

# Cucumber plants (*cucumis sativus* L.) growth and crop yield of chicken manure fertilized with plant spacing

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## Cucumber Plants (*Cucumis sativus* L.) Growth and Crop Yield of Chicken Manure Fertilized with Plant Spacing

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**Abstract.** The research was conducted in Tanjung Sari, Kecamatan Medan Selayang Kotamadya Medan ± 32 meters above sea level. It started since July 2016 to September 2016. It was designed with randomization block design with two factorial experiments which are chicken manure and plant spacing. First factor was 4 doses of chicken manure, symbolized by K: K<sub>0</sub> = 1.5 kg/plot, K<sub>1</sub> = 2 kg/plot, K<sub>2</sub> = 2.5 kg/plot and K<sub>3</sub> = 3 kg/plot. Second was 4 different plant spacing, symbolized by J; J<sub>0</sub> = 30 cm x 60 cm, J<sub>1</sub> = 35 cm x 60 cm, J<sub>2</sub> = 40 cm x 60 cm and J<sub>3</sub> = 45 cm x 60 cm. The result shows that giving 3kg/plot of chicken manure increases plant height to 162.15 cm with 22.44 number of leaves. Fresh fruits per sample was weight 1121.88 g and per plot is 4.52 kg with 9.17 and 36.67 units of fruits per sample and plot respectively. With 45 cm x 60 cm (J<sub>3</sub>) for plant spacing gives a plant with the height of 160.51 cm and 22.85 number of leaves. Fresh fruits obtained is 1216.67 g and 9.33 units per sample while per plot gives 4.90 kg and 7.33 units of fresh fruits. This plant spacing leads to a better output for the yield compared to narrower spacing. There are no interaction between chicken manure dosage and plant spacing towards plant height, number of leaves, fresh fruits weight and units per sample and plot.

**Keywords:** *Cucurbitaceae*, dose, Organic fertilizer, space

### 1. Introduction

Cucumber (*Cucumis sativus* L.) is a kind of plant in *Cucurbitaceae* (gourd) plant family largely consumed raw in Indonesia. As a vegetable, it is one of the good vitamin and mineral sources. Cucumber is commonly processed into fresh products like pickles, kimchi, and salad or as beverages like juice. Cucumber can also be used for beauty purpose as for body scrub and cleansing cream [1].

Cucumber plantation in Indonesia covered almost 61.000 hectares of land in 2010 and decreased to approximately 49.000 hectares in 2014 producing nearly 550.000 tonnes of cucumber each year. It is reported, the production to have slightly increase from 2010 - 2014 where the number dropped to 480.000 tonnes in 2014. Nevertheless, it could still suffice for cucumber consumption. Both of land and crop yield for cucumber should be taken into a concern to prevent import from taking place [2].

Fertilizer is used to increase soil fertility and the content of minerals to support plants growth and give optimum yield [3]. There are two fertilizers commonly used which are inorganic (chemical synthesized) and organic fertilizers, one of the examples is manure. Manure is natural and does not destroy the soil, provides macronutrients (nitrogen, phosphorous, potassium, calcium and sulfur) and micronutrients (iron, boron, zinc, cobalt, and molybdenum)[6].

Besides the dosage of manure, plant spacing is also one factor needs to be considered to create the right environment for crop growth and production [4].

Plant spacing has to be done in the right measurement. When space is wide, evaporation and weed growth are high[7]. On the contrary having not enough space leads to competition between plants to get sunlight, nutrients and water. It experimented that space 30 cm x 60 cm is suitable for cucumber plants [5].

The usage of chicken manure in cucumber plants has not gained much information. Therefore, the author would like to research about growth and crop yield of chicken manure with plant spacing cucumber plants (*Cucumis sativus L.*).

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## 2. Methods

The research was conducted in Tanjung Sari, Kecamatan Medan Selayang Kotamadya Medan ± 32 meters above sea level and started in July to September 2016.

### 2.1. Experimental apparatus

Local cucumber seed, chicken manure, ultra gen fertilizer, soil, bamboo, plastic rope, paint, and water were used. Equipment like a pruning saw, hoe, knife, measurement, hand sprayer, weigher, rope, saw, triplex board, brushes, and stationery were needed.

