

# Interrelationship between number of flowers, fruits, and cucumber production (*Cucumis sativus*) grown on a mixture of soil and chicken manure

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**Abstract.** Limbongan YL. 2023. *Interrelationship between number of flowers, fruits, and cucumber production (Cucumis sativus) grown on a mixture of soil and chicken manure. Biodiversitas 24: 3448-3453.* This study aimed to determine the effect on the relationship between the number of flowers, fruits formed and the production of cucumber (*Cucumis sativus* L.) in chicken manure-supplemented soil. The research was conducted from June to August 2022 in Tikala Village, Tikala Sub-district, North Toraja District, South Sulawesi, Indonesia, at an altitude of 866.9 m above sea level with climate type B (Schmidt and Ferguson) and was arranged in a randomized complete block design (RCBD). The treatment used chicken manure at five levels, namely, control, 100 g, 200 g, 300 g, and 400 g chicken manure per plant. The results showed that the application of chicken manure at different doses gave different responses to the growth and production of cucumbers. A dose of 400 g/plant is the best treatment to increase the number of flowers, number of fruits, size, and production of the fruit up to 54 days after planting, with a fruit weight of 2.69 kg per plot or 17.93-ton ha<sup>-1</sup>. The number of flowers, number of fruits, fruit diameter, and fruit length had linear responses and a significant positive correlation with the production of cucumbers.

**Keywords:** Chicken manure, cucumber, fruits formed, linear correlation

## INTRODUCTION

Cucumber (*Cucumis sativus* L.) is a horticultural crop that is widely cultivated by Indonesian farmers. Cucumbers are cultivated and remain available throughout the year on every major Indonesian island, and as more people are becoming aware of the value of nutrition in food, the demand for cucumbers is increasing steadily. Nutritional content per 100 g of cucumber consists of 15 calories, 0.8 g of protein, 3 g of carbohydrates, 30 mg of phosphorus, 0.5 mg of iron, 0.02 mg of thiamine, 0.01 mg of riboflavin, 14 mg of acid, 0.3 mg of vitamin A, 0.3 mg of vitamin B1, 0.02 mg of vitamin B2, and 0.8 mg of vitamin C (Gustianti 2016).

The topographical condition of North Toraja District is at an altitude of 500-2,500 m above sea level and is supported by an adequate climate (15-28°C); therefore, it is suitable for cucumber cultivation. Although the demand for cucumbers has increased, the cultivation of cucumbers, especially in the North Toraja District, is still not given sufficient attention by the community, especially regarding the provision of fertilizers. Farmers still prefer to use chemical fertilizers, which they consider easier and more efficient. According to the data from the Central Bureau of Statistics of South Sulawesi, cucumber production in South Sulawesi has increased in the last 3 years. In 2018, cucumber production in South Sulawesi reached 7,629 tons; in 2019, it reached 8,477 tons; and in 2020, it reached 8,627 tons (Statistics of South Sulawesi Province 2020). It is anticipated that the use of chemical fertilizers will

decrease and may be replaced by organic fertilizers. Animal waste, plant residues, and microbes that are beneficial to plants may be used to obtain organic fertilizers. Moreover, organic fertilizers do not produce plant residue. They can enhance the quality of plants and reduce the need for inorganic fertilizers in addition to improving the physical, chemical, and biological properties of soil (Glio 2015).

Chicken manure, as one kind of organic fertilizer, have the ability to reduce the use of inorganic fertilizers supplied through the soil. It has various benefits and advantages, including decrease in environmental pollution, increase in agricultural production (quality and quantity), and enhancement of land quality. The presence of a binding agent in the fertilizer solution allows it to be directly utilized by plants serving as an added advantage.

