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Carrot (Daucus carota L.) Growth and Yield at Various Doses of Chicken Manure

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ABSTRACT

This research was in the form of an experiment that aims to determine the effect of chicken manure with the appropriate dose which can give the best effect on the growth and yield of carrots which was carried out in Buluballea Environment, Pattapang Village, Tinggimoncong District, Gowa Regency, South Sulawesi Province, took place from December 2011 until February 2012. This experiment was carried out using a randomized block design (RAK) consisting of one factor, namely the dose of chicken manure where there were six levels: 0 kg m-2; 0.4 kg m^{-2} ; 0.8 kg m^{-2} ; 1.2 kg m^{-2} ; 1.6 kg m^{-2} and 2 kg m^{-2} . Observations were made by taking plant samples at random, for one bed ten samples were taken. Observations included plant height, number of branching leaves, tuber length, tuber diameter, weight per tuber, weight per plot, weight per hectare and normal number of tubers. Observations were made once in two weeks after the plants were one month old. The application of chicken manure at a dose of 1.2 kg m^{-2} /12 tons ha^{-1} gave the best results on the growth and yield of carrots with a production of 30.33 tons ha^{-1}.

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1. INTRODUCTION

The development of horticultural crops, especially vegetables, has considerable potential for economic development, this is because the demand for vegetables is increasing day by day due to public awareness of the importance of nutrition for health. One type of vegetable that has increased demand by consumers is carrot (Daucus carrota L.). The market opportunities for carrots are getting wider and more diverse, including in the form of fresh tubers, fresh frozen tubers and fresh young tubers. The prospect of developing carrot cultivation in Indonesia is very bright. In addition to the agro-climatological conditions of the archipelago which are suitable for carrots, also because it can have a positive impact on increasing farmers' income, improving community nutrition, expanding job opportunities and developing agribusiness.

In the research program on horticulture development in Indonesia by the Horticulture Research and Development Center in 2000-2005, carrots were one of the main commodities that received attention from the government. Carrots are very necessary for the health of the body, because carrots contain nutrients, especially vitamins and minerals. Carrots contain lots of vitamin A and other nutrients that are important for health, every 100 grams of material contains 12,000 SI of vitamin A. For this reason, this vegetable is good for consumption in the daily diet to meet the needs of vitamins and minerals that are essential for the body.

In serving for consumption as food, carrots can be processed into food or eaten fresh. With the recommendation to increase the consumption of carrots for health reasons, efforts are also made to increase the production of carrots that are good and safe for consumption by the community.

South Sulawesi is a potential producer of horticultural crops, but its production and productivity, both quality and quantity, are still relatively low compared to other regions. Carrot productivity in South Sulawesi has reached 8.68 tons ha-1, while in South Sumatra it has reached 21.20 tons ha-1 (BPS, 2010). Several cases experienced by farmers in the field were the application of inorganic fertilizers that were not based on good fertilization recommendations and recommendations. Farmers tend to use fertilizers in high amounts and not based on local soil analysis so that fertilizer application is not effective and efficient, and is not healthy for consumption.

A good carrot is a carrot that can meet the nutritional needs of the community and does not contain chemicals that can harm health. Carrot cultivation should be without or reduce the use of inorganic fertilizers and materials containing substances that can endanger health. This can be done by using organic fertilizers, in other words, carrot cultivation based on organic farming.

Organic farming that is environmentally friendly and produces healthy food (free from chemicals that can harm health) has actually become a traditional knowledge that many farmers practice. Organic farming is very beneficial for health, freeing consumers to consume chemicals that can harm health. In addition, organic farming makes it easier for farmers to cultivate plants because compared to conventional farming, organic farming is relatively cheaper because the materials used are also relatively easy to find. The use of chicken manure in agriculture is one way towards environmentally friendly agriculture that has many benefits in terms of health, environment and community welfare.