### 2.2. Problem formulation

This research uses randomized block design with two factorial experiments which are chicken manure and plant spacing. The experiments are as follow:

8 Factor I is chicken manure symbolized by "K"; with four doses:

K<sub>0</sub>: 1.5 kg/plot; K<sub>1</sub>: 2 kg/plot; K<sub>2</sub>: 2.5 kg/plot; K<sub>3</sub>: 3 kg/plot

Factor II is plant spacing to cucumber plants symbolized by "J"; with four different distances:

J<sub>0</sub>: 30 cm x 60 cm; J<sub>1</sub>: 35 cm x 60 cm; J<sub>2</sub>: 40 cm x 60 cm; J<sub>3</sub>: 45 cm x 60 cm

Therefore 16 different treatments were obtained as follow:

K <sub>0</sub> J <sub>0</sub>	K <sub>1</sub> J <sub>0</sub>	K <sub>2</sub> J <sub>0</sub>	K <sub>3</sub> J <sub>0</sub>
K <sub>0</sub> J <sub>1</sub>	K <sub>1</sub> J <sub>1</sub>	K <sub>2</sub> J <sub>1</sub>	K <sub>3</sub> J <sub>1</sub>
K <sub>0</sub> J <sub>2</sub>	K <sub>1</sub> J <sub>2</sub>	K <sub>2</sub> J <sub>2</sub>	K <sub>3</sub> J <sub>2</sub>
K <sub>0</sub> J <sub>3</sub>	K <sub>1</sub> J <sub>3</sub>	K <sub>2</sub> J <sub>3</sub>	K <sub>3</sub> J <sub>3</sub>

### 2.3. Experiment Procedural

#### 2.3.1. Tillage

Before being used, land was measured, and weed was killed, and it was dug down 15 cm to 20 cm depth with a hoe.

#### 2.3.2. Plot Plan

After plowing research plot was made with 120 cm x 100 cm measurement with the distance between each plot was 30 cm.

#### 2.3.3. Chicken Manure Application

Chicken manure was embedded in the plot 1 week prior to planting. The application was done according with dose.

#### 2.3.4. *Planting*

After tillage, cucumber seed was planted. With a dibber, 2 cm holes were made the soil to put the seed. Into every hole, as many as two seeds that used. Each hole was arranged to have 30 cm x 60 cm, 35 cm x 60 cm, 40 cm x 60 cm and 45 cm x 60 cm space which then was covered by plowed soil.

#### 2.4. *Plant Care*

##### 2.4.1. *Watering*

Watering was done twice a day; in the morning and afternoon but it was dependent on the condition the field.

##### 2.4.2. *Vining*

Vining purpose was to make a trellis to improve care and as fruit support. Vining was done as early as  $\pm 7$  days after planting to avoid disturbing rooting. Trellis is made approximately 2 meters high.

##### 2.4.3. *Thinning*

Thinning was done when plants were two weeks old by cutting one bad growing plant and leaving one good growing plant.

##### 2.4.4. *Binding*

Raffia rope was used to bind plant onto trellis. It was aim to maintain trellis on vines in order support growth and care.

##### 2.4.5. *Weeding*

Weeding plants to remove a weed was manually done by pulling out weed or using a hoe. This was done to plants after two and four weeks old.

##### 2.4.6. *Pest and Disease Control*

Pathogen pest and disease control are one of the most important things in ongoing care for cucumber plants. It was done using active ingredients Deltamethrin (Decis 2.5 EC) with 2cc/liter concentration using a hand sprayer and was done accordingly to plant condition. Besides that, casting out livestock such as chickens and cucumber eaters from the planting area has to be done.

##### 2.4.7. *Harvesting*

After cucumber is seven weeks old, harvesting is ready. Cucumber plants have to have harvest criteria as follow: at least 4 cm and 18 cm of diameter and length respectively, fruits which do not fulfill the required measurement can be harvested if there are defects on the peels either caused by nature or pests and deep green fruits with yellowish bottoms as indications of over ripeness. Harvesting was done every 2 days continuously by cutting the stem.

#### 2.5. *Observed Parameters*

In this research, parameters analyzed were:

##### a. *Plants Height (cm)*

Plants height was measured from root neck to the highest point on plant samples. The measurement was done once a week since two weeks old until flowering took place.

