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Application Effect of Chicken Manure on Growth and Yield of Okra (*Abelmoschus esculentus* L. Moench)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Original Research Article

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ABSTRACT

The research of application of chicken manure to growth and yield of okra (*Abelmoschus esculentus* L. Moench) was conducted in the experimental farm at the Faculty of Agriculture Andalas University, Limau Manis Padang, from June to September 2017. The location of the study is at an altitude of ± 256 meters above sea level (as this research aim was to find out the best chicken manure dose for the growth and yield of okra treatments. Treatment was arranged in a completely randomized design with four treatments and four replications. The treatment level is the dose of chicken manure A: 0.0 ton / ha, B: 10 ton / ha, C: 20 ton / ha and D: 30 ton / ha. The data were analyzed using the F test at 5% if of F Calculate > F table then followed by DNMRT test at 5%. The results showed that the application of chicken manure with the dosage of 20 tons/ha had an effect and gave the best result on the number of leaves, the number of branches, the number of fresh pods per plant, the number of fresh pods per plot, the fresh weight of pods per plant, the fresh weight of pods per plant and the fresh weight of pods per hectare.

Keywords: Nutrition; dose; pod; response; ultisol.

1. INTRODUCTION

The okra plant (*Abelmoschus esculentus* L. Moench) originates from Africa. Okra belongs to the Hibiscus plant from the Malvaceae family, which is spread in tropical and subtropical areas such as India, West Africa, and Brazil [1]. According to Luther [2], okra has a relatively high

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nutritional content where every 100 g of young okra fruit contain 40 kl of energy, 1 g of mucus, 7 g of carbohydrates, 70-90 mg of calcium, 18 mg of vitamin C, 2 g of protein, 1 g of fiber, 90 g of water and various kinds of other minerals that are good for health.

The benefits of consuming okra are very good for health, such as losing weight and alleviating asthma symptoms. Okra fruit contains folic acid [3]. Tadimalla [4] reports that okra is filled with anti-oxidants, which this makes it an excellent anti-fatigue food. Okra contains adequate fiber to boost digestion, lower cholesterol levels which contribute to heart health. Okra fruit, also, contain, pectin, which could fight human breast cancer cells.

Rukmana and Yudirachman [5] reported that the Lucky Five 473 okra cultivar had the characteristics of solid growth, good branching, large pod size, weight per pod of ± 14 grams, green pods, pentagon shape, high productivity, fast harvest time, good environmental adaptability, sturdy stems, resistant to pests and diseases and seeds are easy to obtain.

The expansion of okra cultivation is still profitable considering that Indonesia has a large and uncultivated ultisol land.

The use of ultisol as a plant growth medium still has many problems related to its fertility, namely low organic matter content, macronutrients such as nitrogen, phosphorus, and potassium which are often deficient, acid soil reactions, and high aluminum saturation and this can be a growth-inhibiting factor plant.

During the last half of the century, significant improvement in crop yields can be attributed to the elevated nutrient application [6]. Long-term fertilizer application impacts soil damage, water pollution, and the disruption of the ecosystem [7] (Syofyan and Sara, 2018). Poultry Manure extended the N supply for a more extended period and helped improve the soil's ion exchange and water-holding capacity. Therefore, integrating organic manure with inorganic fertilizers could be recommended for environment-friendly, sustainable agriculture [8]. Refers to Warnita and Aisman [9], environmentally friendly organic materials can suppress soil organic disease attacks.

The application of organic fertilizers is very necessary to increase crop yields such as cow manure, compost, and other organic fertilizers. Wahyuni *et al*. [10] applied 9 tons/ha of guano fertilizer to potato plants. Another organic fertilizer to support growth is chicken manure. Chicken manure is an essential nutrient because it contains higher nitrogen and phosphate than other manures such as N 3.21%, P2O5 3.21%, K2O 1.57%, Ca 1.57%, Mg 1.44%, Mn 250 ppm, and Zn 315 ppm [11].

The chicken manure is the source of macro and micronutrients that can increase the soil fertility and substrate for soil microorganisms and increase the microbe activity, so that the decomposition becomes faster and releases the nutrients. Dwipa et al. [12] mentioned that using chicken manure as a source of macro and micronutrients and 20 ton/ha of chicken manure dose affected the plant height, number of leaves, fresh tuber weight per hectare, and dry weight per hectare of shallot. The purpose of this study was to obtain the best dose of chicken manure for the best t yields.of okra

2. MATERIAL AND METHODS

This experimental research was carried out in the experimental garden, soil laboratory and, physiology laboratory of the Faculty of Agriculture, Andalas University, Padang from June to September 2017. The altitude is ± 256 m above sea level.