Organic fertilizers can be in the form of liquid organic fertilizer, compost and manure. Organic fertilizers that are often used by the community are manure which can be defined as all waste products from pets that can be used to add nutrients, improve physical, chemical and biological properties of the soil. If the livestock is given a base such as husks for chickens, straw for cows, buffalo and horses, then the mat will be mixed into a single unit and is referred to as manure.

Manure is a source of several nutrients such as nitrogen, phosphorus, potassium and others. However, nitrogen is one of the main nutrients for most plants that can be obtained from manure. Nitrogen from manure is generally converted into available nitrate form. Nitra is easily soluble and moves to the root area of plants. The use of manure as plant fertilizer is a nutrient cycle that is very useful in optimizing the use of renewable natural resources. On the other hand, the use of manure can reduce nutrients that are toxic to plants. Chicken manure has a high nutrient content compared to other units of manure, namely 1.5% (N); 0.77% (P); and 0.89% (K). Nutrient levels are strongly influenced by the type of concentrate given. In addition, the chicken manure is mixed with the remains of chicken food and husks as a base for the cage which can contribute additional nutrients to the manure for vegetables. In general, the use of chicken manure among farmers is 15 tons ha-1 (Setyorini et al. 2004).

The use of chicken manure as fertilizer for plants can be useful in reducing environmental pollution because chicken manure is not thrown anywhere that can pollute the environment and public water bodies. In addition, the use of manure is beneficial in reducing heavy metals that are toxic to plants and can also be used in reclaiming polluted land, such as ex-mining lands.

2. METHOD

2.1 Place and Time

The experiment was carried out in Buluballea, Pattapang Village, Tinggimoncong District, Gowa Regency, South Sulawesi Province. The research site is located at an altitude of ± 1500 m above sea level with an average temperature of 18-26oC. The research took place from November 2011 to February 2012.

2.2 Tools and Materials

The tools used in this experiment were hoes, scales, rulers, digital cameras, calculators, treatment boards, analytical scales, caliper, plastic sticks and writing utensils. The materials used in this experiment were carrot seeds of the Pusaka Cap Panah Merah variety, water and chicken manure.

2.3 Research Methods

This research was carried out in the form of a one-factor experiment (chicken coop fertilizer) using a randomized block design, which consisted of 6 dose levels, namely: P0 = 0.0 kg m^{-2} (Without chicken manure); P1 = 0.4 kg m^{-2} (4 tons ha^{-1}); P2 = 0.8 kg m^{-2}(8 ton ha^{-1}); P3 = 1.2 kg m^{-2} (12 tons ha^{-1}); P4 = 1.6 kg m^{-2}(16 ton ha^{-1}); P5 = 2.0 kg m^{-2} (20 tons ha^{-1}). Each treatment consisted of one experimental plot measuring 1 m x 2 m, each of which was repeated three times, so that there were 18 plots as experimental units.

2.4 Trial Execution

The research started from seed preparation, land preparation, fertilization, planting, plant maintenance (thin and replanting, weeding and loosening, hoarding, irrigation and watering) and harvesting.

2.5 Observation Parameter

The components that became the observation parameters were: plant height (cm), number of leaves (strands), tuber length (cm), tuber diameter (mm), weight per tuber (grams), tuber weight per plot (kg), tuber weight per hectare (tons), Number of tubers normal (%).

3. RESULTS AND DISCUSSION

3.1 Research results

3.1.1 Plant height

From the results of observations of carrot plant height due to the dose of chicken manure, it can be seen in the table below:

Table 1. Average carrot plant height (cm) at various doses of chicken manure

Action	Average Height Plant (cm)	NP BNT =0.01
P0 (0.0 kg m^{-2}/ 0 ton ha^{-1})	13.41d	
P1 (0.4 kg m^{-2}/ 4 ton ha^{-1})	16.39c	
P2 (0.8 kg m^{-2}/ 8 ton ha^{-1})	19.73b	
P3 (1.2 kg m^{-2}/ 12 ton ha^{-1})	22.43a	2.04
P4 (1.6 kg m^{-2}/ 16 ton ha^{-1})	21.76ab	
P5 (2.0 kg m^{-2}/ 20 ton ha^{-1})	21.83a	

Note: the numbers followed by the same letter in the same column mean that they are not significantly different in the 1% level BNT test.

