GROWTH AND YIELD OF CHILLI AS AFFECTED BY ORGANIC AND INORGANIC LIQUID FERTILIZER APPLICATION IN HOT SEASON OF TAUNGOO TOWNSHIP

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Abstract

The planting pot experiments of chilli were carried out behind Mahogany hostel in Taungoo University Campus, Bago Region from March to July, 2022. The chilli seeds were sown in soil tray for transplanting in field. The transplanted plants were used with five treatments of organic and inorganic liquid fertilizer which including the untreated control treatment. *Capsicum frutescens* L. which belongs to family Solanaceae is referred to as chilli. These chilli plants had significant results for growth parameters, yield and yield components of chilli due to application of organic and inorganic liquid fertilizers compared to control. Among the five different treatments, the combination of organic and inorganic liquid fertilizers (T4) treatment resulted in maximum plant height, number of branches per plant, leaf number, fresh and dry weight of the plant, number of fruits per plant and total yield. The combined organic and inorganic liquid fertilizers (T4) treatment was the highest agronomic characters and set up more fruits of chilli plants in hottest season of Myanmar.

Keywords - Combined organic and inorganic liquid fertilizers, chilli, growth parameters, yield.

Introduction

Chilli are now widely cultivated in the world and are economically important as condiments, vegetables and medicines. It is cultivated mainly in home gardens or small fields and is used for seasoning foods in the daily diet (Sunil, P., *et al*,2012). Most nutrients needed by plants are supplied solely by soil. Insufficient supply of these nutrients may limit plant growth. However, agricultural crops may require more nutrients than natural vegetation (Lim T K ,2013). Organic fertilizers are derived from living things including plants and animals manures while inorganic are synthetically derived chemicals plus minerals from the earth.

Organic fertilizers are naturally available mineral sources that contain moderate amount of plant essential nutrients. Fertilizers are materials that can be added to soil or plants, in order to provide nutrients and sustain growth (Barker and Allen V, 2012*).* The application of organic fertilizers combined with inorganic fertilizers is expected to increase plant growth and the availability of nutrients in plants. Liquid organic fertilizers have the advantage of being able to increase nutrient uptake and quickly overcome nutrient deficiencies because the nutrients in it have broken down so that they are more easily to absorb efficiency (Pangaribuan, *et al*., 2017).

Chicken and cowdung manure contain NPK for almost all types of plants and crops. It brings back nutrient balance to fields organically (Telkamp, M, 2015). Chicken and cowdung manure are some of the commonest farmyard manure. They are used as fertilizers to boost plant yield and also to improve soil structure and fertility. Myanmar has a tropical to sub-tropical monsoon climate with three seasons namely hot (mid-February to mid-May), rainy (mid-May to late October) and cool (late October to mid-February). The present study was carried out to study the effect of organic and inorganic liquid fertilizers on growth and yield of chilli in hot season of

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Taungoo Township. This study aims to evaluate the effects of organic and inorganic liquid fertilizers on growth and yield of chilli in hottest season of Taungoo Township, to reduce the use of excessive inorganic fertilizers among farmers and to give the suitable information of this study to local farmers.

Materials and Methods

Time and place of field experiment

The field experiments on growth and yield of chilli plant were conducted from March to July, 2022 behind the Mahogany hostel in Taungoo University Campus, Bago Region. In this study, chilli seeds were sown from moderate hot to very hot season in Myanmar (from March to July, 2022).

Preparation of seedling for transplanting and planting pot

The chilli seeds were sown in soil tray for transplanting in field. The 30 days ages and 4 ± 1 inch plant height of transplanted chilli plants were sown in each planting pot. This study arranged 15 plants in RCD (Randomized Complete Design).

The planting pots were prepared with soil and rice husk charcoal (2 :1) to better soil aeration and soil physical condition. This cultivation consists of the 15 prepared soil planting pot with 5 treatments and 3 replications of chilli plants. Each soil planting pot was spaced 18 inches in a row. Each row was 2 ft apart to each other and a row consists 5 soil planting pots. Each soil planting pot was filled with 5Kg soil and rice husk charcoal (2: 1).