The nutrient content of chicken manure compost used for fertilizing soil helps in improving the concentrations of P<sub>2</sub>O<sub>5</sub>, K<sub>2</sub>O, Mg, Fe, Al, Ca, and Cation Exchange Capacity (CEC) in the soil, thereby increasing soil and plant fertility (Susikawati et al. 2018). Nevertheless, every livestock manure has its own disadvantages. Likewise, chicken manure is needed and must be used in relatively large quantities. However, in Toraja, it is still widely available. Torajans that operate chicken farming companies, both laying hens and fighting cocks, leave the chicken dung alone, keeping it unprocessed as organic fertilizer. Meanwhile, if ever someone is using chicken manure as fertilizer, the application to plants is still incorrect. Since

most people apply chicken manure directly, the plants eventually die off.

Since chicken manure is a thermal fertilizer, bacteria swiftly break down the manure to produce heat. Before being processed into organic matter rich in biological resources for use as fertilizer, it must first be dried in the sun for at least 7 days. As a result, fertilizer derived from chicken manure is more effective for use on annual crops or types of vegetable plants with a short life span, such as cucumbers.

In several cases, the number of flowers and fruits has a positive correlation and a direct influence on the production of cucumber (Kumar et al. 2018), tomato (Mishra et al. 2019), eggplant (Onyia et al. 2020), and hot pepper (Bekele et al. 2022). Cucumber production is limited by flowering behavior and the availability of balanced nutrients in the soil. In general, cucumber is a monoecious plant. It bears unisexual flowers with male flowers appearing sooner and closer to the plant's base than female flowers (Pandey et al. 2019). Further, male flowers are highly dominant over and outnumber their female counterparts. The ratio of male to female flowers can range from 15:1 to 13:1. Although the ratio is genetically controlled, it can be altered via chemical and mechanical methods such as pruning (Mir et al. 2019). Both inorganic fertilizer and chicken manure are effective for enhancing all the growth parameters, flowering parameters, yield attributing characters, and the yield of cucumbers (Chapagain et al. 2022). As a result, cucumber germplasm productivity may be selected depending on the number of flowers and fruits.

The research objectives of this study are (i) to determine the response of cucumber plants to chicken manure, (ii) to find the appropriate dose of chicken manure for cucumber growth and production, and (iii) to discover the relationship between the number of flowers and cucumber production.

## MATERIALS AND METHODS

The study was carried out from June to August 2022, in Tikala Village, Tikala Sub-district, North Toraja District, Southern Sulawesi, Indonesia, with 2° 56' 58" S latitude and 119° 53' 4" E longitude, at an altitude of 866.9 m above sea level with climate type B (Schmidt and Ferguson) and red-yellow podzolic soil type and pH 5.7.

This research was arranged using a randomized complete block design (RCBD) with three replications and five levels of treatment of chicken manure as follows: (i) a0 = Without chicken manure/plant (control), (ii) a1 = 100 g of chicken manure/plant, (iii) a2 = 200 g of chicken manure/plant, (iv) a3 = 300 g of chicken manure/plant, (v) a4 = 400 g of chicken manure/plant. Each treatment plot consisted of eight cucumber plants, for a total of 120 plants planted.

### Research procedure

#### *Chicken manure decomposition*

The decomposition materials used were 70 kg of chicken manure, 6 kg of rice bran, 300 mL of EM4, 1 kg of

brown sugar, 10 L of water, and a tarpaulin. Chicken manure was mixed well with rice bran. The EM4 and brown sugar were dissolved in water and poured slowly on the mixture of the chicken manure and rice bran while stirring until the moisture was evenly distributed (water content was ~50%). The dough was stacked (20 cm high) on a tarpaulin sheet stretched out on the floor in the shade and then covered tightly with another tarpaulin sheet. The fermenting period lasted for 14 days. When the dough reached a temperature of >50°C, it was stirred and stacked again as before.

#### *Preparation of planting media*

The temporary planting plots used were 100 × 150 cm in size, filled with soil mixed with roasted husks in a ratio of 2:1 and chicken manure based on the treatment level. The plots were arranged based on the experimental plan and labeled accordingly.

