

# Effect of Planting Distance and Manure Dosage on Growth and Yield of Cayenne Pepper (*Capsicum frutescens* L.)

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## ABSTRACT

This study aims to determine the effect of spacing and dose of manure on the growth and yield of cayenne pepper, and whether or not the interaction between the two factors is significant. It was carried out in the experimental garden of the Faculty of Agriculture, Teuku Umar University (UTU) Meulaboh, West Aceh from July to November 2013. The materials used in this study were the Golden phoenix variety, dolomite lime, manure, basic fertilizer Urea, SP-36 and KCl, pesticides Pegasus. The tools used are hoe, machete, elbow, hand spayer, meter, analytical scale, nameplate and other writing instruments. This study used a 3 x 4 factorial randomized block design (RAK) with 3 replications. Factors examined include plant spacing with 3 levels, namely J1 (60 cm x 70 cm), J2 (60 cm x 80 cm) and J3 (60 cm x 90 cm). The manure dose factor is 4 levels, namely P0 (0 tons ha<sup>-1</sup>), P1 (5 tons ha<sup>-1</sup>), P2 (10 tons ha<sup>-1</sup>) and P3 (15 tons ha<sup>-1</sup>). The variables observed were plant height at 30, 45 and 60 DAP, stem diameter at 30, 45 and 60 DAP, number of branches at 30 and 45 DAP, fruit weight and production. The results of the research that have been carried out, that the spacing of plants had a very significant effect on the diameter of the base of the stem at 30 and 45 DAP and the number of branches at 30 DAP, fruit weight and production ha<sup>-1</sup>. The planting distance had a significant effect on the diameter of the base of the stem at 60 DAP, and had no significant effect on plant height at 30, 45 and 60 DAP and the number of branches at 45 DAP. The best cayenne pepper production was found in the treatment (60 cm x 90 cm). The dose treatment of manure had a very significant effect on plant height at 45 and 60 DAP and stem diameter at 45 and 60 DAP, number of branches at 30 and 45 and fruit weight and production of tons ha<sup>-1</sup>. The dose of manure had a significant effect on plant height at 30 DAP, and no significant effect on stem diameter at 30 DAP. The best cayenne pepper production was found in the treatment (60 cm x 90 cm). There was no interaction between spacing and dose of manure on growth and yield of cayenne pepper.

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## 1. INTRODUCTION

Cayenne pepper (*Capsicum frutescens* L.) comes from the mainland of the Americas, to be precise in Latin America. Cayenne pepper which was once a wild plant and spread by birds (bird chili) has the scientific name *Capsicum frutescens* L. *Capsicum pendulum*, *Capsicum baccatum*, and *Capsicum chinense*. Because of the small size of the fruit, in Indonesia this chili is known as cayenne pepper (Setiadi, 2007).

Cayenne pepper is one of the important vegetables with high economic value and suitable for development in tropical areas such as Indonesia. This shows that cayenne pepper is really a community of vegetables that are needed in everyday life. Cayenne pepper is also capable of producing in the lowlands and highlands and is relatively resistant to disease (Setiadi, 2007).

Chili is one of the most popular vegetable commodities in the archipelago, because of its distinctive spicy taste, Maha Chili is widely used as an additional seasoning to complement Indonesian cuisine and specialties, so chili is in great demand and sought after by consumers so that the demand for chili in the market increases.

One of the efforts to increase the production of cayenne pepper is by adjusting the spacing and giving the right organic matter. Spacing is one of the factors that can affect crop production. Increased production of cayenne pepper can be done by improving the level of planting density. To increase the yield of cayenne pepper. Increasing the level of planting density per unit area to a certain extent can increase yields, but increasing the number of plantings will reduce yields due to competition for nutrients, water, solar radiation and growing space so that it will reduce the number of fruits per plant (Irfan, 1999).

The number of plant population per hectare is an important factor to get maximum yield. Maximum production is achieved when using the appropriate spacing. The higher the density of a plant, the higher the level of competition between plants in terms of obtaining nutrients and light. There are several things that need to be considered, namely soil fertility, proper spacing and balanced use of fertilizers (Anonymous, 2006).