##### b. *Number of Leaves*

Leaves counted were those perfectly opened on plant samples. Counting was done once a week from second to the fourth week after planting.

c. Weight of Fresh Fruits per Sample (g)

Fresh fruits per sample were weighted with a weigher. It is done after harvesting by weighing every fruits from each plant sample.

d. Weight of Fresh Fruits per Plot (kg)

Fresh fruit per plot is the result of all yield per plot from the harvest. Weighing was done at the end of harvesting by weighing fruit obtained.

e. Number of Fruits per Sample

It was counted at the end of research and after harvest by counting the number of fruits from each of plant.

f. Number of Fruits per Plot

A number of fruits per plot is the total of fruits obtained from all harvest session. The observation was done at the end of harvesting by summing up the total of fruits.

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### 3. Results and Discussion

#### 3.1. Plants Height

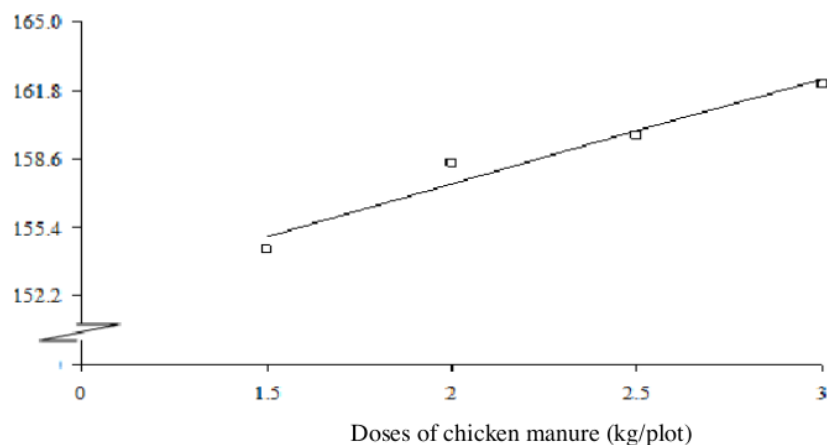
**Table 1.** Mean number of cucumber plant height at two, three and four weeks old with chicken manure application and plant spacing.

Treatment	Plants Height (cm)		
	2 weeks old	3 weeks old	4 weeks old
K <sub>0</sub>	16.84	39.61a	154.39a
K <sub>1</sub>	17.15	40.19ab	158.40b
K <sub>2</sub>	18.09	41.23ab	159.70b
K <sub>3</sub>	18.14	41.59b	162.15c
BNJ <sub>0.05</sub>	-	1.71	2.34
J <sub>0</sub>	16.61	39.30a	155.85a
J <sub>1</sub>	17.94	40.88ab	158.24b
J <sub>2</sub>	17.94	41.54b	160.02b
J <sub>3</sub>	17.73	40.91b	160.51b
BNJ <sub>0.05</sub>	-	1.71	2.34

Note: numbers followed by the same alphabets are based on BNJ test which means no difference from the test at 5% concentration

From Table 1 can be observed that the tallest plant obtained from treatment with chicken manure after three weeks planting, K<sub>3</sub> showed a significant height difference from those of K<sub>0</sub>, but not from K<sub>1</sub> and K<sub>2</sub>. At 4 weeks old, the tallest plant from K<sub>3</sub> showed significant difference from those of K<sub>0</sub>, K<sub>1</sub>, and K<sub>2</sub>, Height from K<sub>2</sub> was far different from K<sub>0</sub>, but not from K<sub>1</sub>. Plant height in K<sub>1</sub> was significantly different from K<sub>0</sub>.

The plant height influenced by chicken manure at four weeks old can be seen on Figure 1. From Figure 1 can be seen that cucumber plant growth increases with the dose of chicken manure which follows positive linear regression curve.



