

Effect of Different Organic Fertilizers on Vegetative Growth of Pepper varieties (*Capsicum Annuum* L.)

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Abstract

The *Capsicum annuum* L. plants were conducted at the Botany department, Dagon University. The survival rate of *Capsicum annuum* L. plant C₁ was ninety three percentage and C₂ was eighty eight percentage obtained in germination. The organic fertilizer treatments were applied to the *Capsicum annuum* L. C₁ and C₂ plants established. The results exhibited that the C₁T₇ (Soil mix + Vermicompost) treatment produced a plant height of 18.8 cm, leaf number of 16.2, leaf length of 3.0 cm and leaf width 1.5 cm. The plant's C₂T₈ (Soil mix + Cow dung) treatment produced plant height of 18.4 cm, a leaf number 16.8, leaf length of 3.8 cm, a leaf width of 1.9 cm. The result of leaf area C₁T₇ (Soil mix + Vermicompost) treatment produced 48cm² and C₂T₈ (Soil mix + Cow dung) treatment produced 10.2cm². It is therefore concluded that C₁ (Soil mix and Vermicompost) and C₂ (Soil mix and Cow dung) pepper plants possessed more increasing the growth characters than those of other treatments.

Keywords : *Capsicum annuum* L., germination, vermicompost and cow dung.

Introduction

Pepper (*Capsicum annuum* L.) is the world's most important vegetable. It is used as fresh, dried or processed products and is also used as spices or condiments (Acquaah, 2004). *Capsicum annuum* L. is commonly grown worldwide. It has many general names in English, such as hot pepper, chili or chili pepper, and is also known as sweet pepper and bell pepper (Bosland, 1996). *Capsicum annuum* L. is a widely cultivated species that has been used since ancient times as food flavoring and for human health (Milia, 2006). *Capsicum annuum* L. belongs to the family Solanaceae. The genus *Capsicum* comprises 20-30 species (Lovelock, 1973). The plants are bushy, about 60–80 cm high and are semi-perennials that are grown as annuals in cultivation. *Capsicum* plants are generally planted as seedling. Seedlings may be obtained from a commercial nursery. *Capsicum* plants grow best on deep (minimum of 30 cm) loamy and well-drained soils. Soil pH should be in the range of 5.5-7.0 (Bosland, 1996).

Drainage is important for *Capsicum* cultivation and depending on soil type raised beds may be necessary. Organic fertilizers can range from organic compost to cow manure but they must be derived from all organic sources (www.maximumyield.com). Adequate water is essential for the crop.

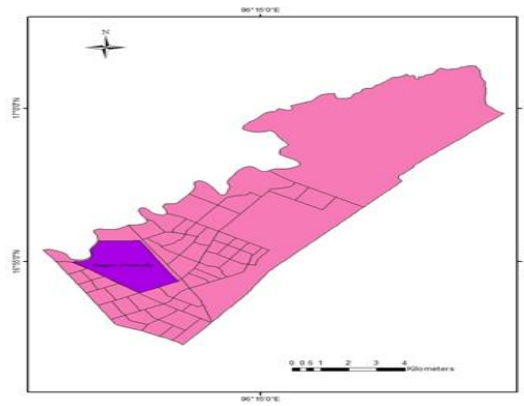
Organic fertilizers may supply nutrients to the soil but different types of source of fertilizer can have some different effects on plants. Organic fertilizers improve soil structure and enhance the activities of useful soil organisms. *Capsicum annuum* usually requires a longer season than most other plants. In recent times, consumers are demanding higher quality and safer food and are highly interested in organic products (www.agriculture.vic.gov.au). According to the above fact, the study was aimed to study the exhibit germination rate and the organic fertilizer effect on growth of *Capsicum annuum* L. plants.

Materials and Methods

The experiments of germination and cultivation of *Capsicum annuum* L. plants were conducted at the Botany Department, Dagon University located at Latitude: 16° 54' 40.47" Longitude: 96° 12' 52.15" (mm.geoview.info/Dagon University) in September 2018 to July 2019 (Figure 1).

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Source: Geography Department at Dagon University

Figure (1) the study area, Botany Department, Dagon University Campus in Dagon Myothit (East) Township

Medium preparation

The medium used in the germination was soil mix.

Experiment 1. Germination of *Capsicum annum* L.

In the experiment, C₁ and C₂ treatments with 4 replicates were used. Each treatment had 200 seeds and thus as total of 400 seeds were sown in seed germination. The distance between plants and rows was 1.0 cm each (Figure 2.).