In addition to setting the right spacing, it is necessary to make efforts to add nutrients to plants, namely by adding organic matter. The addition of organic matter to the soil has an influence on several chemical properties, which will then affect the growth and production of cayenne pepper. Sources of organic fertilizers can come from animal waste, plant material and waste (Sutanto, 2002).

Organic fertilizer is the best soil improvement material, the nutrients contained in organic fertilizers are generally low and very varied. Provision of organic matter can increase soil moisture and help improve soil fertility, especially if it is carried out in a relatively long time (Sutanto, 2002).

The addition of manure can increase the availability of nutrients, it can also improve the physical properties of the soil. One of the manures given through the soil is cow dung. Manure contains very complete nutrients, both macro nutrients such as N, P, and K, as well as micro nutrients Ca, Mg, and S, although in very small amounts.

## **2. METHOD**

### **2.1 Place and time**

This research was conducted at the Experimental Garden of the Faculty of Agriculture, Teuku Umar University, Meulaboh, West Aceh from July to November 2013.

### **2.2 Materials and tools**

The materials used in this research are: Seeds, Dolomite Lime, Manure, Inorganic Fertilizer, Pesticide. The tools used in this study were hoe, machete, screw, hand spayer, gembor, meter, analytical scale, nameplate, and other stationery.

### **2.3 Experimental design**

The experimental design used in this study was a 3 x 4 factorial randomized block design (RAK) with 3 replications. Factors studied include spacing and manure. Planting distance factor (J) which consists of 3 levels, namely: J1: 60 cm x 70 cm; J2 : 60 cm x 80 cm; J3 : 60 cm x 90 cm. Manure factor (P) which consists of 4 levels, namely: P0 : ( 0 tons ha-1); P1 : (5 tons ha-1); P2 : (10 tons ha-1); P3 : (15 tons ha-1)

Thus, there were 12 treatment combinations with 3 replications, so 36 treatment units were obtained.

The mathematical models that will be used in this research are:

$$Y_{ijk} = \mu + \beta_i + J_j + P_k + (JP)_{jk} + \epsilon_{ijk} \quad (1)$$

Information :

$Y_{ijk}$  = Observations on the distance factor (J) at the j-th level and manure (P) at the k-th level on the i-th replication.

$\mu$  = General average

$i$  = Effect of group  $i$  ( $i = 1, 2$  and  $3$ )

$J_j$  = Effect of plant spacing factor (J) at the j-th level ( $j = (1, 2$  and  $3)$ ).

$P_k$  = Effect of manure factor (P) to  $k$  ( $k=1, 2, 3$  and  $4$ )

$(JP)_{jk}$  = The interaction effect of the spacing factor at the j-th level and the manure factor at the k-th level

$\epsilon_{ijk}$  = Experimental error No. Treatment of Planting Distance (cm x cm) Manure (ton Ha-1).

If the results of the F test show a significant effect, it will be continued with a follow-up test (BNJ) at 5% lever (BNJ 0.05).

## 2.4 Research Implementation

The research was carried out with the following activities: Seed Treatment and Seedling, Land preparation, Liming, Manure application, Fertilization, Planting, Maintenance (Cayenne pepper plant maintenance includes: watering, replanting, weeding weeds and controlling pests and diseases) and Harvesting.

## 2.5 Observation

The variables observed in this study were as follows: Plant height (cm), diameter of stem base (mm), number of branches (fruit), fruit weight per plant and production (ton ha-1).

## 3. RESULTS AND DISCUSSION

### 3.1 Research result

#### 3.1.1 Effect of Planting Distance.

The results of the F test on analysis of variance showed that the spacing factor had a very significant effect on the diameter of the base of the stem and the number of branches aged 30 DAP and fruit weight and production, but had no significant effect on other variables.

##### a. Plant Height

The results of the F test on the analysis of variance showed that plant spacing had no significant effect on plant height at 30, 45 and 60 DAP.

**Table 1.** Average plant height of cayenne pepper at various spacing treatments at the age of 30, 45 and 60 DAP.

Symbol	Planting Distance cm x cm	Plant Height (cm)		
		30 HST	45 HST	60 HST
J1	60 x 70	39.78	42.57	48.78
J2	60 x 80	44.78	47.78	50.78
J3	60 x 90	40.44	44.37	54.00

BNJ<sub>0.05</sub>

Information: Number followed by the same letter in the same column, there is no insignificant difference at the 5% probability level.