The transplant was sown in each planting pot to get one plant per soil planting pot. When chilli plants were established, the soil around the base of plants was pulverized, gaps filling, weeding, irrigation and pest management were done as per requirement.

After one week for transplanting of chilli plants, the following treatments were applied in each treated planting pot with two times interval per month.

The treatments were:

T1 - 5 kg of soil with no fertilizer (control)

T2 - 10 Kg ground chicken manure mixed with 20 liter water (Chicken manure liquid fertilizer)

T3 - 10 Kg ground cowdung manure mixed with 20 liter water (Cowdung manure liquid fertilizer)

T4 - 3g NPK mixed with1 liter water + 1 liter chicken manure liquid fertilizer + 1 liter cowdung manure liquid fertilizer (Combined liquid fertilizer)

T5 - 3g NPK mixed with 1 liter water (NPK liquid fertilizer)

Figure1. Transplanted plants and preparation of planting pots in chilli cultivation

Preparation of organic and inorganic liquid fertilizers (Dewi Putri Ratna and Kanevi Octova Paradita, 2010)

Cowdung manure was grounded to make the powder form. Then, 10Kg cowdung manure powdered forms were mixed with 20 liters water (1: 2) for making cowdung liquid fertilizer for chilli cultivation. Then, the both materials are mixed and stirred. Optimally, stirring is done for 4 hours by hand and ready to be use in this study. After that, then filtered or separated between the liquid and solid parts. The liquid, so organic liquid and solid fertilizers were stirred for a few minute before use. 1 liter cowdung liquid fertilizer was applied in each cowdung liquid fertilizer treatment from 1 week after transplanting for 2-week interval in chilli cultivation. Similarly, chicken manure liquid fertilizer was prepared in this procedure. NPK was bought in market being as inorganic fertilizers in this cultivation. 30g per liter NPK liquid fertilizer was applied in each NPK treated planting pot respectively.

Figure 2 . NPK, Chicken and Cowdung manure

Preparation for the Morphological Study

The seeds of chilli were obtained from Taungoo District and Local farmers cultivated these seeds as local variety. The morphological characters of the fresh specimens sample chilli plants were studied from habit to seed. All fresh specimens were recorded by taking the photographs in the study. Chilli plants were collected from the field and were identified by their specific morphological characters according to their literatures.

Measurement of agronomic characters

Plant height was measured starting from the base of the stem to the tip of the highest leaf by using measuring tape. The unit used for plant height measurement was inch. The number of leaves, flowers and fruits per plant were counted weekly after transplanting. Chilli fruits \weight in each treated pot were weighted by digital balance to evaluate the weight yield of chilli plant at harvested time.

Data collection and statistically analysis

Plant height, number of leaves, number of flowers and fruits were counted from 2 week after sowing in chilli cultivation. All data in each treatment were calculated and compared to evaluate the best results in this study of chilli cultivation. Watering and other cultural practices were done whenever it was necessary.

The agronomical data in this study were statistically analysed by using Cropstat software program. Treatment means were compared by using LSD (Least significant Differences) at 1% and 5% level of significant.

Climatological data collection

The climatological data such as monthly minimum temperature, maximum temperature and relative humidity during chilli cultivation was determined at Department of Meteorology and Hydrology, Taungoo township, Bago Region.

Results

Scientific name - *Capsicum frutescens* L.