The treatments are:

C₁ = *Capsicum annum* L. var. *grossum*

C₂ = *Capsicum annum* L. var. *longum*

Data Collection

The germination rate, survived and non- survived plants were daily recorded.

The germination rate was calculated using the formula (Soupe, 2000).

$$\text{Germination Rate (\%)} = \frac{\text{Germinated seeds}}{\text{Total sown seeds}} \times 100 \text{ (Soupe, 2000)}$$



Figure (2) Germination of C₁ and C₂ of *Capsicum annum* L.

Experiment2. Evaluation of the growth of *Capsicum annuum* L. growing in Polyethylene bags

The growing of *Capsicum annuum* L. was conducted in the Department of Botany, Dagon University. The experiment was set up to observe the growth of seedlings.

Soil analysis

The soil mix was submitted to the soil laboratory, Land Use Division, Myanmar Agriculture Service, Insein Township, Yangon Region, for analyzing the physical and chemical properties of soil.

Data collection

The experimental data were recorded every week. There were eight treatments and each treatment had 4 replicates. Before growing the germinated seedlings, the soil was analyzed. The meteorological data during the growing period was also collected.

T₁ – Soil (control)

T₂ – Soil mix

T₃ – Soil + EM (effective microorganisms) (50ml)

T₄ – Soil + Vermicompost(100g)

T₅ – Soil +Cow dung (260g)

T₆ – Soil mix + EM (effective microorganisms) (50ml)

T₇ – Soil mix + Vermicompost(100g)

T₈ – Soil mix +Cow dung (260g)

Growing of *Capsicum annuum* L.

The germinated seedlings were first raised in nursery pots for 30 days to assist in obtaining adequate water for the plant's survival. Thirty days after growing, the plants were transplanted into 18 × 22 cm poly bags containing prepared soil medium. The organic fertilizer application was started 7 days after transplanting.

Results

Morphological Characters of *Capsicum annuum* L.

Annual or perennial herbs, 50-80 cm tall. Stems much branched, Woody at base. Leaves alternate or the upper paired or clustered, base cuneate, apex acuminate or acute, and margin entire, petioles 2-6 cm. Flowers are solitary in axils of leaves or branches. Calyx cup-shaped, 5- toothed. Corolla white, 5 lobed. Stamens 5; anthers blue-purple.

Differences between *Capsicum annuum* L. var. *grossum* and *Capsicum annuum* L. *longum*

<i>Capsicum annuum</i> L. var. <i>grossum</i>	<i>Capsicum annuum</i> L. <i>longum</i>
Leaves are usually solitary, ovate to narrowly lanceolate, dark green, petiole 0.2-4.5cm, base acute to attenuate, apex obtuse to acutely acuminate.	Leaves are smooth-edged, ovate to lanceolate, light to dark green in color long leafstalks, single or collected into a rosette.
Flowers are mostly solitary, bisexual with a 5-sided corolla, white to greenish or bluish white, drooping, calyx cup shape, persistent and enlarging in fruit.	Flower bisexual with a 5-sided corolla, white yellow or violet in color, drooping, calyx cup shaped, undulate.
The fruit with basal depression, inflated and fresh thick that is pointed toward the apex with rounded seeds 61-70 seeds has a mass of 1g.	The fruit droops, triocular, axile placentation .Seeds on the placenta, located at the basis of the fruit, flat or slightly curved 150-200 seeds has a mass of 1g.

Habit



Flower

Figure (3) Morphological Characters of *Capsicum annuum* L.**Experiment 1. Germination of *Capsicum annuum* L.**

The germination of both *Capsicum annuum* L. C₁ and C₂ seeds was started at 7 days after sowing (7DAS) and it was continued to 28 DAS. Out of 200 seeds in C₁, 187 germinated at a rate of 93.5%. Similarly, 176 seeds of C₂ were germinated and 88.0% of germination rate was recorded (Table 1). When comparing the C₁ and C₂ seeds in germination, C₁ seeds were more efficient in germination 5.5% more than C₂ seeds.

Table (1) Daily recorded germination rate of *Capsicum annuum* L.

Treatment	7DAS	14DAS	21DAS	Total % of Germination
C _{1r1}	30	13	4	93.5%
C _{1r2}	25	20	1	
C _{1r3}	20	13	12	
C _{1r4}	30	10	9	
C _{2r1}	30	5	2	88.0 %
C _{2r2}	29	10	7	
C _{2r3}	30	10	7	
C _{2r4}	15	24	7	

DAS = days after sowing C₁ = *Capsicum annuum* L. var. *grossum*

C₂ = *Capsicum annuum* L. *longum*

Figure (4) Germination rate of *Capsicum annuum* L. through C₁ and C₂ treatments

The vegetative growth of *Capsicum annuum* L.