Table 1 shows that chicken manure at a dose of 1.2 kg m^{-2} produced the highest average plant height of 22.43 cm, not significantly different at doses of 1.6 kg m^{-2} and 2.0 kg m^{-2} but significantly different with the administration of a dose of 0.0 kg m^{-2}; 0.4 kg m^{-2} and 0.8 kg m^{-2}.

3.1.2 Number of Leaves

Observations of the number of leaves and their variance are presented in Table 2. The variance prints showed that the dose of chicken manure had a significant effect.

Table 2. Average number of leaves (strands) at various doses of chicken manure.

Action	Average Number of Leaves (strands)	NP BNT =0.05
P0 (0.0 kg m^{-2}/ 0 ton ha^{-1})	5.66e	
P1 (0.4 kg m^{-2}/ 4 ton ha^{-1})	6.00de	
P2 (0.8 kg m^{-2}/ 8 ton ha^{-1})	6.33cd	
P3 (1.2 kg m^{-2}/ 12 ton ha^{-1})	7.33a	0.51
P4 (1.6 kg m^{-2}/ 16 ton ha^{-1})	7.00ab	
P5 (2.0 kg m^{-2}/ 20 ton ha^{-1})	6.66bc	

Note: the numbers followed by the same letter in the same column, mean that they are not significantly different in the BNT test at a level of 0.5%.

Table 2 shows that chicken manure at a dose of 1.2 kg m^{-2} produced the highest average number of leaves, which was 7.33 strands, significantly different from all treatment doses except for a dose of 1.6 kg m^{-2}.

3.1.3 Bulb Length

Observations of tuber length and variance are presented in Table 3. The variance test showed that the number of doses of chicken manure had a very significant effect.

Table 3. Average tuber length (cm) at various doses of chicken manure

Action	Average Bulb Length (cm)	NP BNT =0.01
P0 (0.0 kg m^{-2}/ 0 ton ha^{-1})	8.79b	

P1 (0.4 kg m^{-2}/ 4 ton ha^{-1})	11.13a	
P2 (0.8 kg m^{-2}/ 8 ton ha^{-1})	11.36a	
P3 (1.2 kg m^{-2}/ 12 ton ha^{-1})	12,12a	1.04
P4 (1.6 kg m^{-2}/ 16 ton ha^{-1})	11.89a	
P5 (2.0 kg m^{-2}/ 20 ton ha^{-1})	11.34a	

Note: the numbers followed by the same letter in the same column, mean that they are not significantly different in the 1% level BNT test.

Table 3 shows that chicken manure at a dose of 1.2 kg m^{-2} produced the highest average tuber length of 12.12 cm, not significantly different from all treatment doses except control.

3.1.4 Bulb Diameter

Observations of tuber diameters and their variance are presented in Table 4. The variance prints showed that the dose of chicken manure had a very significant effect.

Table 4. Average tuber diameter (mm) at various doses of chicken manure.

Action	Average Diameter Bulbs (mm)	NP BNT =0.01
P0 (0.0 kg m^{-2}/ 0 ton ha^{-1})	21.50d	
P1 (0.4 kg m^{-2}/ 4 ton ha^{-1})	24,13cd	
P2 (0.8 kg m^{-2}/ 8 ton ha^{-1})	27.04bc	
P3 (1.2 kg m^{-2}/ 12 ton ha^{-1})	30.75a	3.52
P4 (1.6 kg m^{-2}/ 16 ton ha^{-1})	29.83ab	
P5 (2.0 kg m^{-2}/ 20 ton ha^{-1})	30.22a	

Note: the numbers followed by the same letter in the same column mean that they are not significantly different in the 1% level BNT test.