English name - Chilli

Myanmar name - Kala-aww

Family - Solanaceae

Morphological Characters

Habit: Erect herbs, much branched. **Leaves**: alternate, simple, petiolate, stipulate. **Inflorescence:** axillary, solitary, cymose. **Flower:** solitary, terminal, axillary, bisexual, regular, actinomorphic, complete, pentamerous, cyclic, hypogynous. **Calyx:** (5 - 6), synpetalous, petaloid, valvate, cupshape, sepaloid,persistent, inferior. imbricate, persistent, inferior. **Corolla:** (5 - 6), synpetalous, petaloid (greenish), imbricate, inferior. **Androecium:** 5, apostemonous, petalostemonous, adnate at base to corolla tube, long anther with groove, filament short, introrse, longitudinal dehiscence, and inferior. **Gynoecium:** (2), syncarpous, bilocular, axile placentation, many ovules in each locule in T. S, style long and slender, stigma capitate, superior. **Fruits:** The berries fruit is red when mature and tapered. The fruit are narrow, conical or elliptical, 1 - 2.5cm long and 0.5cm wide and contain numerous pale yellow, flattened seeds.

Figure 3. Morphological Characters chilli

Plant height of chilli plant during growing periods

Plant heights of chilli plant were presented in Table 1. Among the different fertilizers, the plant height was the highest in combined fertilizer application from 8 week to 12 week after transplanting. All treatments including control were developed the different height to each other. Control (without fertilizer) was the shortest in all treatments. The plant height in all treatments were significantly different compared to the control treatment.

Table 1. Mean values of plant height of chilli during growing periods

Treatments	Plant height plant^{-1}of chilli plant during growing periods (inch)					
	2wk	**4wk**	**6wk**	**8wk**	**10wk**	**12wk**
Control (T_1)	3.00	8.67	12.33	14.33	17.33	19.33
Chicken manure liquid fertilizer (T_2)	5.67	12.33	15.33	20.33	26.67	30.33
Cowdung manure liquid fertilizer (T_3)	4.47	10.33	17.33	19.67	21.67	24.00
Combined liquid fertilizer (T_4)	5.50	10.33	17.33	21.33	28.33	32.00
NPK liquid fertilizer (T_5)	4.13	10.33	17.33	21.33	27.67	31.00
F-test	**	**	**	**	**	**
LSD (5%)	**0.68**	**1.14**	**0.84**	**1.29**	**1.68**	**1.58**
cv (%)	**7.9**	**5.8**	**2.8**	**3.5**	**3.6**	**3.1**

**=significant at 1% level of LSD, *=significant at 5% level of LSD, ns=not significant, wk= week after transplanting

Leaves numbers of chilli plant during growing periods

Among the different fertilizers, the maximum number of leaves was found in combined fertilizer application from two week after transplanting to harvested time. Control (without fertilizer) was the minimum number of leaves in all treatments. The detailed results were presented in table 2.

Table 2. Mean values of number of leaves of chilli plant during growing periods

Treatments	Leaves number plant^{-1}of chilli plant during growing periods					
	2wk	**4wk**	**6wk**	**8wk**	**10wk**	**12wk**
Control (T_1)	7.33	21.33	35.33	45.33	52.33	58.33
Chicken manure liquid fertilizer (T_2)	10.33	42.67	68.33	89.33	117.67	124.33
Cowdung manure liquid fertilizer (T_3)	8.33	25.67	38.67	51.67	89.67	97.33
Combined liquid fertilizer (T_4)	16.33	48.67	79.67	98.00	137.33	147.00
NPK liquid fertilizer (T_5)	9.33	31.33	52.67	71.33	100.67	106.33
F-test	**	**	**	**	**	**
LSD (5%)	**1.03**	**1.79**	**1.19**	**1.65**	**1.99**	**1.99**
cv (%)	**5.3**	**2.8**	**1.2**	**1.2**	**0.6**	**1.0**

**=significant at 1% level of LSD, *=significant at 5% level of LSD, ns=not significant, wk= week after transplanting

Number of branches in chilli plant during growing periods

Among the different fertilizers, the maximum number of branches was founded in combined fertilizer application from two week after transplanting to harvested time. Control (without fertilizer) was the minimum number of branches in all treatments. The detailed results were presented in table -3.