The materials used in this experiment were okra seeds of Lucky Five 473cultivar, ultisol soil, water, plastic mulch, chicken manure and inorganic fertilizer. The tools used in this experiment were tractors, hoes, tape measure, raffia rope, standard poles, cameras, labels, scales, calculators and stationery.

Treatment was arranged in a completely randomized design (CRD) with four treatments and four replications. The treatment level is the dose of chicken manure with 4 levels of treatment as follows: 0.0, 10, 20 and 30 tons/ha. Each experimental unit consisted of 18 plants and 4 plants were used as samples. Observational data were statistically analyzed with the F test at a 5% significance level, if the calculated F was greater than the F Table 5%, then continued with Duncan's New Multiple Range Test (DNMRT).

The implementation of the research begins with clearing the land of weeds and processing with tractors and hoes. Furthermore, 16 plots were made with a size of 3 x 2.5 m and a row height of

0.2 m. distance between hills 0.20 cm. Chicken manure was given 1 week after tillage according to each treatment and incubated for 2 weeks. The plots were covered with silver black plastic mulch and the spacing is 100 x 50 cm.

Before planting the seeds were soaked in water. The seeds were sown in the prepared planting holes. The maintenance carried out was watering, weeding, and fertilizing with 100 kg/ha urea, 75 kg/ha SP 36 and 75 kg/ha KCl. Control of pests that attack was done mechanically.

Harvesting was carried out on okra fruit that was 10-15 cm in size and 4-8 cm in diameter. Harvesting was done by cutting the fruit stalks with scissors.

Observations carried out in this study were plant height, number of leaves, number of branches, number of pods per plant, number of pods per plot, fresh weight of pods per plant, fresh weight of pods per plot, and fresh weight of pods per hectare.

3. RESULTS AND DISCUSSION

3.1 Results of Analysis of Soil Nutrients and Chicken Manure

Analysis of soil and chicken manure was carried out in the laboratory of the Research Center for the Utilization of Nuclear Science and Technology (P3IN) of the Department of Soil Science. The results of the analysis of soil nutrients and chicken manure can be seen in Table (1).

Based on the results of the laboratory soil analysis (Table 1), it shows that the pH of the soil used as the experimental plot was 4.97. The application of chicken manure will increase the pH of the soil. Okra plants can grow in all types of soil, both sandy and clay soils. However, to be able to produce optimal okra requires loose soil that is rich in organic matter, well drained, and has a pH of 6-7. According to Luther [2] okra does not require special conditions for its growth, it can be planted in all seasons, but the drainage must be good. Okra can grow at an altitude of 0.0-800 meters above sea level and air temperatures between 27-30 ° C support fast and healthy growth.

The results of the analysis of the nutrient content of the chicken manure used showed that the nutrients contained in the manure used were good. The ratio of C/N of chicken manure used was 4.857% which is a very low criterion, This indicates that the chicken manure used has decomposed perfectly.

3.2 Plant Height, Number of Leaves, and Number of Branches

In Table 2 it can be seen that the dose of chicken manure 0 tons/ha to 30 tons/ha gave almost the same effect on plant height, while the dose of chicken manure 0.0 tons/ha to 30 tons/ha but had a significant effect on the number of leaves. and the number of okra branches. Observation of plant height at the used doses of chicken manure did not show a significant differences. This is presumably because at the time of the experiment the rainfall conditions were high ranging from 225.5-459 mm per month. This rainfall is higher than the optimum rainfall required by okra plant growth, which is 1,700-3,000 mm per year or 141.6-250 mm per month. So that the intensity of sunlight received by