**Figure 1.** Chicken manure dose to cucumber plant height at four weeks old.

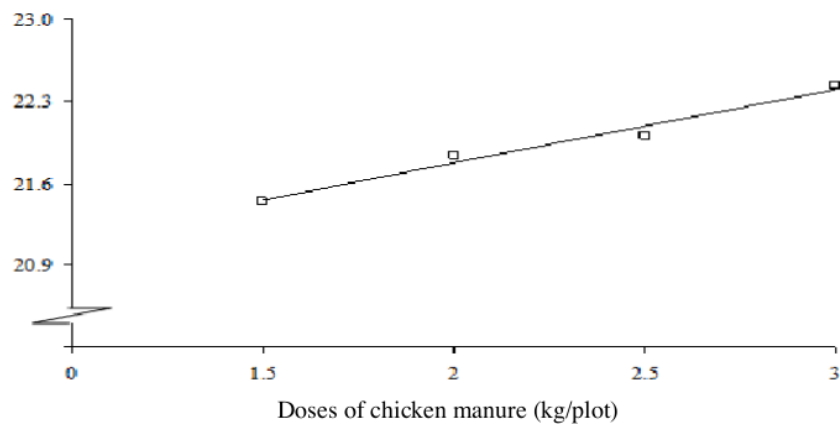
### 3.2. Number of Leaves

A mean number of cucumber plants leaves at two, three and four weeks old with chicken manure application can be seen on Table 2. From Table 2 can be seen in that after three weeks with chicken manure application the plant with the most number of leaves is  $K_3$  differ significantly from  $K_0$ , but not from  $K_1$  and  $K_2$ . A number of leaves on plant  $K_2$  was differed significantly from  $K_0$ , but not from  $K_1$ . The leaves on  $K_1$  differ significantly from  $K_0$ . At four weeks, the plant with a most number of leaves is  $K_3$  which shows the significant difference from those of plants  $K_0$ ,  $K_1$ , and  $K_2$ . Plant  $K_2$  has far greater number of leaves than  $K_0$  but not than  $K_1$ . Plant  $K_1$ , however, has a significant difference number of leaves from  $K_0$ .

**Table 2.** Mean number of cucumber plant leaves at 2, 3 moreover 4 weeks old with chicken manure application and plant spacing.

Treatment	Number of Leaves		
	2 weeks old	3 weeks old	4 weeks old
$K_0$	4.96	10.00a	21.44a
$K_1$	5.23	10.38b	21.83ab
$K_2$	5.31	10.42b	22.00b
$K_3$	5.23	10.56b	22.44c
$BNJ_{0.05}$	-	0.37	0.40
$J_0$	5.00	9.90a	20.69a
$J_1$	5.17	10.19ab	21.75b
$J_2$	5.21	10.42b	22.42c
$J_3$	5.35	10.85c	22.85d
$BNJ_{0.05}$	-	0.37	0.40

The influence of chicken manure application to number of cucumber plant leaves at 4 weeks old can be seen on Figure 2. From Figure 2 can be seen that the number of leaves increases with the increase dose of chicken manure following the positive linear regression curve.



**Figure 2.** The influence of chicken manure dose to number of cucumber plant leaves at four weeks old.

### 3.3. Fresh Fruits Weight per Sample

The mean weight of fresh fruits per sample with chicken manure application and plant spacing can be seen in Table 3.

**Table 3.** Mean weight of fresh fruits per sample with chicken manure application and plant spacing (g).

Treatment	J <sub>0</sub>	J <sub>1</sub>	J <sub>2</sub>	J <sub>3</sub>	Mean
K <sub>0</sub>	762.50	887.50	1008.33	1116.67	943.75a
K <sub>1</sub>	904.17	979.17	1058.33	1304.17	1061.46ab
K <sub>2</sub>	820.83	1104.17	1179.17	1187.50	1072.92b
K <sub>3</sub>	1000.00	1050.00	1179.17	1258.33	1121.88b
Mean	871.88a	1005.21b	1106.25bc	1216.67c	

