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Article

The Effect of Chicken Cage Fertilizer with Dosage of Waste Shrimp on Growth and Production of Sweet Corn *(Zea mays saccharata* Sturt)

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Abstract. Test Effect of Chicken Manure Enriched with Shrimp Waste Dosage in order to determine the effect of chicken manure enriched with shrimp waste dose on growth and production of sweet corn plants. This experiment used a randomized block design (RAK) consisting of Factor U, namely 20 tons/ha of chicken manure with several levels of shrimp waste dose, namely 0 ml of shrimp waste/1, 3 ml of shrimp waste/1, 6 ml of shrimp waste/1, 9 ml of shrimp waste/1, 12 ml of shrimp waste/1 and 6 ml/1 of chitosan. Based on the experimental results, it can be concluded that the application of chicken manure enriched with a dose of shrimp waste was able to increase the growth and production of sweet corn plants with the best dose of chicken manure + 12 ml/1 of shrimp waste.

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1. Introduction

Sweet corn (*Zea mays saccharata*) or better known as sweet corn began to be developed in Indonesia in the early 1980s and commercially cultivated on a small scale to meet the needs of hotels and restaurants [1-3]. Sweet corn is one of the most popular vegetable commodities in the United States and Canada. Sweet corn consumption has also increased in Asia, Europe and Latin America, including Indonesia. In Indonesia, sweet corn has been known since 1970. Sweet corn consumption continues to increase in line with population growth and consumption patterns. Currently, sellers of

ready-to-eat sweet corn can be found in almost every city, both in simple form and consumed fresh in the form of boiled corn or roasted corn [4-5].

The Central Statistics Agency of West Sumatra (2019) reported that corn production in West Sumatra decreased in 2018. Corn production in 2017 reached 985.847 tons, while in 2018 it was 92.564 tons, down 60.283 tons [6]. One effort to increase soil fertility is to add organic matter to the soil with organic fertilizer. Organic fertilizers are fertilizers with basic ingredients taken from nature with the amount and type of nutrients contained naturally [7-8].

Chicken manure contains macro and micro elements such as N, P, K, Ca, Mg and Mn which are needed by plants and plays a role in maintaining nutrient balance in the soil because manure has an effect for a long period of time and is a nutrient for plants. The fertilizer has the following nutrient content of 57% water content, 29% organic matter, 1.5 % nitrogen, 1.3% P_2O_5, 0.8% K_2O_2, 4.0% CaO and 9-11 C/N ratio. Another organic material that can be added to increase soil fertility is shrimp waste. Most of the shrimp waste generated by the shrimp processing business comes from the head, shell and tail. Shrimp shell contains protein (25 - 40%), chitin (15 - 20%), and calcium carbonate (45 - 50%) [9-11].

2. Materials and Methods

The material used in this experiment is sweet corn seeds of the Bonanza variety. Chicken manure (manure), Chitosan, Urea fertilizer, SP36, KCL, while the tools used are hoe, machete, rake, tugal, bucket, gembor, meter, scissors, label board, scale, raffia rope and stationery. This experiment used a single factor treatment, namely a randomized block design (RAK) with 4 replications. The addition of shrimp waste (U) in the treatment of 20 tons/ha with 6 concentration levels, namely U0= 0 ml/l, U1=3 ml/l, U2= 6 ml/l, U3= 9, U4= 12 ml/l and U5 = 6 ml/l chitosan.

The land used is measured and cleared of weeds and existing plants and leveled. Plots were made after land preparation was completed, namely by making as many as 24 plots, plots measuring 280 cm x 150 cm. The distance between plots is 30 cm. Labeling on each plot according to a predetermined plan.

The treatment was given 7 days before planting. Planting is done by making planting holes with a depth of 3-5 cm, with a spacing of 70 cm x 25 cm. Pest and disease control was carried out by spraying insecticides Ripcord and Ridomil 35 SD with a dose of 2 ml/liter of water which was sprayed on the plants in the morning. Sweet corn is harvested when it is young or milky. Harvest age under these conditions was 64-82 DAP. Observations were made on plant height, ILD, age at emergence of male flowers, age of emergence of female flowers, weight of cob, weight of cob without cob, length of cob without cob, percentage of cob filled, diameter of cob without cob, cob production per plot and per hectare.

3. Results and Discussion

3.1. Parameters of Plant Height and Leaf Area Index of Sweet Corn Plants

The plant height variance showed that the application of chicken manure enriched with shrimp waste had a very significant effect, presented in Table 1. Table 1 shows that the application of chicken manure enriched with a dose of shrimp waste was able to increase the height growth of sweet corn plants. The application of chicken manure +12 ml/l of shrimp waste had the highest plant height of 224.68 cm which was different from the application of chicken manure + 0, 3, 6, 9 ml/l of shrimp waste and chitosan with each plant height of 169.10 cm, 196.78 cm, 196.50 cm, 197.00 cm, and 170.18 cm.

