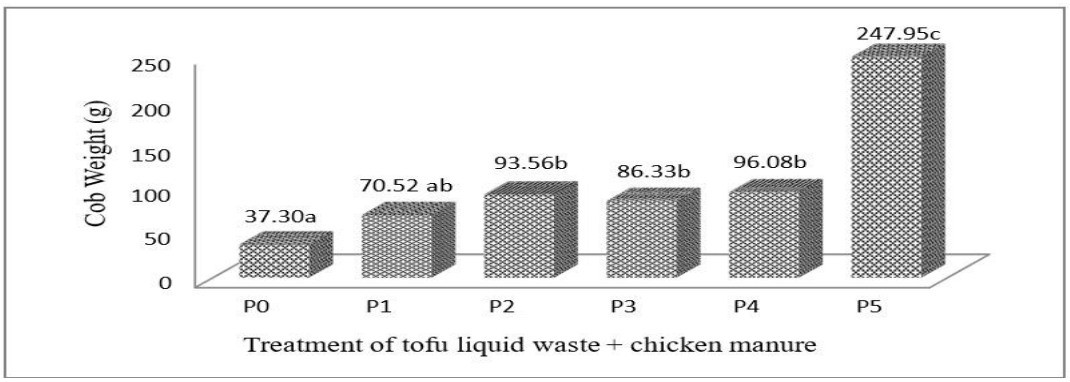

Figure 4. Effect diagram of tofu liquid waste organic fertilizer and chicken manure fertilizer on the weight of plant cobs.

Information:
P0: Control (Without manure)
P1: 300 ml of tofu waste

P2: 600 ml of tofu waste
P3: Chicken manure fertilizer
P4: 300 ml of tofu waste + chicken manure
P5: 600 ml of tofu waste + chicken manure

Figure 4 shows that the highest average cob weight was found in treatment P5 with a concentration of 600 ml of tofu liquid waste + chicken manure which was 247.94 g and very significantly different from treatment P0 (37.30 g), P1 (70, 52 g), P2 (93.56 g), P3 (86.33 g) and P4 treatment (96.08 g). While the lowest effect was in treatment P0 (37.30 g) and was not significantly different from treatment P1 (70.52 g) but significantly different from treatment P2, P3, P4 and P5.

Application of tofu liquid waste fertilizer at a dose of 600 ml + P5 chicken manure (247.94 g) resulted in a better sweet corn cob weight. This was because in the P5 treatment, the amount of nutrients was more able to meet the needs of the corn plant, causing better generative growth, cob weight was one of the parameters that proved this.

3.1.5 Wet weight of plants without cobs

The results of variance showed that tofu liquid waste fertilizer had an effect on the fresh weight of sweet corn (Zea mays saccharata Sturt) yield, followed by Duncan's test at 5% level.

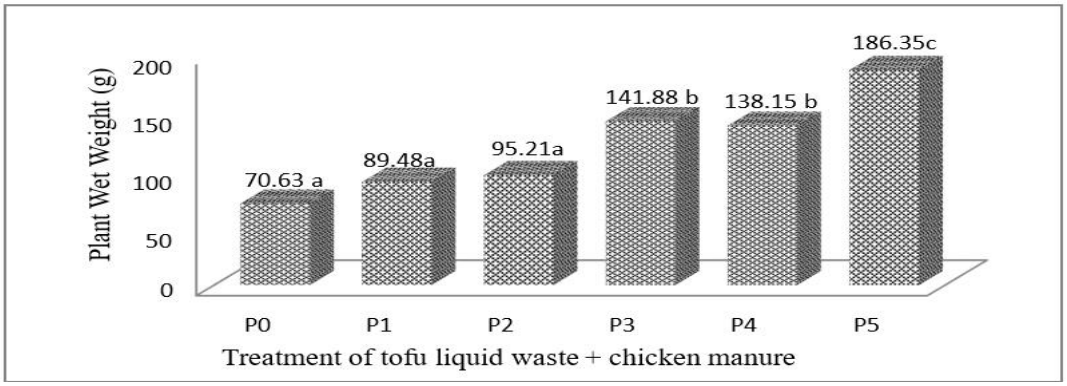

Figure 5. Effect diagram of tofu liquid waste organic fertilizer and chicken manure fertilizer on plant wet weight.

Information:
P0: Control (Without manure)
P1: 300 ml of tofu waste
P2: 600 ml of tofu waste
P3: Chicken manure fertilizer
P4: 300 ml of tofu waste + chicken manure
P5: 600 ml of tofu waste + chicken manure

The treatment that had the highest effect on the fresh weight of the sweet corn plant was the P5 treatment, which was 186.35 grams, which was very significantly different from all the treatments, namely P0 (70.63 g), P1 (89.48 g), P2 (95.21 g).), P3 (141.88 g), and P4 (138.15 g). The lowest treatment was treatment P0 (70.63 g) and was very significantly different from treatment P3 (141.88 g), P4 (138.15 g) and P5 (186.35 g) but not significantly different from treatment P1 (89 .48 g) and P2 (95.21 g).