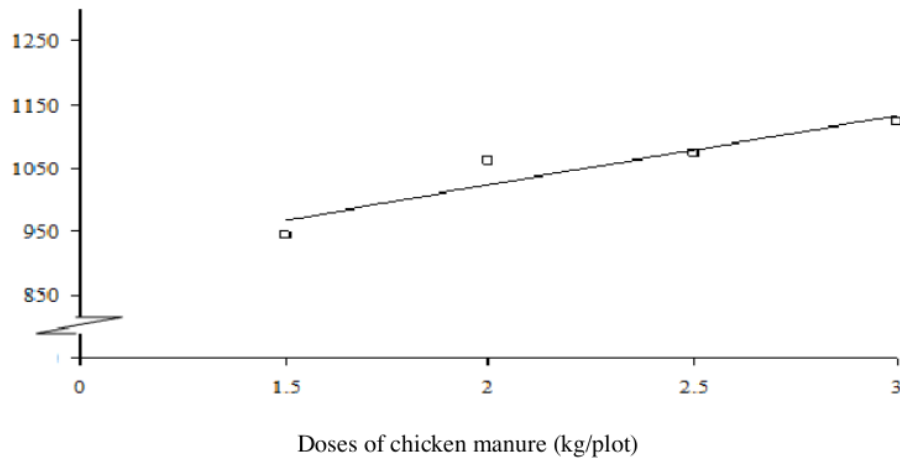
BNJ<sub>0.05</sub> = 127.39

Note: numbers followed by the same alphabets are based on BNJ test which means no difference from the test at 5% concentration.

From Table 3 can be seen that at chicken manure application, the greatest weight for fresh fruits was from K<sub>3</sub> which differ significantly from K<sub>0</sub>, but not from K<sub>1</sub> and K<sub>2</sub>. The weight of fresh fruits per sample in K<sub>2</sub> was far different from K<sub>0</sub> but not from K<sub>1</sub>. Weight from K<sub>1</sub> does not differ far from K<sub>0</sub>.

The influence of chicken manure application to fresh fruits weight per sample can be seen in Figure 3.





**Figure 3.** The effect of chicken manure dose to fresh fruits weight per sample

#### 3.4. Fresh Fruits Weight per Plot

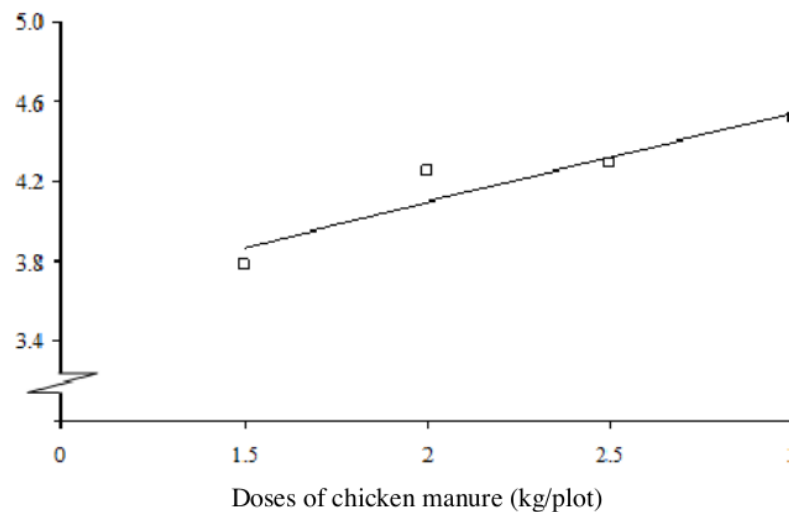
**Table 4.** Mean weight of fresh fruits per plot at chicken manure application and plant spacing (kg).

Treatment	J <sub>0</sub>	J <sub>1</sub>	J <sub>2</sub>	J <sub>3</sub>	Mean
K <sub>0</sub>	3.05	3.55	4.03	4.47	3.78a
K <sub>1</sub>	3.62	3.92	4.23	5.22	4.25ab
K <sub>2</sub>	3.28	4.42	4.72	4.75	4.29b
K <sub>3</sub>	4.00	4.20	4.72	5.15	4.52b
Mean	3.49a	4.02b	4.43bc	4.90c	

BNJ<sub>0.05</sub> = 0.51

Note: a numbers followed by the same alphabets are based on BNJ test which means no difference from the test at 5% concentration.

From Table 4 can be seen that the heaviest fresh fruits obtained with chicken manure application are on plant K<sub>3</sub> which differ significantly from K<sub>0</sub>, but not from K<sub>1</sub> and K<sub>2</sub>. Fresh fruits weight, per plot at K<sub>2</sub> differ significantly from K<sub>0</sub> but not from K<sub>1</sub>. The influence of chicken manure dose to fresh fruits weight per plot can be seen in Figure 4.