Table 1. The nutrient content of ultisol and broiler chicken manure

Nutrient content of ultisol	Unit	Criteria	Nutrient content of chicken manure	Unit	Criteria
Nitrogen (N)	0.152 %	Very low	Nitrogen (N)	1.050 %	Very high
Phosphorus (P)	15.349 ppm	low	Phosphorus (P)	57.641 ppm	Very high
Potassium (K)	0.16 me, 100g	Very low	Potassium (K)	0.467me,100 g	medium
Organik- C	2.600 %	medium	Organik- C	5.100 %	Very high
organic ingredients	4m482 %	high	organic ingredients	8.792 %	Very high
C/N Ratio	17.105 %	high	C/N Ratio	4.857 %	Very low
pH (H2O)	4.97	acid	pH (H2O)	6.55	Neutral
pH (KCl)	4.00	acid	pH (KCl)	6.38	Neutral

Source: Laboratory, Department of Soil, Faculty of Agriculture, Andalas University, 2017

Table 2. Plant height, number of leaves and number of branches of okra at several doses of chicken manure aged 5 weeks after planting

Dosage of chicken manure ton/ha	Plant height (cm)	Number of leaves leaves/plant	Number of branches branches/plant
0 ton/ha	75.19	54.81 c	7.81 b
10 ton/ha	77.29	62.25 b	8.69 a
20 ton/ha	79.52	69.94 a	9.31 a
30 ton/ha	78.73	68.19 a	9.25 a
CV =	5.63%	8.87%	5.94%

Note: Means with different letters, in the same column differ significantly (p≤0.05, according to Duncan's New Multiple Range test

plants is low. The low light received by plants affects the process of photosynthesis that takes place. Disruption of the photosynthesis process in plants will affect the photosynthate produced. Low photosynthate results in suboptimal plant growth, due to insufficient nutrient intake.

However, N from poultry manure is released at slower rates via mineralization which may not meet growing crop N requirements [13]. The application of chicken manure at a dose of 20 tons/ha had the highest number of leaves, namely 69.94 strands and the number of branches 9.31 not much different from the dose of 30 tons/ha. This is presumably due to the application of chicken manure at a dose of 20 tons/ha. was able to meet the nutrient requirements for the increase in the number of leaves and the number of branches of okra. This is supported by research [14] that the application of chicken fertilizer at a dose of 20 tons/ha was able to increase the average number of leaves by 19% from the control treatment on plants.

Warnita et al. [15] reported that a high N content would increase the size and number of leaf cells, thus increasing the number of leaves. This is in line with the statement of Aisyah et al. [16], nitrogen has a function, one of which is as a constituent of chlorophyll, when leaves have a chlorophyll content that is not optimal, it can slow down leaf propagation and vice versa.

The application of chicken manure was able to affect the growth of the number of okra leaves, presumably because the chicken manure given during land cultivation had decomposed or decomposed properly so that it was easily absorbed by plant roots. According to Noverita [17] the nitrogen element contained in manure functions in increasing the vegetative growth of plants, especially to stimulate leaf growth. Nitrogen is the raw material for chlorophyll in the photosynthesis process. Chlorophyll which functions to capture solar energy will promote the process of supplying energy to be used for the synthesis of macro-molecules in cells.

The number of leaves affects photosynthesis, the more the number of leaves contained in a plant, the higher the photosynthesis that occurs. Isaac et al. [18] stated that the leaf functions as the main organ of photosynthesis, if the formation of the leaf is disturbed, the photosynthesis process will also be disrupted and plant growth will be disrupted and if there is a lack of nitrogen, the plant will grow slowly and stunted.

The number of branches is related to the number of leaves, which means that the more branches, the more the number of leaves. Nutrient N contained in chicken manure affects the formation of branches and leaves. Linga and Marsono [19], stated that nitrogen serves to stimulate plant growth such as plant stems, branches, and leaves.

3.3 NUMBER OF PODS, FRESH WEIGHT OF PODS PER PLANT AND PER HECTARE

Table 3 shows that the application of chicken manure at a dose of 0.0 tons/ha to 30 tons/ha gave different effects on the number of okra pods per plant and fresh weight of okra pods per plant and per hectare. The application of chicken manure at a dose of 20 tons/ha had the highest number of pods at (52.06 pod) and not much different from the dose of 30 tons/ha of manure at 51.19 pod, but different from giving chicken manure at a dose of 10 tons/ha. namely 47.31 pieces and the addition of chicken manure 0.0 tons/ha only had 43.63 okra pods.