#### *Planting*

Planting holes were made in the planting beds with a distance of 40 × 40 cm in between holes as a place to plant cucumber seeds. One hole was planted with two cucumber seeds. Planting was carried out at around 4 to 5 PM in the afternoon.

#### *Maintenance*

Maintenance included watering, weeding, replanting, and pest and disease control. Watering was performed every morning and evening. Weeding was performed manually, i.e., by removing any weeds that grow in the plot, and replanting was carried out by replacing plants that grow abnormally or were attacked by pests and diseases with new plants. This embroidery was carried out at the maximum age of 15 days after planting. The pests and diseases were controlled using bio-pesticides.

#### *Harvest*

Cucumber plants were harvested 40 days after planting when the fruits entered the ripening stage, with their stalks starting to dry until the fruits were released. Late harvesting of fruits can reduce their quality because the structure becomes tough, and the taste deteriorates. Harvesting was done two times with an interval of 1 week.

#### *Observational variables*

The variables observed were the number of flowers, number of fruits/plots, fruit diameter, fruit length, and the production per hectare.

#### *Data analysis*

Observational data for each observed variable were analyzed using analysis of variance with RCBD, least significance difference (LSD) test with a 5% level, and multiple correlation analysis. Data analysis was performed using the IBM SPSS Statistics version 2.0 application program.

## RESULTS AND DISCUSSION

### Effect of treatment chicken manure on the number of flowers and fruits

The results of observations and analysis of variance and orthogonal polynomial tests on the number of flowers per plot and the number of fruits per plot in Table 1 show that the cucumber plants gave a significantly substantial response to the application of chicken manure. The pattern of the relationship between doses of chicken manure and the number of flowers and fruits is observed to be linear.

The LSD 0.05 test level showed that the highest number of flowers was achieved in the 400 g/plant chicken manure treatment, which was not significantly different from the 300 g per plant treatment but was significantly different from the other treatments. The same thing was achieved regarding the number of pods; the highest number of pods was achieved in the treatment of 400 g/plant chicken manure per plant, which was not significantly different from the 200 g per plant treatment but was significantly different from other treatments. Similar results were also reported by Rasyid et al. (2020).

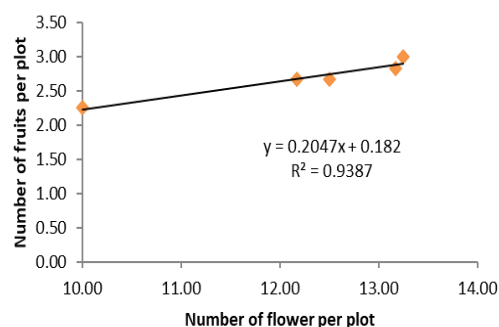
The LSD 0.05 test level showed that the largest fruit was achieved in the 400 g/plant chicken manure treatment, which was not significantly different from the 300 g per plant treatment but was significantly different from the other treatments. The same result was achieved regarding fruit length and fruit production-the longest fruit and the highest production were achieved in the 400 g/plant chicken manure treatment, which was significantly different from the other treatments. The growth, yield, and yield components of cucumbers increased markedly with various doses of poultry manure (Agu et al. 2015; Kharga et al. 2019; Chapagain et al. 2022).

The results of orthogonal polynomial analysis of the number of flowers per plot of cucumber plants show that 73,72% of the increase in the number of plant flowers is affected by the dose of chicken manure (Figures 1 and 2A), i.e., every provision of chicken manure with an increase of one unit will increase the number of the flower per plot of cucumber plants by 0.0072 units and if chicken manure was not provided, the number of flowers per plot of cucumber plants becomes 10.783. The cucumber plants treated with poultry manure produced many branches, which in turn produced abundant fruit with longer fruit having larger diameters (Oke et al. 2020; William et al. 2022).