Table 4 shows that chicken manure at a dose of 1.2 kg m^{-2} produced the highest average diameter of 30.75 mm which was not significantly different from the application of chicken manure at a dose of 1.6 kg m^{-2} and 2.0 kg. m^{-2} but significantly different with a dose of 0.0 kg m^{-2}; 0.4 kg m^{-2} and 0.8 kg m^{-2}.

3.1.5 Weight per Bulb

Observations of weight per tuber and its variance are presented in Table 5. The variance test showed that the dose of chicken manure had a very significant effect.

Table 5. Average weight per tuber (g) at various doses of chicken manure.

Action	Average Bulb Weight (g)	NP BNT =0.01
P0 (0.0 kg m^{-2}/ 0 ton ha^{-1})	34.29d	
P1 (0.4 kg m^{-2}/ 4 ton ha^{-1})	55.65c	
P2 (0.8 kg m^{-2}/ 8 ton ha^{-1})	74.42b	
P3 (1.2 kg m^{-2}/ 12 ton ha^{-1})	96.67a	15.36
P4 (1.6 kg m^{-2}/ 16 ton ha^{-1})	90.13a	
P5 (2.0 kg m^{-2}/ 20 ton ha^{-1})	92.12a	

Note: the numbers followed by the same letter in the same column mean that they are not significantly different in the 1% level BNT test.

Table 5 shows that chicken manure at a dose of 1.2 kg m^{-2} produced the highest average tuber weight of 96.67 g, not significantly different from the application of chicken manure with sausage 1.6 kg m^{-2} and 2.0 kg m^{-2} but significantly different with a dose of 0.0 kg m^{-2}; 0.4 kg m^{-2} and 0.8 kg m^{-2}.

3.1.6 Bulbs Weight per Plot

Observation of tuber weight per plot for variance is presented in Table 6. The variance test showed that the dose of chicken manure had a very significant effect.

Table 6. Average tuber weight per plot (kg) at various doses of chicken manure g.

Action	Average Bulb Weight Per Plot (kg)	NP BNT =0.01
P0 (0.0 kg m^{-2}/ 0 ton ha^{-1})	3.17b	
P1 (0.4 kg m^{-2}/ 4 ton ha^{-1})	4.29b	
P2 (0.8 kg m^{-2}/ 8 ton ha^{-1})	5.81a	
P3 (1.2 kg m^{-2}/ 12 ton ha^{-1})	6.07a	1.49
P4 (1.6 kg m^{-2}/ 16 ton ha^{-1})	7.20a	
P5 (2.0 kg m^{-2}/ 20 ton ha^{-1})	6.08a	

Note: the numbers followed by the same letter in the same column mean that they are not significantly different in the 1% level BNT test.

Table 6 shows that chicken manure at a dose of 1.6 kg m^{-2} produced the highest average tuber weight per plot of 7.20 kg, not significantly different from other treatments except at doses of 0.0 kg m^{-2} and 0.4 kg m^{-2}.

3.1.7 Bulbs Weight per Hectare

Observation of tuber weight per hectare for its variance is presented in Table 7. The variance print shows that the dose of chicken manure has a very significant effect.

Table 7. Average tuber weight per hectare (tons) at various doses of chicken manure.

Action	Average Bulb Weight Per Ha (tons)	NP BNT =0.01
P0 (0.0 kg m^{-2}/ 0 ton ha^{-1})	15.87b	
P1 (0.4 kg m^{-2}/ 4 ton ha^{-1})	21.43b	
P2 (0.8 kg m^{-2}/ 8 ton ha^{-1})	29.05a	
P3 (1.2 kg m^{-2}/ 12 ton ha^{-1})		7.49
	30.33a	
P4 (1.6 kg m^{-2}/ 16 ton ha^{-1})	36.02a	
P5 (2.0 kg m^{-2}/ 20 ton ha^{-1})	30.42a	

Note: the numbers followed by the same letter in the same column mean that they are not significantly different in the 1% level BNT test.

Table 7 shows that chicken manure at a dose of 1.6 kg m^{-2} produced the highest average tuber weight per hectare which was 36.02 tons but was not significantly different from other treatments except for the control (0.0 kg m^2) and 0, 4 kg m^{-2}.