Plant height (cm)

The result showed that C₁ and C₂ plant height from C₁T₇ (Soil mix + vermicompost) 18.8 cm, C₂T₈ (Soil mix + cow dung) 18.4cm were maximum, 16.9 cm from C₁T₁ (Soil), C₁T₃ (Soil + EM), 15.0 cm from C₂T₃ (Soil mix), 16.4 cm from C₁T₃ (Soil + EM). The last four treatments showed the least growth.

Table (2) Symbiotic effect of different organic fertilizers on the plant height of C₁ and C₂

Treatments	Plant Height (cm)									
	7DAS		14DAS		21DAS		28DAS		Mean	
	C ₁	C ₂	C ₁	C ₂	C ₁	C ₂	C ₁	C ₂	C ₁	C ₂
T ₁ Soil (Control)	14.1	14.8	16.5	17.6	18.3	18.0	18.3	18.0	16.9	17.1
T ₂ (Soil mix)	15.8	13.3	17.3	13.8	17.8	14.3	18.2	18.5	17.3	15.0
T ₃ (Soil + EM)	14.8	14.3	16.8	16.3	17.6	16.5	18.2	18.5	16.9	16.4
T ₄ (Soil + Vermicompost)	15.4	14.8	17.3	18.0	19.9	18.3	21.0	18.5	18.4	17.4
T ₅ (Soil + Cow dung)	15.1	13.5	16.1	18.0	18.6	18.2	21.5	23.0	17.8	18.2
T ₆ (Soil mix + EM)	15.0	15.3	16.2	16.1	18.4	17.5	22.0	21.0	17.9	17.5
T ₇ (Soil mix+ Vermicompost)	15.4	14.0	18.5	14.2	19.8	17.5	21.5	18.5	18.8	18.1
T ₈ (Soil mix +Cow dung)	15.8	15.1	16.1	16.1	19.4	18.2	23.0	24.0	18.6	18.4

Number of leaves

The result showed that C₁ and C₂ number of leaves 16.2 from C₂T₇ (Soil mix +vermicompost), 20.1 from C₁T₅ (Soil + vermicompost), 16.8 from C₁T₈ (Soil mix+ cow dung) were maximum, 9 from C₂T₃ (Soil mix), 10.6 from C₁T₆ (Soil mix + EM) which showed the least developed in the leaves number.

Table (3) Symbiotic effect of different organic fertilizers on the leaf number of C₁ and C₂

Treatments	Number of Leaves									
	7DAS		14DAS		21DAS		28DAS		Mean	
	C ₁	C ₂	C ₁	C ₂	C ₁	C ₂	C ₁	C ₂	C ₁	C ₂
T ₁ Soil(control)	5.7	5.2	9.5	13.5	17.0	17.5	24.5	21.5	14.2	14.4
T ₂ (Soil mix)	6.0	2.8	6.7	7.5	12.5	10.0	21.2	17.5	11.6	12.4
T ₃ (Soil + EM)	4.5	4.8	6.0	12.5	11.5	13.0	14.0	20.0	9.0	12.6
T ₄ (Soil + Vermicompost)	6.5	6.0	10.0	14.2	24.0	18.2	27.0	28.0	14.6	16.6
T ₅ (Soil + Cow dung)	6.5	3.8	10.2	11.2	21.2	18.5	28.0	47.0	16.5	20.1
T ₆ (Soil mix + EM)	6.0	4.5	7.0	4.8	13.5	11.2	20.0	22.0	11.6	10.6
T ₇ (Soil mix + Vermicompost)	6.0	5.8	7.0	6.0	20.7	20.0	31.0	28.0	16.2	15.0
T ₈ (Soil mix + Cow dung)	5.2	5.8	7.0	10.8	20.5	18.5	28.0	32.0	15.2	16.8

Figure (5) Leaf number of C₁ and C₂

Leaf length (cm)

The result showed that C₁ and C₂ leaf length from C₁T₄ (Soil + vermicompost) 3.3 cm, C₁T₇(Soil mix + vermicompost) 3cm, 3.8 cm from C₂T₄ (Soil + vermicompost), 3.8 cm from C₂T₈(Soil mix + cow dung) were the maximum, 2.2 cm from C₁T₁ (Soil), 3.1 cm from C₂T₂ (Soil mix) were the least.