This is because in the P5 treatment, tofu liquid waste fertilizer and chicken manure were able to be absorbed in corn plants. Tofu liquid waste and chicken manure that are given break down properly so that the roots of the sweet corn plant can easily be absorbed. The elements absorbed are used for photosynthesis, the results of photosynthesis are circulated to all parts of the plant for plant growth.

3.2 Discussion

The results of variance in the application of tofu liquid waste fertilizer and chicken manure were able to provide growth and yield of sweet corn plants and had a significantly different effect on the parameters of plant height, number of leaves, number of cobs, cob weight and plant fresh weight. Sweet corn production can be increased by fertilizing, fertilizing with organic fertilizers in sufficient quantities can improve the physical, chemical and biological properties of the soil so that it can increase the availability of nutrients for plants and stimulate the activity of microorganisms (Nurkholis, 1994).

The use of organic fertilizers can be a solution in reducing the excessive application of inorganic fertilizers due to the presence of organic matter that can improve the physical, chemical and biological properties of the soil. Improvements to physical properties, namely loosening the soil, improving aeration and drainage, preventing erosion and landslides.

The function of organic fertilizers on chemical properties is to increase the availability of nutrients and increase the weathering process of mineral materials. Soil chemical properties can increase soil pH, the pH before the study was 3.77 while the pH produced after 2 months of harvesting sweet corn fruit was P0; 3.77, P1; 3,8, P2; 4.0 P3; 4.1 P4; 4,2 and P5; 4.4 Provision of tofu liquid waste and chicken manure can increase soil pH. Soil pH in the tofu liquid waste treatment can increase the soil pH lower than chicken manure, this is because tofu liquid waste fertilizer is more volatile and there is nothing to help break down tofu liquid waste fertilizer in the soil so that it is more easily leached into the soil.

As for the biological properties of the soil, namely making it a food source for soil microorganisms such as fungi, bacteria, and other microorganisms so that their development becomes faster (Hadisuwito, 2008).

NPK nutrients are nutrients that are needed by corn plants for the growth and production of corn plants, corn plants need 158 kg/ha N; 72 kg/ha P; and 60 kg/ha K so that proper nutrient management is needed so that the plant's need for nutrients can be fulfilled optimally.

Tofu liquid waste can be used as organic fertilizer for plants, this is because of the NPK nutrient content in tofu liquid waste according to Murbandono (2005), states that tofu waste contains N : 1.12 mg/l, P : 51.51 mg /l and K: 163.35 mg/l. In this study the provision of liquid waste gave the best results in the P5 treatment.

The results of the content of tofu liquid waste fertilizer and chicken manure can be seen in chicken manure having a higher NPK content than tofu liquid waste fertilizer. It can be seen that in all observation parameters the P5 treatment is better than the others.

The application of chicken manure shows that there is an influence on all observation parameters, this is because the chicken manure given has been well composed or decomposed so that it is easily absorbed by plant roots. With the presence of nitrogen in the soil that is absorbed by plant roots for photosynthetic purposes, more and more leaves produce chlorophyll, where the results of photosynthesis are circulated to all parts of the plant for growth.

Another factor that affects plant growth is the plant growing environment according to Salisbury and Ross (1995), states that the growth of a plant will be influenced by internal factors, namely the plant itself, such as plant anatomy and physiology.

While external factors are environmental factors such as soil, temperature, humidity, sunlight and so on. Soil that contains lots of nutrients will have a different effect on less fertile soil. In this study the results of soil analysis had an effect on the growth yield of sweet corn plants with hard soil conditions and low C-organic content, which was only about 0.92%, total N was 0.31% and very low soil pH, which was only about 3 ,77 so that this causes the effect of adding tofu liquid waste fertilizer and chicken manure fertilizer.

The results showed that the treatment of tofu liquid waste and chicken manure had significantly different results in plant height and number of leaves. It was clear that the P5 treatment was the best treatment. According to Lingga (2003), states that the nutrient requirements for the growth of sweet corn include Nitrogen which is important in increasing the vegetative growth of plants. Furthermore Marschner (1986), states that plants that lack nitrogen elements will grow slowly and stunted. Nitrogen nutrient deficiency results in inhibition of the formation or growth of vegetative parts such as leaves, stems and plant roots.

In the observation parameters of plant height and number of leaves, the highest yield was P5 when compared to other treatments. One of the influencing factors is the availability of Nitrogen nutrients, one of the processes of plant life is photosynthesis which is a biochemical process for producing usable energy or nutrients. The main organs of plants where photosynthesis takes place are leaves, plants capture light using a pigment called chlorophyll which gives green color to plants. The rate of photosynthesis will run maximum when the light is maximum and good so that the nitrogen elements needed by plants can be as optimal as possible (Lakitan, 1993)

The results of the research on the number of cobs and the weight of the cobs obtained the highest results in the P5 treatment and were very significantly different from the P1, P2, P3, P4 and P0 treatments. One of the environmental factors that affect the percentage of cobs is the availability of phosphorus and potassium nutrients. Phosphorus nutrients function in cob

refinement, stimulate flowering and fertilization, stimulate seed formation and stimulate root growth. Potassium is also important for filling cobs, namely making cobs full of seeds (Soetoro, 1988). Furthermore, Nurhayati (2002) stated that the increase in cob weight is closely related to the amount of photosynthate flowing into the cob. If the photosynthate transport to the cob is high, the greater the cob will be produced.