The results of the orthogonal polynomial analysis of the number of fruits per plant plot show that the coefficient of determination ( $R^2$ ) is 0.7385 (Figure 2B). This indicates that 73.85% of the number of fruits per cucumber plot is affected by the provision of chicken manure and only 26.15% are influenced by other factors, in which each increase in the dose of chicken manure by 1 g will increase the number of fruits per plot by 0.008 units and if there is no administration of chicken manure, then the number of fruits per plot is only 10.4.

### Effect of treatment chicken manure on fruit diameter, length, and production

The results of observations and analysis of variance and orthogonal polynomial tests on fruit diameter, fruit length, and production in Table 2 show that cucumber plants give a significant response to the dose of chicken manure. The pattern of the relationship between doses of chicken manure and fruit diameter, fruit length, and production is observed to be linear as well as positive and significant correlation (Figure 3). In Table 2, the results of observations and analysis of variance on fruit diameter show that cucumber plants gave a significant response to the chicken manure in treatment a4, i.e., a dose of 400 g.



**Figure 1.** Interrelationship between the number of flowers and fruits

**Table 1.** The number of flowers and fruits per plot

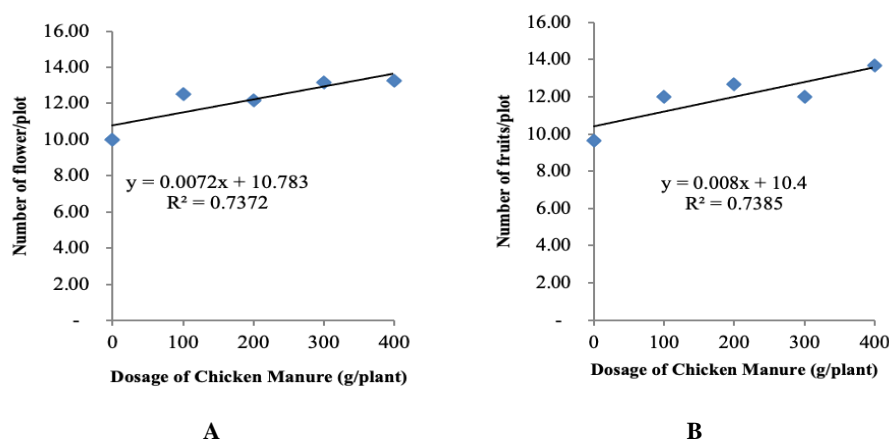
Treatments	Number of flowers per plot	Number of fruits per plot
a0 Control	10.00+0,250 <sup>d</sup>	9.67+0,577 <sup>c</sup>
a1 100 g/plant	12.50+0,026 <sup>cd</sup>	12.00+0,000 <sup>b</sup>
a2 200 g/plant	12.17+0,382 <sup>c</sup>	12.67+1,155 <sup>ab</sup>
a3 300 g/plant	13.17+0,629 <sup>ab</sup>	12.00+1,000 <sup>b</sup>
a4 400 g/plant	13.25+0,250 <sup>a</sup>	13.67+0,577 <sup>a</sup>
LSD 0.05	0.63	1.35
F stat	31.35 <sup>**</sup>	8.67 <sup>**</sup>
F linear	92.45 <sup>**</sup>	25.60 <sup>**</sup>

Note: Average values followed by the same letter in the same column is not significantly different at the LSD 0.05

**Table 2.** The fruit diameter, length, and production

Treatments	Fruit diameter (cm)	Fruit length (cm)	Production (ton/ha)
a0 Control	5.14+0,062 <sup>c</sup>	19.60+0,036 <sup>d</sup>	18.22+1,925 <sup>d</sup>
a1 100 g/plant	5.45+0,018 <sup>b</sup>	20.94+0,126 <sup>ab</sup>	22.00+0,667 <sup>c</sup>
a2 200 g/plant	5.45+0,070 <sup>b</sup>	20.68+0,211 <sup>b</sup>	23.56+1,540 <sup>bc</sup>
a3 300 g/plant	5.59+0,036 <sup>a</sup>	20.06+0,272 <sup>c</sup>	24.67+0,667 <sup>b</sup>
a4 400 g/plant	5.68+0,172 <sup>a</sup>	21.02+0,125 <sup>a</sup>	28.89+1,678 <sup>a</sup>
LSD 0.05	0.16	0.30	2.43
F stat	12.71 <sup>**</sup>	29.50 <sup>**</sup>	18.56 <sup>**</sup>
F linear	44.91 <sup>**</sup>	30.15 <sup>**</sup>	70.69 <sup>**</sup>