**Figure 4.** The influence of chicken manure dose on fresh fruits weight per plot.

### 3.5. Number of Fruits per Sample

**Table 5.** Mean a number of fresh fruits obtained per sample with chicken manure application and plant spacing.

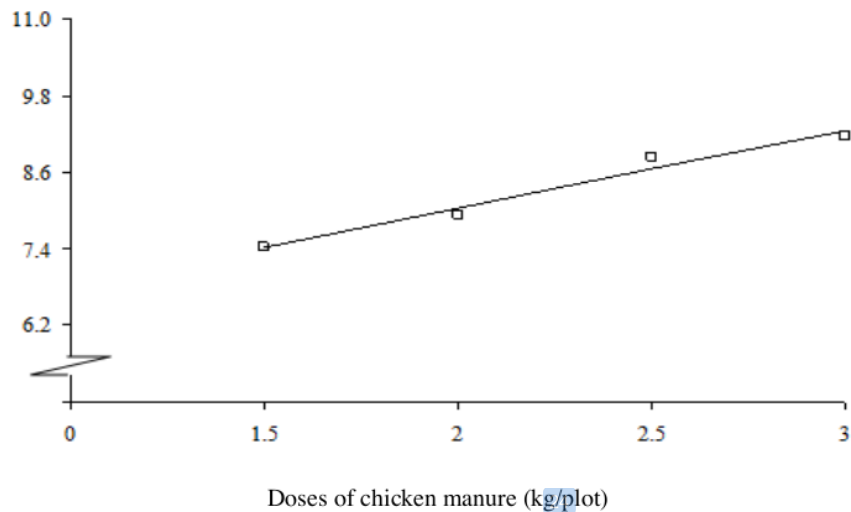
Treatment	J <sub>0</sub>	J <sub>1</sub>	J <sub>2</sub>	J <sub>3</sub>	Mean
K <sub>0</sub>	7.00	6.92	7.58	8.17	7.42a
K <sub>1</sub>	7.33	7.00	8.42	9.00	7.94b
K <sub>2</sub>	7.67	8.92	9.00	9.75	8.83c
K <sub>3</sub>	8.08	8.67	9.50	10.42	9.17c
Mean	7.52a	7.88a	8.63b	9.33c	

BNJ<sub>0.05</sub> = 0.50

Note: numbers followed by the same alphabets are based on BNJ test which means no difference from the test at 5% concentration.

From Table 5 can be seen that the biggest number of fresh fruits obtained from chicken manure application is at plant K<sub>3</sub> which differs significantly from K<sub>0</sub> and K<sub>1</sub>, but not from K<sub>2</sub>. The number of fruits per sample for plant K<sub>2</sub> differ significantly from K<sub>0</sub> and K<sub>1</sub>. Number of fruits per sample from plant K<sub>1</sub> differ significantly from K<sub>0</sub>.

The influence of chicken manure dose to a number of fruits per sample can be seen in Figure 5. From Figure 5 can be seen that the number of fruits increases with the increased dose of chicken manure following the positive linear regression curve.



**Figure 5.** The influence of chicken manure dose to the number of fruits per sample.

### 3.6. Number of Fruits per Plot

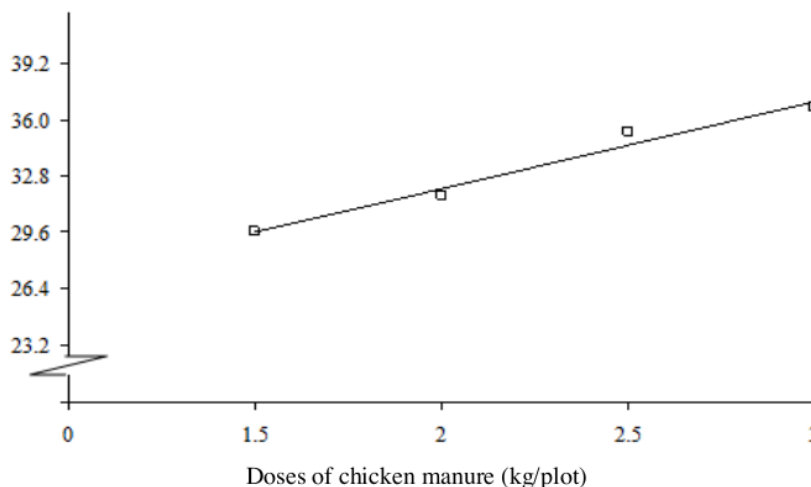
**Table 6.** The mean a number of fruits per plot with chicken manure application and plant spacing