Table 3. The number of okra pods per plant and fresh weight of okra pods per plant and per hectare at several doses of chicken manure aged 3 months after planting

Dosage of Chicken Manure ton/ha	Number of pods per plant (pod)	Fresh weight of pods per plant (g)	Fresh weight of pods per hectare (ton)
0 ton/ha	43.63 c	509.25 c	7.68 b
10 ton/ha	47.31 b	594.25 b	8.40 b
20 ton/ha	52.06 a	742.88 a	10.01 a
30 ton/ha	51.19 a	679.13 a	9.33 a
CV =	3.95%	8.69%	6.47 %

Note: Means with different letters, in the same column differ significantly (p≤0.05, according to Duncan's New Multiple Range test

The increase in the number of pods in okra plants was also followed by an increase in fresh weight of okra pods, this was because the number of pods was positively correlated with pod weight. By observing the fresh weight of okra pods per plant and pod weight per hectare, it can be seen that chicken manure has a different effect. The application of chicken manure at a dose of 20 tons/ha has the higher fresh weight of okra pods per plant and per hectare

Application of chicken manure with the right dose will increase the nutrient content in the soil and some soil properties such as soil biology, soil chemistry and soil physical properties. When soil fertility becomes better, plants will also be more optimal in absorbing nutrients in the soil, resulting in differences in the number of pods and pod weight in each okra plant.

The number of leaves with a lot of leaf area is larger so that photosynthesis is more and will increase the resulting fresh weight higher [15]. According to Santi's research [20], the application of manure has an effect on plant height, number of leaves, number of fruits and fruit weight of tomato plants.

The increase in fruit weight is a result of the supply of nutrients given to the plant. The more nutrients a plant receive, the more fruit it produces and its size and weight will also increase. The application of chicken manure at a dose of 20 tons/ha gave a higher yield of fresh weight of pods per plant than the description, which was 742.88 grams per plant, this is presumably because the application of chicken manure at a dose of 20 tons/ha has been able to improve physical conditions, chemical and biological soil in the experimental field, so that plant roots can absorb nutrients properly.

The number and weight of okra pods were positively correlated with plant height and number of leaves. As the plant grows taller, the number of pods will also increase. Plant height also affects the number of leaves, because the number of leaves will increase as the plant height increases. The number of leaves affects the food provider for plants. The more the number of leaves, the higher the photosynthesis that occurs. High photosynthesis will cause high photosynthate produced by leaves. High photosynthate resulted in more optimal plant production, so it would affect the number and weight of okra pods. This is in accordance with the statement of Singh et al. [21] who mentioned that the high and low number of pods is also influenced by the vegetative growth of the plant itself, so that if the vegetative period of the plant is good, the generative period of the plant will also be good. Increased vegetative growth such as plant height, number of leaves, and number of branches cause the utilization of sunlight and absorption of nutrients by plants to increase, resulting in maximum production yields [22].

The greater the amount of chicken manure, the greater the availability of nutrients. Not all of these nutrients are absorbed and utilized by plants, some are lost by water, bound in the soil and consume by soil macro and microorganisms so that even at the highest doses, not much nutrients are absorbed, so that production will decrease. Organic fertilizers have an important meaning for agriculture, because the application of organic fertilizers in addition to increasing the chemical fertility of the soil also improves the physical and biological properties of the soil.

Chicken manure contains phosphorus which is useful for increasing the generative phase of plants. The limited macronutrients in the soil is a factor that plants cannot grow and develop optimally. Therefore, the provision of chicken manure is very helpful in supporting plant production, so that the yield of pod weight in

each treatment plot can be obtained optimally. Fresh weight of okra pods per hectare was positively correlated with fresh weight of okra pods per plant and fresh weight of okra pods per plot.

Fresh weight of pods per hectare will increase along with the increase of fresh weight of pods per plant and fresh weight of pods per plot. Fresh weight of pods of a plant is influenced by vegetative growth such as plant height, number of branches and number of leaves. The better the vegetative growth of a plant is in indiction for the better the resulting production.

The research results of Sachan et al. [23], significantly higher vegetative growth and yield parameters of okra viz., plant height, number of leaves, dry weight of plants, number of fruits fruit length, dry weight of fruits and total fruit yield.. Therefore, the integration of organic manure with inorganic fertilizers could be recommended for environment friendly sustainable agriculture.

4. CONCLUSION

The results of this study showed that the application of chicken manure at a dose of 20 tons/ha had an effect on the number of leaves, number of branches, number of fresh pods per plant, number of fresh pods per plot and fresh weight of pods per hectare.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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