Table 1. Average plant height and ILD of sweet corn with chicken manure enriched with shrimp waste

Treatment	Plant Height (cm)	ILD
Chicken manure + 0 ml/l shrimp waste	169.10 c	3.50 c
Chicken manure + 3 ml/l shrimp waste	196.78 b	4.34 ab
Chicken manure + 6 ml/l shrimp waste	196.50 b	3.99 bc
Chicken manure + 9 ml/l shrimp waste	197.00 b	3.81 bc
Chicken manure + 12 ml/l shrimp waste	224.68 a	5.05 a
Chitosan	170.18 c	3.88 bc
KK	7.26%	11.87%

Column numbers followed by lowercase letters are the same no different according to DMRT 5%

Chicken manure is an organic fertilizer that can increase the population of microorganisms in the soil and fertilize the soil so that nutrients can be absorbed optimally for plant growth [12-13]. Chicken manure contains elements of N: 1.3%, P: 1.3%, and K: 0.8% [14-15]. The chicken manure has characteristics and has low nutrient content for plant needs. Manure can be enriched with a dose of shrimp waste to meet the nutrient needs of plants [16-18].

Shrimp shell waste has nutrients 9.45% N, 1.09% P, 0.52% K and high protein and chitin content [19-20]. Plant height growth is influenced by the availability of nitrogen nutrients in the soil. The nitrogen nutrients can help stimulate vegetative growth in cultivated plants [21-22]. Shrimp shells contain high levels of chitin compounds. If the chitin compound undergoes a deacetylation process it will produce chitosan, chitosan can be used for ZPT and as a natural pesticide [23-24].

Table 1 shows that the application of chicken manure enriched with a dose of shrimp waste was able to increase the ILD growth of sweet corn plants. The application of chicken manure + 12 ml/l of shrimp waste had the highest ILD of 5.05 which was no different from the application of chicken manure + 3 ml/l of shrimp waste which had an ILD of 4.34 and different from the application of chicken manure + 0, 6, 7 ml/l shrimp waste and chitosan with each having an ILD of 3.50, 3.99, 3.81 and 3.88.

Organic fertilizers such as chicken manure are a source of nutrient needs for plants because they can provide nutrients such as macro and micro nutrients for plant growth [25-26]. Chicken manure contains elements of N: 1.3%, P: 1.3%, and K: 0.8% [27].

Vegetative growth of plants such as leaf area requires optimal nutrients so that chicken manure can be enriched with shrimp waste. Shrimp shell waste to the head has a pH of 7.90 and nutrients 9.45% N, 1.09% P, 0.52% K and high protein and chitin content [28-29]. Leaf area is affected by the availability of nutrients in the soil. Nitrogen nutrients play an important role in the process of cell division so that it can accelerate leaf growth in plants [30-31]. The chitin content contained in shrimp shells has the potential as a substrate for producing chitinase enzymes. Chitinase enzymes can be used for leaf expansion in plants [32-33].

3.2. Parameters of Male Flower Age, Female Flower Age and Harvest Age

The fingerprint of the age of the male flowers appeared, the age of the female flowers showed a significant effect on the application of chicken manure enriched with a dose of shrimp waste, which can be seen in Table 2.

Table 2. The average age of emergence of male flowers, age of emergence of female flowers and age of harvest by giving chicken manure enriched with a dose of shrimp waste

Treatment	Age of appearance of male flowers (HST)	Age of Emergence of Female Flowers (HST)
Chicken manure + 0 ml/l shrimp waste	53.50 b	58.75 b
Chicken manure + 3 ml/l shrimp waste	48.50 ab	54.75 ab
Chicken manure + 6 ml/l shrimp waste	53.00 b	57.25 ab
Chicken manure + 9 ml/l shrimp waste	49.50 ab	53.75 ab
Chicken manure + 12 ml/l shrimp waste	47.00 a	52.00 a
Chitosan	52.00 ab	57.75 b
KK	6.01%	5.46%

Column numbers followed by lowercase letters are the same no different according to DMRT 5%

Table 2 shows that the application of chicken manure enriched with a dose of shrimp waste was able to affect the age of emergence of male flowers on sweet corn plants. Provision of chicken manure + 12 ml/l of shrimp waste had a faster flower emergence age of 47.00 DAP which was not different from giving chicken manure + 3 and 9 ml/l of shrimp waste and chitosan, each of which had a flower emergence age of 48, 50 DAP, 49.50 DAP, and 52.00 DAP and differed from the provision of chicken manure + 0 and 6 ml/l of shrimp waste, each of which had a male flower age of 53.50 DAP and 53.00 DAP.