Table 1 shows that plant spacing has no significant effect on cayenne pepper plant height at the age of 30, 45 and 60 DAP, but statistically showed no significant difference.

##### b. Diameter of Trunk

Results F test on analysis of variance showed that plant spacing had a very significant effect on stem diameter at 30, 45 and 60 DAP.

**Table 2.** The average diameter of the base of the cayenne pepper at various spacing treatments was 30, 45 and 60 DAP.

Symbol	Planting Distance cm x cm	Trunk Diameter (mm)		
		30 HST	45 HST	60 HST
J1	60 x 70	4.93 a	7.09	8.31 a
J2	60 x 80	6.21 b	7.49	9.08 ab
J3	60 x 90	5.82 b	7.51	10.20 b
BNJ <sub>0.05</sub>		0.81	-	1.65

.Description: Numbers followed by the same letter in the same column are not significantly different at the 5% probability level

Table 2 shows that the diameter of the base of the cayenne pepper plant at the age of 30 DAP had a very significant effect on the spacing in treatment J2 which was not significantly different from treatments J3 and J1, at the age of 45 it had no significant effect on the diameter of the base of the stem. However, statistically, the difference in diameter of the base of the stem was not significant, and the age of 60 DAP had a significant effect on plant spacing in treatment J3 which was not significantly different from treatment J2 and J1.

### c. Number of Branches

The results of the F test on the analysis of variance showed that the spacing had a very significant effect on the number of branches 30 and 45 DAP.

**Table 3.** The average number of cayenne pepper branches at various spacing treatments was 30 and 45 DAP.

Planting Distance		Number of branches (fruit)	
Symbol	cm x cm	30 HST	45 HST
J1	60 x 70	6.67 a	16.56
J2	60 x 80	7.99 b	18.78
J3	60 x 90	9.78 c	17.89
BNJ <sub>0.05</sub>		1.76	-

Description: Numbers followed by the same letter in the same column are not significantly different at the 5% probability level

Table 3 shows that the highest number of branches at the age of 30 DAP was found in treatment J3, which was significantly different from other treatments, while at the age of 45 DAP, it was found in J2, which was not significantly different from J1 and J3.

### d. Fruit Weight Per Plant

The results of the F test on the analysis of variance showed that plant spacing had a very significant effect on plant fruit weight.

**Table 4.** Average fruit weight of cayenne pepper in various spacing treatments.

Planting Distance		Fruit weight per plant (gr)
Symbol	cm x cm	
J1	60 x 70	37.59 a
J2	60 x 80	47.56 b
J3	60 x 90	67.01 c
BNJ <sub>0.05</sub>		5.19

Information: Number followed by the same letter in the same column is not significantly different at the 5% probability level

Table 4 shows that the weight of planted fruit was found in treatment J3 (60cm x 90 cm), which was significantly different from treatments J2 and J1.

### e. Production

The results of the F test on analysis of variance showed that plant spacing had a very significant effect on production.

**Table 5.** Average production of cayenne pepper in various spacing treatments.

Planting Distance		Production (ton ha <sup>-1</sup> )
Symbol	cm x cm	
J1	60 x 70	3.25 a
J2	60 x 80	4.58 b
J3	60 x 90	5.87 c
BNJ <sub>0.05</sub>		0.49

Description: Numbers followed by the same letter in the same column are not significantly different at the 5% probability level

Table 5 shows that the highest production of cayenne pepper was found in treatment J3 (60 cm x 90 cm) which was not significantly different from treatment J2 (60 cm x 80) but significantly different from treatment J1 (60 cm x 70).

#### 3.1.2 Effect of Manure.

The results of the F test on analysis of variance (Appendix 2 to 20) showed that the manure factor had a very significant effect on plant height 45 and 60 DAP, stem diameter 45 and 60 DAP, number of branches 30 and 45 DAP, fruit weight and production. no significant effect on other variables.

##### a. Plant Height

The results of the F test on analysis of variance showed that manure had a very significant effect on plant height at 30, 45 and 60 DAP.