Treatment	J <sub>0</sub>	J <sub>1</sub>	J <sub>2</sub>	J <sub>3</sub>	Mean
K <sub>0</sub>	28.00	27.67	30.33	32.67	29.67a
K <sub>1</sub>	29.33	28.00	33.67	36.00	31.75b
K <sub>2</sub>	30.67	35.67	36.00	39.00	35.33c
K <sub>3</sub>	32.33	34.67	38.00	41.67	36.67c
Mean	30.08a	31.50a	34.50b	37.33c	

$BNJ_{0.05} = 1.99$

Note: numbers followed by the same alphabets are based on BNJ the test which means no differ from test at 5% concentration.

From Table 6 can be seen that the most fruits were obtained from plant K<sub>3</sub> which differs significantly from plants K<sub>0</sub> and K<sub>1</sub> but not from K<sub>2</sub>. The number of fruits from plant K<sub>2</sub> was far different from K<sub>0</sub> and K<sub>1</sub>. The number of fruits per plot in K<sub>1</sub> was far different from K<sub>0</sub>. The influence of chicken manure dose to a number of fruits per plot can be seen in Figure 6.



**Figure 6.** The influence of chicken manure dose to a number of fruits per plot.

### 3.7. The Influence of Chicken Manure Dose to Cucumber Plants Growth and Crop Yield

From ANOVA (analysis of variance) test shows that the application of chicken manure great influence on plant height, number of leaves, fresh fruits weight and number of fresh fruits per sample and plot.

Dosage of chicken manure up to 3kg/plot can increase the growth of height and number of leaves. It is because chicken manure provides organic matters that influence physical, chemical and biological properties of soil [4]. That is also can affect like texture, water binding ability, humidity and nutrients in soil. Therefore, soil which has been given organic matter like chicken manure can bind water and nutrients which can be easily used by plants.

### 3.8. The Influence of Plant Spacing to Cucumber Plants Growth and Crop Yield

ANOVA test shows that plant spacing also great influence on plants' height, number of leaves, fresh fruits weight and number of fresh fruits per sample and plot.

Results show 45 cm x 60 cm ( $J_3$ ) leads to the best cucumber plants growth and crop yield. If space is too tight being a competition between plants to get sunlight, nutrients, and water which then causes nutrients deficiency in half plants. Gardner, Pearce and Mitchell [2] stated that plant spacing is a factor influencing plant growth, because the absorption of solar energy leaves surface strongly influenced by this condition. When space is too close, it can affect vegetative growth and crop yield due to decreased rate of photosynthesis and leaves.

### 3.9. Interaction between Chicken Manure Dose and Plant Spacing for Cucumber Plants Growth and Crop Yield

ANOVA test shows chicken manure application, and plant spacing together do not affect plants' height, number of leaves, fresh fruits weight and a number of fresh fruits per sample and plot. It is because chicken manure application tends to improve soil physical properties for better cultivation, therefore supports better root growth. The four different spaces applied in the research are still optimum space for growing cucumber plants were no competition between plants for nutrients. Therefore the application of fertilizer in which chicken manure was used can result in better growth and crop yield with only slight differences in results with four different plant spacing.

#### 4. Conclusions

1. 3kg/plot of chicken manure can increase plants height to 162.15 cm, with 22.44 number of leaves, giving 1121.88 g and 4.52 kg of fresh fruits per sample and plot respectively with 9.17 units and 36.67 units of fruit per sample and plot.
2. 45 cm x 60 cm plant spacing ( $J_3$ ) gives 160.51 cm height and 22.85 number of leaves. Fresh fruits weight, 1216.67 g with 9.33 units of fruits and 4.90 kg with 7.33 units of fruits per sample and plot respectively. The result is a better compared to narrower plant spacing.
3. There is no real influence on height, number of leaves, fresh fruits weight and number of fruits per sample and plot between the interactions of chicken manure at certain dose with plant spacing.

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# Cucumber plants (*cucumis sativus* L.) growth and crop yield of chicken manure fertilized with plant spacing

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