Note: Average values followed by the same letter is not significantly different at the LSD 0.05

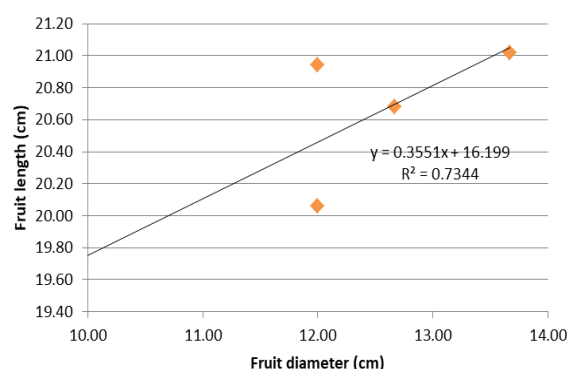


**Figure 2.** The orthogonal polynomial graph of: A. The number of flowers per plot and; B. The number of fruits per plot

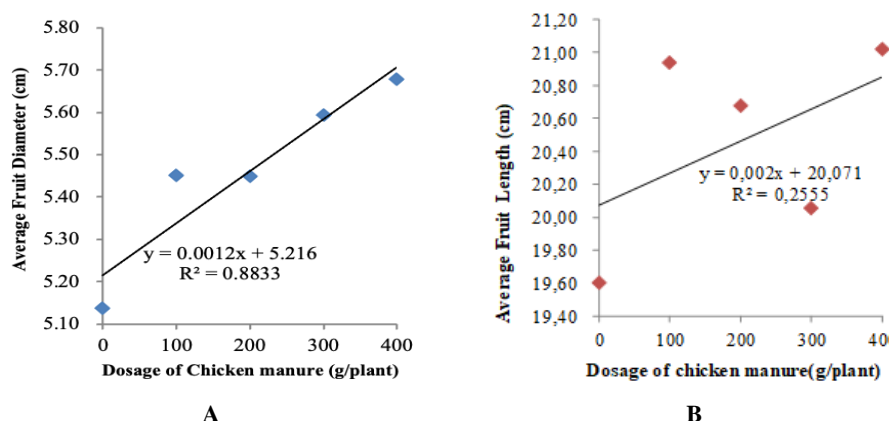
The results of the orthogonal polynomial analysis of fruit diameter show that the coefficient of determination ( $R^2$ ) is 0.883 (Figure 4A). This indicates that 88.3% of fruits' diameter is affected by giving chicken manure and only 11.7% are influenced by other factors, in which every increase in the dose of 1 unit of chicken manure will increase the length of fruits per plot by 0.001 units; however, without administering chicken manure, the diameter of the fruit remains at only 5.216 cm. Figure 3 shows that the relationship between fruit diameter and fruit length is positive and significant.

The results of observations and analysis of variance on fruit length in Table 2 show that cucumber plants gave a significant response to giving chicken manure in treatment A4, i.e., a dose of 400 g. The results of the orthogonal polynomial analysis of fruit length show that the coefficient of determination ( $R^2$ ) is only 0.2555 (Figure 4B). The correlation of the fruit length seemed very weak or no correlation. This was indicated by the result that 25.55% of fruit length is affected by administering chicken manure and the remaining 74.4% is influenced by other factors, in which every increase in the dose of 1 unit of chicken manure will increase the length of the fruit by 0.002 unit, and without giving the chicken manure, the length of the