**Table 6.** The average height of cayenne pepper in various treatments of manure was 30, 45 and 60 DAP.

Manure		Plant Height (cm)			
Symbol	Ton ha-1	30 HST	45 HST	60 HST	
P0	0	18.75 a	26.30 a	32.67 a	
P1	5	24.17 ab	34.86 b	41.33b	
P2	10	24.75 ab	35.89 b	39.56 b	
P3	15	26.08 b	37.67 b	40.00 b	
BNJ <sub>0.05</sub>		6.07	5.61	5.18	

Note: Numbers followed by the same letter in the same column are not significantly different at the 5% probability level.

Table 6 shows that tall cayenne pepper plants aged 30 DAP were found in P3 treatment which were significantly different from the other treatments, which at 45 and 60 DAP were found in P3 which were not significantly different from P2 and P1 treatments, but significantly different from P0 treatments. .

#### b. Diameter of Trunk

The results of the F test on analysis of variance showed that manure had a very significant effect on stem diameter at 30, 45 and 60 DAP.

**Table 7.** Average diameter of stem base on various manures aged 30, 45 and 60 DAP.

Manure		Trunk Diameter (mm)			
Symbol	Ton ha-1	30 HST	45 HST	60 HST	
P0	0	3.92	4.71a	5.35 a	
P1	5	4.12	5.76 b	7.29 b	
P2	10	4.40	5.88 b	7.28 b	
P3	15	4.53	5.74 b	7.66 b	
BNJ 0.05		-	0.70	1.29	

Description: Numbers followed by the same letter in the same column are not significantly different at the 5% probability level

Table 7 shows that cayenne pepper plants with stem diameter at the age of 30 DAP found in P3 treatment were not different from other treatments, which at 45 and 60 DAP were found in P3 treatment (15 tons ha-1), which were not significantly different from P2 treatment. and P1 but significantly different from the treatment P0.

#### c. Number of Branches

The results of the F test on analysis of variance showed that manure had a very significant effect on the number of branches at the age of 30, and 45 DAP.

**Table 8.** The average number of branches of cayenne pepper in various treatments of manure aged 30, and 45 DAP.

Manure		Number of branches (fruit)	
Symbol	Ton ha-1	30 HST	45 HST
P0	0	4.85 a	12.33 a
P1	5	5.64 ab	11.78 a
P2	10	6.31 bc	13.11 a
P3	15	7.64 c	16.00 b
BNJ <sub>0.05</sub>		1.38	2.32

Description: Numbers followed by the same letter in the same column are not significantly different at the 5% probability level

Table 8 shows that the number of branches of cayenne pepper at the age of 30 and 45 DAP was found in treatment P3, which at 30 DAP was not significantly different from treatments P2 and P1, but at 45 DAP it was significantly different from other treatments.

#### d. Fruit Weight Per Plant

The results of the F test on the analysis of variance showed that manure had a very significant effect on plant fruit weight.

**Table 9.** Average fruit weight per plant of cayenne pepper in various manure treatments.

Manure		Fruit weight per plant (gr)
Symbol	Ton ha-1	
P0	0	30.93 a
P1	5	36.36 b
P2	10	41.25 c
P3	15	43.63 c
BNJ 0.05		4.07

Note: Numbers followed by the same letter in the same column are not significantly different at the 5% probability level.

Table 9. shows that cayenne pepper plants with fruit weight were found in treatment P3 which was not different from treatment P2 and P1 but significantly different from treatment P0.

#### e. Production

The results of the F test on analysis of variance showed that manure had a very significant effect on production.

**Table 10.** Average production of cayenne pepper in various treatments of manure.

Manure		
Symbol	Ton ha-1	Production (ton ha-1)
P0	0	2.93 a
P1	5	3.36 b
P2	10	3.53 b
P3	15	3.86 c
BNJ <sub>0,05</sub>		0.38

Note: Numbers followed by the same letter in the same column are not significantly different at the 5% probability level.

Table 10 shows that cayenne pepper production (ton ha-1) was found in P3 (15 tons ha-1) which was not significantly different from treatments P2 and P1 but different from treatment P0.

#### 3.1.3 Interaction Effect.

The results of the F test on the analysis of variance showed that there was no significant interaction between plant spacing and manure on all growth variables and cayenne pepper plant yields observed. This shows that the difference in the response of several spacings does not depend on the dose of manure and vice versa.