3.1.8 Number of Normal Bulb Shapes

Observations on the number of normal tubers and their variance are presented in Appendix Tables 8a and 8b. The variance test showed that the dose of chicken manure had a very significant effect.

Table 8. Average number of normal tubers (%) at various doses of chicken manure

Action	Average of Normal Bulbs (%)	NP BNT =0.05
P0 (0.0 kg m^{-2}/ 0 ton ha^{-1})	92.33a	
P1 (0.4 kg m^{-2}/ 4 ton ha^{-1})	85.33b	
P2 (0.8 kg m^{-2}/ 8 ton ha^{-1})	87.67ab	
P3 (1.2 kg m^{-2}/ 12 ton ha^{-1})		6.49
	76.33c	
P4 (1.6 kg m^{-2}/ 16 ton ha^{-1})	71.33c	
P5 (2.0 kg m^{-2}/ 20 ton ha^{-1})	77.33c	

Note: the numbers followed by the same letter in the same column, mean that they are not significantly different in the 1% level BNT test.

Table 8 shows the highest average number of normal tubers was found at P0 which was 92.33% which was significantly different from all treatment doses except at a dose of 0.8 kg m^{-2}.

3.2 Discussion

The application of various doses of chicken manure on carrot plants for plant height had a significant effect with the highest average yield found at a dose of 1.2 kg m^{-2}/12 ton ha^{-1}. Chicken manure has a good effect on plant height, where the application of chicken manure helps the availability of nutrients in the soil which is a source of energy in the work of the meristem tissue to develop. Nutrients play a role in plant growth and development starting from leaf development, accelerating root growth, accelerating plant maturation, and increasing production.

Provision of chicken manure in addition to adding nutrients also improves soil aggregates, so that the soil becomes loose and can facilitate plant roots to penetrate the soil and absorb nutrients to meet their needs. Nutrients that play a role in plant height growth are N which is needed for vegetative growth (leaf and stem growth), increasing protein levels, as well as for the development of microorganisms in the soil. Plants will grow and develop well if their needs are met, the better the plant height growth, the higher the photosynthesis process that occurs. According to Gardner et al., (1991), leaves function as the main organs of photosynthesis in plants, are effective in light absorption, and fast in CO2 uptake. Photosynthesis process also depends on the availability of nutrients that support plant growth, it can be seen from the results of the treatment 0.0 kg m^{-2}/0 ton ha^{-1} (without chicken manure) has the lowest plant height of 13.41 cm. This is because the nutrient requirements needed are not met so that the photosynthesis process produces less nutrients than plants with higher plant heights.

For the average number of branching leaves (stems), tuber length (cm), tuber diameter (mm), weight per tuber (g), the highest average yield was obtained at a dose of 1.2 kg m^{-2}/12 tons ha^{-1}. For the development of carrot tubers is influenced by the condition of the soil that has

sufficient availability of nutrients to meet their needs. With the availability of sufficient nutrients for carrot plants will stimulate the work of meristem tissue, where the content of chicken manure is 1.5% (N); 0.77% (P); and 0.89% (K) can meet the needs of rapidly dividing meristem tissue to form plants that have good growth and produce good production as well.

Based on the soil analysis, the percentage of N, P and K values on the planted land is low so that fertilizer is needed or fertilization is carried out to meet the needs of plant growth and development. Where, if the nutrient needs of the plant are not met it will inhibit plant growth so that its size becomes small. In accordance with the opinion of Rusdanti (2011), which suggests that the effect of a real nutrient deficiency is to inhibit plant growth so that the plant size becomes relatively small. Likewise, Isnaini (2006) argues that plant growth and development is highly dependent on the availability of nutrients, meaning that to obtain good plant development and yields it is necessary to apply fertilization according to plant needs.