Table 3. Mean values of number of branches of chilli plant during growing periods

Treatments	Number of branches plant^{-1} of chilli plant during growing periods								
	4wk	**5wk**	**6wk**	**7wk**	**8wk**	**9wk**	**10wk**	**11wk**	**12wk**
Control (T_1)	3.33	5.33	5.67	5.67	5.67	5.67	5.67	5.67	5.67
Chicken manure liquid fertilizer (T_2)	7.33	9.33	9.33	9.67	9.67	9.67	9.67	9.67	9.67
Cowdung manure liquid fertilizer (T_3)	2.33	2.67	4.33	4.67	6.33	6.33	6.33	6.33	6.33
Combined liquid fertilizer (T_4)	8.33	9.33	10.33	10.67	11.33	11.33	11.33	11.33	11.33
NPK liquid fertilizer (T_5)	6.33	7.33	7.33	9.00	9.33	9.33	9.33	9.33	9.33
F-test	**	**	**	**	**	**	**	**	**
LSD (5%)	**0.14**	**0.49**	**0.77**	**0.60**	**0.60**	**0.60**	**0.60**	**0.60**	**0.60**
cv (%)	**0.0**	**3.8**	**5.6**	**6.5**	**3.7**	**3.7**	**3.7**	**3.7**	**3.7**

**=significant at 1% level of LSD, *=significant at 5% level of LSD, ns=not significant, wk= week after transplanting

Number of flowers of chilli plant during growing periods

Among the different fertilizers, the maximum number of flowers was combined fertilizer application from four week after transplanting to harvested time. The number of flowers in control

(without treatment) and other treatments were a differences throughout the chilli cultivation. The detailed results were shown in Table 4 and figure 4.

Table 4. Mean of number of flowers in chilli plant during growing periods

Treatments	Number of flowers plant^{-1} of chilli plant during growing periods						
	6wk	**7wk**	**8wk**	**9wk**	**10wk**	**11wk**	**12wk**
Control (T_1)	5.33	7.33	10.33	12.33	14.67	7.67	12.67
Chicken manure liquid fertilizer (T_2)	9.33	13.33	20.33	38.33	25.33	11.67	14.33
Cowdung manure liquid fertilizer (T_3)	7.33	10.33	12.33	27.67	19.67	13.33	15.67
Combined liquid fertilizer (T_4)	13.33	18.33	22.67	56.67	84.33	20.33	23.33
NPK liquid fertilizer (T_5)	10.33	14.33	21.67	31.33	23.33	11.33	15.67
F-test	**	**	**	**	**	**	**
LSD (5%)	1.11	1.11	1.11	1.74	1.46	1.58	1.68
cv (%)	6.5	4.6	3.4	2.8	2.3	6.5	5.5