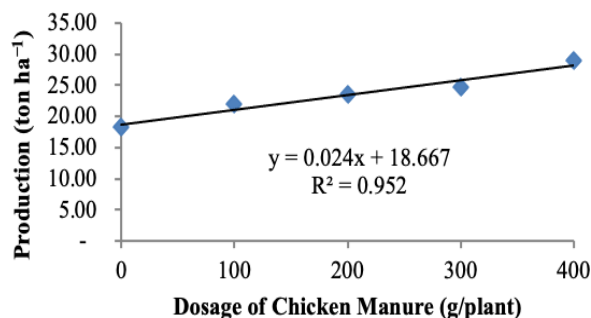
fruit remains only 20.071 cm. This is due to the addition of chicken manure of more than 100 g per plant does not increase the length of cucumber fruit. The higher the dose of chicken manure, the greater the growth rate of vegetative organs (Adinde et al. 2021), fruit diameter (Alkharpotly 2019), fruit length (Tufaila 2014), and fruit weight (Aprilian 2019).



**Figure 3.** Interrelationship of cucumber fruits diameter and fruit length



**Figure 4.** The orthogonal polynomial graph of: A. Fruit diameter and; B. Fruit length



**Figure 5.** The orthogonal polynomial graph of fruit production.

**Table 3.** The correlation matrix between the number of flowers, number of fruits, fruit length, fruit diameter, and fruit production per hectare

	X1	X2	X3	X4	Y
Number of flowers (X1)	1				
Number of fruits (X2)	0.97**	1			
Fruit diameter (X3)	0.88**	0.93**	1		
Fruit length (X4)	0.98**	0.99**	0.91**	1	
Production (Y)	0.87**	0.96**	0.93**	0.95**	1

The results of the orthogonal polynomial analysis of production per hectare show that the coefficient of determination ( $R^2$ ) is 0.952 (Figure 5). This indicates that 95.2% of fruit weight per plot is affected by the provision of chicken manure, and only 4.8% is influenced by other factors, in which every increase in the dose of 1 unit of chicken manure will increase the fruit weight per plot by 0.024 units; and without administering chicken manure, the fruit weight per plot remains only 18.667 kg. The additional doses of chicken manure increase the growth rate and fruit size (Enujeke 2013; Singh et al. 2017; Zahid et al. 2021).

Table 3 presents the correlation matrix between the number of flowers, number of fruits, fruit diameter, fruit length, and production. The table shows that the number of flowers, number of fruits, fruit diameter, and fruit length are positively and significantly correlated with cucumber fruit production.

The positive correlation is thought to occur because the additional dose of chicken manure increases the water and nutrient content in the soil, accelerating the leaf growth rate (Aritonang et al. 2018), increasing the number of flowers (Mawarni and Siahaan 2022), and increasing fruit size (Abul-soud 2008). This is in line with the results of the study by Khan et al. (2017) that chicken manure increases the water-holding capacity and moisture in the soil, which in turn eases the uptake of nutrients from the soil for plants. The addition of doses of chicken manure significantly increased the number of flowers and the number of fruits produced. This is because the balanced nutrients in chicken manure improved the ratio of female to male flowers, resulting in an increase in the number of fruits developed.

The results of this study are in coherence with those reported by Pandey et al. (2019).

Based on the results, the following conclusions can be drawn: (i) The addition of doses of chicken manure has a significant effect on the formation of flowers and cucumber production. (ii) the administration of chicken manure at different doses has a different response to the growth and production of cucumbers.

The dose of 400 g/plant responded best for plant height, number of leaves, stem diameter, and fresh fruit production. (iii) the number of flowers, number of fruits, diameter, and length of the fruit are positively and significantly correlated with the production of cucumber fruit. Therefore, the recommended dose of chicken manure for cultivating good cucumber plants is 400 g/plant. This treatment dose is most effective for increasing the number of flowers, number of fruits, fruit size, and production for up to 54 days after planting, with a fruit weight of 2.69 kg per plot or 17.93 ton ha<sup>-1</sup>.

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