Fertilization using organic fertilizers in addition to providing nutrient requirements for plants can also improve soil properties. According to Hakim (1986), organic fertilizer is an important ingredient in creating soil fertility both physically, chemically, and biologically from organic material, where by improving soil properties it will make it easier for carrot tubers to penetrate the soil, fertilization with chicken manure is carried out at the right dose. it will help in the process of loosening the soil making it easier for carrot plants to grow and develop.

Parameters observed were plant height (cm), number of branching leaves (stem), tuber length (cm), tuber diameter (mm), weight per tuber (g), the best results were obtained, namely the treatment with a dose of 1.2 kg m^{-2} /12 tons ha^{-1}. This is because the right dose of chicken manure has a good effect on the growth and production of carrot plants. Widowati (2005), who stated that the application of chicken manure in an appropriate dose always gives the best response to plants, where chicken manure can meet the needs of nutrients for plant growth that are not available in sufficient quantities in the soil. Therefore, to obtain maximum yield and plant quality, it is necessary to make efforts to increase the availability of nutrients by fertilizing (Suriatna, 1988).

Fertilization is done by paying attention to the growing environment of carrots, namely by conducting soil analysis to determine the state or availability of nutrients so that the area to be planted has the availability of nutrients sufficient for growth and produces high production. The availability of sufficient nutrients will be responded to by good growth in plants, starting from leaf growth and development, strengthening stems, root development, to the formation of tubers, this is because the meristem tissue works quickly because the need for nutrients needed in its activities is fulfilled. .

The average tuber weight per plot and the highest average tuber weight per hectare was found at a dose of 1.6 kg m^{-2}/16 ton ha^{-1}, in quantity it had the highest weight but in quality it was low because in this treatment there were many tubers. abnormal (branched). This can be seen from the number of normal tubers produced, the highest average is found at a dose of 0 kg m^{-2}, while the lowest is at a dose of 1.6 kg m^{-2}/16 ton ha^{-1}.

High or low production and quality can be influenced by growing environmental factors, where carrots can grow well in cold and humid weather with optimal temperatures that are good for growth and tuber production, namely 15.6oC - 21.1^{oC}. In addition, the state of the soil is also very influential, such as soil pH. Carrots can grow well at a pH of optimal results, a pH of 6.0-6.8 is required. In soils that have a pH of less than 5.0, plants will find it difficult to form tubers because soil acidity also affects the amount of nutrients that can be absorbed by the soil, also results in mineral hydrolysis or lack of nutrient availability, and can even increase elements such as Al, Fe, Mn, and Bo released from the soil which is toxic to plants. For this reason, it is necessary to apply the right dose of fertilization. it can be seen in the results of giving chicken manure that the best effect is at a dose of 1.2 kg m^{-2}/12 ton ha^{-1} where this treatment gives the best effect for several observation parameters, it can also be seen that fertilizer application is less or more than dosage of 1.2 kg m^{-2}/12 ton ha^{-1} production and quality will be lower. This is because if the application of manure is not enough, the productivity will be low due to insufficient nutrient requirements.

Lack of nutrients will have an influence on the state of the plant, namely growth will be disrupted so that it gets less yields (Anonymous, 2012). Meanwhile, giving excess chicken manure will also have an adverse effect on plants because if the plant has excess nutrients it will experience toxicity which can affect the yield and quality of plant production. According to

Susanto (2002), chicken manure also contains coccidiostat substances that function as herbicides. If used in high doses continuously, it can become an allelopathic substance that can inhibit the growth of seeds and seeds.

Giving manure with the right dose on carrot plants can give good results too. It can be seen from the results, namely that the plants that were given manure got a little less yield, while the plants that were given the highest dose obtained the results that the quality decreased, namely many were abnormal.

4. CONCLUSION

Based on the results obtained, it can be concluded that the application of chicken manure at a dose of 1.2 kg m^{-2} / 12 tons ha^{-1} gave the best results on the growth and yield of carrots with a production of 30.33 tons ha^{-1}.

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It is recommended that further research be conducted on the application of chicken manure to carrot plants for different seasons, namely the dry season where this research was conducted in the rainy season, to compare the growth and yield of carrots in different seasons.

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