The application of tofu liquid waste and chicken manure also had an effect on the wet weight of the plants from the observation that the P5 treatment still had the highest value compared to the other treatments. This is because the wet weight of the harvest is affected by the photosynthesis produced by the plant. Photosynthate produced by plants is used for growth and food reserves. If photosynthesis in plants takes place optimally, the photosynthate produced will be more optimal so that it will affect the wet weight or yield (Djunaedy, 2009).

The results of the research on the use of tofu liquid waste fertilizer on sweet corn plants. The parameters observed were plant height, number of leaves, number of cobs, cob weight and plant fresh weight. It showed that the P5 treatment with a concentration of 600 ml of tofu liquid waste and chicken manure could give the highest results. in sweet corn plants.

4. CONCLUSION

Treatments P5 (tofu liquid waste 600 ml + chicken manure) and P3 (chicken manure 10 tons/ha) were able to significantly affect the vegetative growth of sweet corn plants. Based on the existing treatment P5 (tofu liquid waste 600 ml + chicken manure) gave the best corn yields with a plant height of 61.20%, number of leaves 40.16%, number of cobs 79%, cob weight 564.74% and weight wet plant 163.83%.

ACKNOWLEDGEMENTS

Based on the conclusions stated above, the authors suggest that further research is needed by increasing the dose of tofu liquid waste and chicken manure from the previous one.

REFERENCES

Asmoro, Y., & Suranto, S. (2008). Pemanfaatan limbah cair tahu untuk peningkatan hasil tanaman petsai (Brassica chinensis). *Jurnal Biologi*, *5*(2), 2.

Djunaedy, A. 2009. Pengaruh Jenis Dosis Pupuk Bokhasi terhadap Pertumbuhan Kacang Panjang (Vigna sinensis L.) Agrovigor. 2 (1).Hal: 4.

Lakitan, B. 1993. Dasar-Dasar Fisiologi Tumbuhan. Raja Grafindo Persada, Jakarta. 205 hal.

Marschner, H. 1986. Mineral Nutrition in Higher Plants. Academis Press. London.

Mansyur, N. I., Pudjiwati, E. H., & Murtilaksono, A. (2021). *Pupuk dan pemupukan*. Syiah Kuala University Press.

Marian, E., & Tuhuteru, S. (n.d.). *PEMANFAATAN LIMBAH CAIR TAHU SEBAGAI PUPUK ORGANIK CAIR*.

Nazirah, L., & Marpaung, I. S. (2021). Pertumbuhan dan Hasil Beberapa Varietas Jagung (Zea Mays L) Akibat Pemberian Pupuk Organik Eceng Gondok (Eichhornia Crassipes). *J Agrotek Indones (Indonesian J Agrotech)*, *6*(2), 15–21.

Nurhayati. 2002. Pengaruh Takaran Pupuk Kandang dan Umur Panen Terhadap Hasil dan Kandungan Gula Jagung Manis . Skripsi. Fakultas Pertanian Universitas Terbuka.

Nurkholis,M.M. 1994. Pupuk dan Cara Pemupukan. Mediatama. Jakarta

Pramushinta, I. A. K., & Yulian, R. (2020). Pemberian POC (Pupuk Organik Cair) Air Limbah Tempe dan Limbah Buah Pepaya (Carica papaya L.) terhadap Pertumbuhan dan Produktivitas Tanaman Pakcoy (Brassica rapa L.). *Journal Pharmasci*, *5*(1), 29–32.

Pranata, A. S. (2010). Meningkatkan hasil panen dengan pupuk organik. AgroMedia.

Rosalina, R. (2008). Pengaruh konsentrasi dan frekuensi penyiraman air limbah tempe sebagai pupuk organik terhadap pertumbuhan dan hasil tanaman tomat (Licopersicum esculentum Mill.*)*. Universitas Islam Negeri Maulana Malik Ibrahim.

Setyastiawan, I., Wahyono, T., & Lubis, Y. (2010). Peranan komoditas jagung (zea mays l.) Terhadap peningkatan pendapatan wilayah kabupaten karo. *Jurnal Agrica*, *3*(2), 96–103.

Salisbury, F.B dan Ross, C.W. 1995. Fisiologi Tumbuhan. ITB, Bandung. 241 hal

Sutoro, Y., Soelaeman dan Iskandar. 1988. Budidaya Tanaman Jagung. Balai Penelitian Tanaman Pangan Bogor. Badan Penelitian dan Pengembangan Pertanian. Pusat Penelitian dan Pengembangan Tanaman Pangan . Bogor.