Chicken manure can increase nutrient requirements for plants and to optimize nutrient requirements, chicken manure can be enriched with shrimp waste. Chicken manure contains elements of N: 1.3%, P: 1.3%, and K: 0.8% [14-15], while shrimp shell waste has nutrients 9.45% N, 1.09 % P, 0.52% K and high protein and chitin content [21-22]. The element N in plants is used as a building block for amino acids and for cell divisionand the formation of chlorophyll to increase the photosynthesis process in plants [13].

The use of organic fertilizers can improve the physical, chemical, and biological properties of the soil so that it can increase the nutrient content in the soil [14-15]. The P element contained in the soil can be used by plants for the assimilation process and assists in the formation of flowers in plants [34-35]. Chitosan is derived from the chitin biomaterial which can be used as a growth regulator for plant growth, both from vegetative and generative growth [36-37].

Table 2 shows that the application of chicken manure enriched with a dose of shrimp waste was able to increase the age of emergence of female flowers on sweet corn plants. The provision of chicken manure + 12 ml/l of shrimp waste which had a faster flower emergence age of 52.00 DAP which was not different from the provision of chicken manure + 3, 6, and 9 ml/l of shrimp waste, each of which had an age of flower emergence, namely 54.75 DAP, 57.25 DAP, and 53.75 DAP and differed from the provision of chicken manure + 0 ml/l of shrimp waste and chitosan, each of which had flower ages of 58.75 DAP and 57.75 DAP.

Chicken manure contains elements of N: 1.3%, P: 1.3%, and K: 0.8% [14-15]. Nutrients contained in chicken manure can be increased by adding shrimp waste. Leather waste shrimp has nutrients 9.45% N, 1.09% P, 0.52% K and high protein and chitin content [30-31].

The formation of female flowers can be influenced by several factors, namely genetic factors and environmental factors such as the availability of nutrients. Nutrient P plays an important role in root growth, stimulates the formation of flowers and seeds [38]. Flower formation in plants is also influenced by the nature of the genes carried by each cultivated plant [39-40]. Chitosan is a derivative of chitin which is absorbed by plants and will be translocated through the xylem tissue to all plant tissues so that it can trigger growth hormones in plants [41-42].

3.3. Parameters of Cob Weight and Cob Weight without Cob

The variance of cob weights and weights without cobs showed that the application of chicken manure enriched with shrimp waste had a very significant effect, as shown in Table 3.

Table 3. Average weight of cobs and weight of cobs without sweet corn husks with chicken manure enriched with shrimp waste

Treatment	Cob Cob Weight (g)	Cob Weight Without Crab (g)
Chicken manure + 0 ml/l shrimp waste	250.25 c	143.50 d
Chicken manure + 3 ml/l shrimp waste	312.00 bc	226.50 bc
Chicken manure + 6 ml/l shrimp waste	340.50 b	248.25 b
Chicken manure + 9 ml/l shrimp waste	364.75 b	251.25 b
Chicken manure + 12 ml/l shrimp waste	448.25 a	335.25 a
Chitosan	252.75 c	173.75 cd
KK	11.63%	15.93%

Column numbers followed by lowercase letters are the same no different according to DMRT 5%

Table 3 shows that the application of chicken manure enriched with a dose of shrimp waste was able to increase the weight of the cob weight on sweet corn plants. Giving chicken manure + 12 ml/l shrimp waste which has the highest cob weight, which is 448.25 g, which is different from chicken manure + 0, 3, 6, 9 ml/l shrimp waste and chitosan, each of which has a cob weight, namely 250.25 g, 312.00 g, 340.50 g, 364.75 g, and 252.75 g.

Chicken manure and shrimp waste are organic fertilizers that can increase nutrients and fertilize the soil for plant growth. Chicken manure contains elements of N: 1.3%, P: 1.3%, and K: 0.8% [14-15]. Shrimp shell waste to the head has a pH of 7.90 and nutrients 9.45% N, 1.09% P, 0.52% K and high protein and chitin content [21-22].

In soil conditions that have less than optimal nutrients, fertilization can increase the availability of P nutrients in the soil, where P nutrients play a role in improving the quality of cob weight in sweet corn plants [38]. Chitin derived from shrimp shells can produce chitosan which is able to stimulate the hormone auxin through the tryptophan pathway which is able to increase vegetative and generative growth of plants [41-42].