#### 3.2 Discussion

Based on the results of research that has been done, that plant height has no significant effect. This is presumably because the required spacing is the optimal spacing, so that there is no influence of competition for either water, light or nutrients in the soil, Rosmarkum and Yuwono (2002). Wide spacing will provide sufficient space for plants to get sunlight because it is not shaded (Gardner et al., 1991).

Based on the results of research that has been carried out, that the largest diameter of the base of the stem was found at a spacing of J3 (60 cm x 90 cm). It is suspected that the spacing between plants is less frequent and there is no competition between plants for nutrients, water, sunlight and growing space. With the optimum level of density it will result in the formation of maximum dry matter (Effendi, 1997). When plants with close spacing, there is competition between plants for light, as Marjenah (1992) observed, at relatively low light intensities, plants tend to spur growth to get the light they need. At a wider spacing professionally get enough light for physiological activities.

That the highest production of cayenne pepper was found in treatment J3 (5.87 tons ha-1). It is suspected that one of the efforts to increase chili production is to regulate the number of plants per hectare or plant spacing which is an important factor for obtaining high yields, such as tillage. The yield of cayenne pepper is also influenced by the number of plants per unit area. The use of the right spacing for the type of plant is aimed at avoiding competition between plants in water absorption, nutrients, the use of sunlight and competition with nuisance plants. The use of the right spacing is very important in the maximum utilization of sunlight for the photosynthesis process (Gerry, 2004).

Based on the results of research that has been done, that the height of cayenne pepper was found at P3 (15 tons ha-1). This is presumably because manure is a type of fertilizer that is applied to the soil and carries essential elements for plant growth. Manure has many advantages including, it contains certain substances such as micro-organisms. Manure when mixed with other solid organic fertilizers can activate the nutrients in the organic fertilizer. Manure can improve the chemical properties of soil containing macro and micro nutrients although the amount is lower when compared to inorganic fertilizers, manure plays an important role in the growth of cayenne pepper plants (Musnamar, 2005).

Based on the results of research that has been done, that the weight of cayenne pepper was found at P3 (15 tons ha-1). This is presumably because manure can provide additional organic matter, improve soil physical properties, and restore nutrients transported by crops. It can also

prevent water loss in the soil and the rate of water infiltration. Some of the nutrients contained in manure are N, P, K, Ca, Mg, S, Fe and many other elements (Musnamar, 2003).

Based on the results of research that has been done, that the production (ton ha<sup>-1</sup>) of cayenne pepper was found in P3 (15 tons ha<sup>-1</sup>). It is suspected that the highest P3 content means higher yields, but not significantly different from P2 and P1 but different from P0. The chemical composition of manure varies from place to place. The arrangement depends on the type of livestock, the age and condition of the animal, as well as how to manage and store fertilizer before use. Manure has advantages compared to other fertilizers, namely; is a humus that can keep the soil so that the soil is easily processed and filled with lots of oxygen, as a source of macro nutrients (nitrogen, phosphorus, and potassium). Increases water holding capacity. Many contain micro-organisms. All the advantages of manure make manure considered a complete fertilizer.

#### 4 CONCLUSION

Spacing had a very significant effect on the diameter of the base of the stem at 30 DAP and the number of branches at 30 DAP, fruit weight and production per hectare. It had a significant effect on the diameter of the base of the stem at 60 DAP, and had no significant effect on the height of the plants at the age of 30,45 and 60 and the diameter of the base of the stem at the age of 45 DAP, the number of branches at the age of 45 DAP. The highest production of cayenne pepper was found at the spacing (60 cm x 90 cm).

Manure had a very significant effect on plant height 45, 60 DAP, diameter of stem base 45,60 DAP, number of branches aged 30, 45 DAP, plant weight and production per hectare. Significant effect on plant height at 30 DAP, and no significant effect on stem diameter at 30 DAP. The highest production of cayenne pepper was found with the application of 15 tons ha<sup>1</sup> of manure.

There is no significant interaction between plant spacing and manure on cayenne pepper plants.

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Further research is needed on the use of plant spacing and manure on cayenne pepper and other horticultural crops.

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