Table (4) Symbiotic effect of different organic fertilizers on the leaf length of C₁ and C₂

Treatments	Leaf length(cm)									
	7DAS		14DAS		21DAS		28DAS		Mean	
	C ₁	C ₂	C ₁	C ₂	C ₁	C ₂	C ₁	C ₂	C ₁	C ₂
T ₁ Soil(control)	1.7	3.2	2.0	3.5	3.1	3.8	3.8	4.5	2.7	3.7
T ₂ (Soil mix)	2.8	2.7	2.8	3.0	2.9	3.5	2.9	3.1	2.9	3.1
T ₃ (Soil + EM)	1.6	2.6	2.0	3.0	2.2	3.5	3.1	3.7	2.2	3.2
T ₄ (Soil + Vermicompost)	2.2	2.8	3.0	3.5	3.9	4.4	3.9	4.6	3.3	3.8
T ₅ (Soil + cow dung)	2.3	2.2	2.5	4.0	3.0	4.5	3.0	4.5	2.7	3.8
T ₆ (Soil mix + EM)	2.3	1.2	2.5	3.0	2.7	4.5	4.3	4.5	3.0	3.3
T ₇ (Soil mix + Vermicompost)	2.4	1.5	3.0	3.0	3.1	4.2	3.7	4.3	3.0	3.3
T ₈ (Soil mix +Cow dung)	1.8	2.3	2.0	3.5	3.2	4.8	4.6	4.4	2.9	3.8



Figure (6) Leaf length of C₁ and C₂ varieties

Leaf width (cm)

The result showed that C₁ and C₂ leaf width from 1.6 cm C₁T₇ (Soil mix + vermicompost), 1.9cm from C₂T₈(Soil mix + cow dung) were the maximum, 1.2 cm from C₁T₃(Soil + EM), 1.5 cm from C₂T₂ (Soil mix) were the least.

Table (5) Symbiotic effect of different organic fertilizers on the leaf width of C₁ and C₂

Treatments	Leaf width (cm)									
	7DAS		14DAS		21DAS		28DAS		Mean	
	C ₁	C ₂	C ₁	C ₂	C ₁	C ₂	C ₁	C ₂	C ₁	C ₂
T ₁ Soil(control)	0.8	1.5	1.0	1.8	1.5	1.9	1.9	2.3	1.3	1.8
T ₂ (Soil mix)	1.2	1.3	1.7	1.5	1.7	1.8	1.7	1.6	1.6	1.5
T ₃ (Soil + EM)	0.9	1.2	1.0	1.5	1.3	1.7	1.6	1.8	1.2	1.6
T ₄ (Soil + Vermicompost)	1.3	1.3	1.5	1.7	1.8	2.2	1.9	2.3	1.6	1.9
T ₅ (Soil + Cow dung)	1.2	1.1	1.3	2.0	1.5	2.2	1.5	2.2	1.4	1.9
T ₆ (Soil mix + EM)	1.2	0.6	1.3	1.5	1.4	2.3	2.1	2.2	1.5	1.7
T ₇ (Soil mix + Vermicompost)	1.8	0.3	1.5	1.5	1.6	2.1	1.8	2.2	1.7	1.7
T ₈ (Soil mix +cow dung)	0.7	1.1	1.0	1.3	1.8	2.4	2.3	2.2	1.5	1.9



Figure (7) Leaf width of C₁ and C₂

Leaf area (cm²)

The result showed that the total leaf area from C₁T₇ (Soil mix +vermicompost) 48 cm², C₂T₈ (Soil mix +cow dung) 10.2 cm² were maximum followed by C₁T₃ (Soil + EM) 13.5 cm², C₂T₂ (Soil) 5.0 cm² were the least.

Table (6) Total leaf area of C₁ and C₂

Treatments	Leaf area (cm ²) of C ₁	Leaf area (cm ²) of C ₂
T ₁ Soil(control)	13.9	5.4
T ₂ (Soil mix)	14.7	5.0
T ₃ (Soil + EM)	13.5	5.6
T ₄ (Soil + Vermicompost)	17.3	6.4
T ₅ (Soil + Cow dung)	21.8	6.1
T ₆ (Soil mix + EM)	14.8	7.0
T ₇ (Soil mix+ Vermicompost)	48	8.3
T ₈ (Soil mix +cow dung)	30.6	10.2