Table 3 shows that the application of chicken manure enriched with a dose of shrimp waste was able to increase the weight of the cobs without weight in sweet corn plants. The provision of chicken manure + 12 ml/l of shrimp waste which has the highest cob weight of 335.25 g which is different from other treatments, namely the provision of chicken manure + 0, 3, 6, 9 ml/l of shrimp waste and the provision of chitosan, each of which has cob weights were 143.50 g, 226.50 g, 248.25 g, 251.25 g, and 173.75 g.

Chicken manure contains elements of N: 1.3%, P: 1.3%, and K: 0.8% [14-15]. Shrimp shell waste to the head has a pH of 7.90 and nutrients 9.45% N, 1.09% P, 0.52% K and high protein and chitin content [21-22].

The availability of nutrients in the soil greatly affects the weight of the cobs in corn plants, especially in corn seeds, because the nutrients absorbed by plants will be used for the synthesis of protein, carbohydrates, and fats which will later be translocated in the form of seeds so as to increase the weight of the cobs [43-44].

Chitosan derived from shrimp shells can stimulate the hormones auxin and gibberellin in plants [41-42]. The hormone axin plays a role in the induction of development in plant fruit while the hormone gibberellin plays a role in fruit growth [45]. Calcium (Ca) is an important component in the cell wall that functions as a strengthening of the cell tissue [46-47].

3.4. Cob Length without Corns, Percentage of Cobs Contains, Diameter of Cobs without Crab

Variation of the length of the cob without shells, the percentage of cob filled, the diameter of the cob without shells, showed that the application of chicken manure enriched with a dose of shrimp waste had a significant effect on the diameter of the cob without husks, had no significant effect on the percentage of cobs filled with shells, and had no effect on the length of the cob without shellsshown in Table 4.

Table 4. Average growth of cob length without husks, percentage of cobs containing and diameter of cobs without husks of corn on the application of chicken manure enriched with shrimp waste dose.

Treatment	Cob Length without Cob (cm)	Percentage of Cobs Contains (%)	Cob Diameter without Cob (cm)
Chicken manure + 0 ml/l shrimp waste	18.50	90.89	5.03 c
Chicken manure + 3 ml/l shrimp waste	20.13	86.36	5.45 bc
Chicken manure + 6 ml/l shrimp waste	19.65	87.82	5.55 abc
Chicken manure + 9 ml/l shrimp waste	19.75	91.96	5.64 abc
Chicken manure + 12 ml/l shrimp waste	21.08	95.37	6.18 a
Chitosan	19.13	84.75	5.47 abc
KK	8.05%	7.13%	7.07%

Table 4 shows that the application of chicken manure enriched with a dose of shrimp waste has not been able to increase the length of the cob without shells on sweet corn plants. The provision of chicken manure + 12 ml/l of shrimp waste which has the highest cob diameter is 21.08 cm, the provision of chicken manure + 0 ml/l of shrimp waste is 18.50 cm, the provision of chicken manure + 3 ml/l of shrimp waste is 20, 13 cm, chicken manure + 6 ml/l shrimp waste was 19.65 cm, chicken manure + 9 ml/l shrimp waste was 19.75 cm, and chitosan had a cob length of 19.13 cm.

Chicken manure contains elements of N: 1.3%, P: 1.3%, and K: 0.8% [14-15]. Shrimp shell waste has nutrients 9.45% N, 1.09% P, 0.52% K and high protein and chitin content [21-22]. P nutrients greatly affect the formation of cob length in sweet corn. Nutrients that are not optimal for the length of the cob so that it does not show any effect on the observed growth. Nutrient P plays an important role in the generative growth of corn plants, namely to increase the length of the cob in corn plants [38].

Table 4 shows that the application of chicken manure enriched with a dose of shrimp waste was not able to increase the percentage of filled cobs in sweet corn plants. Provision of chicken manure + 12 ml/l of shrimp waste which has the highest percentage of cob containing 95.37%, chicken manure + 0 ml/l of shrimp waste is 90.89%, chicken manure + 3 ml/l of shrimp waste is 86 .36%, the provision of chicken manure + 6 ml/l of shrimp waste was 87.82%, the provision of chicken manure + 9 ml/l of shrimp waste was 91.96% and the provision of chitosan had the lowest percentage of cobs containing 84.75%.

The formation of sweet corn seeds is strongly influenced by the high and low photosynthetic activity that occurs in the leaves of the plant, if the results of photosynthesis increase, the photosynthate yield will also increase during the seed filling phase so that the grain yield will also

increase [48-49]. Conversely, if the photosynthetic process is low, the photosynthate yield will also be low so that there is no increase in the treatment given to sweet corn plants.