Discussion and Conclusion

The germination of *Capsicum annuum* L. experiment showed that C₁ and C₂ were germinated at 7 days after sowing (7DAS) and it was continued to (21DAS). The result showed that C₁ had 93.5% germinated and C₂ had only 88 %. The germination seedbeds of two treatments werer set up under shade and the result showed that the seeds of two treatments could germinate at 31.5°C. The result of this experiment was in agreement with Hazra and Som (2005)and Shinohara(1984) who reported the optimum soil temperature for germination in most of the vegetable was 20- 30°C. The seeds of C₁ and C₂ were germinated 7 days after sowing. The result of this experiment in agreement with Stephanie (2012) who reported the *Capsicum annuum* L. (pepper) seeds only 4-7 days to germinate. The soil was analyzed before the growth of seedlings. The result of the soil analysis revealed that the texture of the soil was loamy sand soil and pH of 6.77. This result was totally in agree with (Bosland, 1996) that (pepper) plant prefer a soil pH should be in the range of 5.5-7.0 (www.deedi.qld.gov.au).

The morphological characteristics of *Capsicum annuum* L. were annual or perennial herbs, 50-80 cm tall. Leaves alternate or the upper paired or clustered, base cuneate, apex acuminate or acute, margin entire, ad axial surface ,petioles 2-6 cm. These characters were in agreement with Hooker (1879), Backer (1963) and Dassanayake (1997).

The results of the vegetative growth such as the plant height,of number of leaves, leaf length, and leaf width of (21 DAS) were better than the (7DAS) of C₁ and C₂ pepper plants.

The *Capsicum annuum* plant C₁T₇ (Soil mix + Vermicompost) treatment produces a plant height 18.8 cm, a leaf number of 16.2, a leaf length of 3cm and a leaf width of 1.5 cm. This soil type was suitable for the growth of pepper plant. Bosland and Votava (2000) agreed that the *Capsicum annuum* L. (pepper) plant can be successfully grown from sandy to heavy clays

but sandy loam soil is preferred for *Capsicum annuum* L.(pepper) plant production. John Burt (2008) also agreed with *Capsicum annuum* L. (pepper) plant usually grow well in soil the must be well- drained, with an optimum pH of 5.5- 6.5. The cultivation period of C₁ and C₂ plants was from October to December 2018. The mean temperature of the cultivation area during the cultivation period was 31.5°C. The *Capsicum annuum* L. plant C₂T₈(Soil mix + Cow dung) treatment produces a plant height of 18.4cm, a leaf number of 16.8, a leaf length of 3.8cm and a leaf width of 1.9cm. C₁T₇(Soil mix + vermicompost) treatment produced plant height 18.8cm, leaf number 16.2, leaf length 3.0cm and leaf width 1.7cm. Among them, C₁T₅ (Soil + Cow dung) produces a leaf number 16.5 and C₂T₅ (Soil + Cow dung) produce plant height of 18.2 cm and leaf number 20.1. The C₁T₄ (Soil + Vermicompost) produced leaf length of 3.3cm and a leaf width 1.6 cm, C₂T₄ (Soil +Vermicompost) produces leaf length 3.8cm. C₁T₂ (Soil mix) produces leaf length of 2.9cm. The C₂T₁ (Soil) produce leaf length 3.7cm and leaf width 1.8 cm. The increased number of leaves may have more Photosynthetic and thus more energy for plant growth. O'Sullivan (1979) and Akande *et al.* (2008) reported that pepper plants have also been shown to good respond well to the application of fertilizer. Peck and MacDonald (1975) also reported that pepper plants produce well when they are adequately supplied with the essential nutrients. The results were in agreement with Ewulo *et al.* (2007) who discussed organic fertilizer increased growth parameters of pepper plant such as number of leaves and plant height.

The result of the leaf area of the *Capsicum annuum* L. (pepper) plants in the experiment showed that C₁T₇ (Soil mix+ Vermicompost) 48 cm² and C₂T₈ (Soil mix + Cow dung) 10.2 cm² so they had a bigger area than other treatments. Ahmad and Shad (2010) reported that key role in improving the growth during seedling emergence and consequently affects the leaf area.

In conclusion, the results of these experiments showed that C₁ and C₂ increased the plant growth by using fertilizers. Most small-scale farmers still rely on crude inputs, land and human labor with less use of chemical fertilizers and improved varieties of crops. The use of fertilizer is reported to be responsible for over 50 percent yield increase in crops. It has been widely accepted that organic farming alone could serve as a holistic approach towards achieving sustainable agriculture as it is nature based, environment by friendly and ensures the conservation of resources for the future.

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Website

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