Table 4 shows that the application of chicken manure enriched with a dose of shrimp waste was able to increase the diameter of the cob without shells on sweet corn plants. The provision of chicken manure + 12 ml/l of shrimp waste which has the highest cob diameter of 6.18 cm which is no different from the provision of chicken manure + 6 and 9 ml/l of shrimp waste and the provision of chitosan, each of which has a cob diameter of 5.55 cm, 5.64 cm, and 5.47 cm, and differed from the addition of chicken manure + 0 and 3 ml/l of shrimp waste, each of which had a cob diameter of 5.03 cm and 5.45 cm.

Chicken manure contains elements of N: 1.3%, P: 1.3%, and K: 0.8% [14-15]. Shrimp shell waste to the head has a pH of 7.90 and nutrients 9.45% N, 1.09% P, 0.52% K and high protein and chitin content [21-22].

In the cultivation of sweet corn, fertilization is a very important thing, especially those that contain nutrients N and P because it is useful in increasing root activity in plants and can carry out cell division so that it can increase the diameter of sweet corn cobs [48-49]. Chitosan, which is a derivative of chitin, is useful as a PGR so that it can increase the growth and size of plant fruit [50].

3.5. Production per Plot and per Hectare

A survey of the variety of production per plot and per hectare showed that the application of chicken manure enriched with shrimp waste had a very significant effect. Production per plot and per hectare of sweet corn is presented in Table 5.

Table 5 shows that the application of chicken manure enriched with a dose of shrimp waste was able to increase the production per plot and per hectare of sweet corn plants. The provision of chicken manure + 12 ml/l of shrimp waste which has the highest production of 9.08 kg is equivalent to 21.61 tons/ha which is no different from the provision of chicken manure + 6 and 9 ml/l of shrimp waste with each having a production of 8.24 kg is equivalent to 19.63 tons and 8.57 kg is equivalent to 20.40 tons/ha and is different from the provision of chicken manure + 0 and 3 ml/l of shrimp waste and chitosan, each of which has a production of 6.79 kg is equivalent to 16.17 tons/ha, 7.64 kg is equivalent to 18.20 tons/ha, and 7.03 kg is equivalent to 16.74 tons/ha.

Table 5. Average production per plot and per hectare of sweet corn with chicken manure enriched with shrimp waste

Treatment	Plot Production (kg)	Production Per Hectare (tons)
Chicken manure + 0 ml/l shrimp waste	6.79 c	16.17
Chicken manure + 3 ml/l shrimp waste	7.64 bc	18.20
Chicken manure + 6 ml/l shrimp waste	8.24 ab	19.62
Chicken manure + 9 ml/l shrimp waste	8.57 ab	20.40
Chicken manure + 12 ml/l shrimp waste	9.08 a	21.61
Chitosan	7.03 bc	16.74
KK	7.46%	

Column numbers followed by lowercase letters are the same no different according to DMRT 5%

Organic fertilizers can improve the physical, chemical and biological properties of soil, from physical properties to improve soil structure so that the soil becomes more friable, from chemical properties to increase soil pH and increase nutrients, and from biological properties to increase soil biological activity [51-52].

Optimal production produced by a plant is strongly influenced by the availability of sufficient nutrients in the soil [53]. Nutrient N plays a role in vegetative growth such as in leaves, stems, and roots, nutrient P plays a role in the formation of flowers and fruit in plants, and nutrient K plays a role in the photosynthesis process, if photosynthesis is maximal, the results of photosynthesis will also be maximized so that production the resulting product is more optimal [54].

Chicken manure contains elements of N: 1.3%, P: 1.3%, and K: 0.8% [14-15]. Shrimp shell waste has nutrients 9.45% N, 1.09% P, 0.52% K and high protein and chitin content [21-22].

The kinetin enzyme produced by chitin can be used to prevent aging in leaves and stimulate growth and expansion in plant leaves, the wider the leaves, the more light absorption will be, the increased light absorption will increase the rate of photosynthesis in the leaves, and the photosynthate results will be translocated on the cob and can increase the size of the cob and production of maize [55-56].

4. Conclusion

Based on the results of the experiment, it can be concluded that the application of chicken manure enriched with a dose of shrimp waste was able to increase plant height growth, ILD, age at emergence of male flowers, age of emergence of female flowers, weight of cob cobs, weight of cobs without husks, diameter of cobs without husks and production per plot and per hectare with the best dose of chicken manure + 12 ml/l shrimp waste. Based on the conclusion, it is suggested that sweet corn cultivation can provide chicken manure plus 12 ml/l of shrimp waste.

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