**=significant at 1% level of LSD, *=significant at 5% level of LSD, ns=not significant, wk= week after transplanting

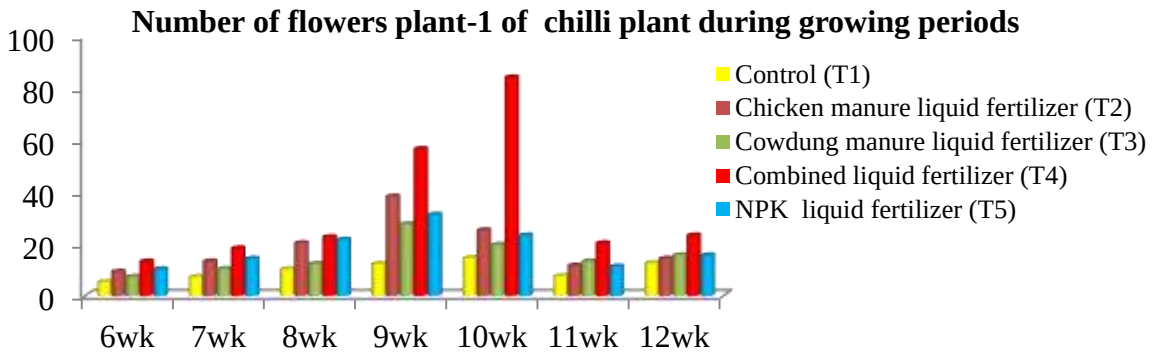

Figure 4. Mean of number of flowers in chilli plant during growing periods

Number of fruits of chilli plant during growing periods

Among the different fertilizers, the maximum number of fruits was the highest combined fertilizer application in chilli plant during the growing periods. The detailed results were shown in Table 5 and figure 5.

Table 5. Mean of number of fruits in chilli plant during growing periods

Treatments	Number of fruits plant^{-1} of chilli plant during growing periods						
	6wk	**7wk**	**8wk**	**9wk**	**10wk**	**11wk**	**12wk**
Control (T_1)	0.00	0.00	0.00	7.33	13.33	20.33	22.33
Chicken manure liquid fertilizer (T_2)	0.00	0.00	1.33	15.33	54.67	75.33	77.33
Cowdung manure liquid fertilizer (T_3)	0.00	0.00	0.00	10.33	30.33	54.67	58.33
Combined liquid fertilizer (T_4)	0.00	2.33	5.33	17.33	66.67	92.67	98.33
NPK liquid fertilizer (T_5)	0.00	0.00	0.00	12.67	50.33	69.67	75.33
F-test	**ns**	**	**	**	**	**	**
LSD (5%)	**0.00**	**0.49**	**0.94**	**1.22**	**0.73**	**1.11**	**1.11**
cv (%)	**0.0**	**55.3**	**27.8**	**5.1**	**0.9**	**0.9**	**0.9**

**=significant at 1% level of LSD, *=significant at 5% level of LSD, ns=not significant, wk= week after transplanting

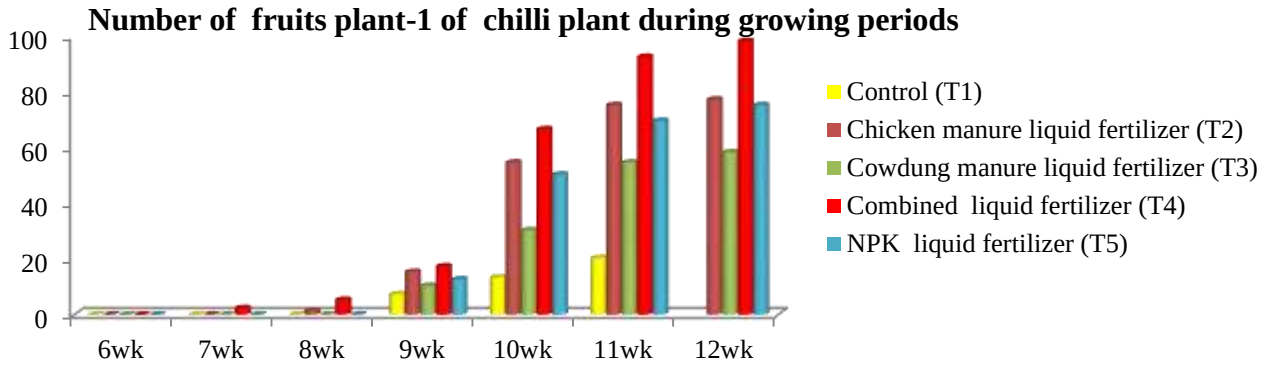

Figure 5. Mean of number of fruits in chilli plant during growing periods

Yields of chilli at harvested time

Among the different fertilizers, the highest weight of yields were combined fertilizer application in chilli plant at harvesting time. In the fruit weight of different treatments, the fruit weight of combined fertilizer application was the highest at harvesting time. The detailed results were shown in Table - 6.

Table 6. Mean of number of yields in chilli plant during growing periods

Treatments	**Yields of chilli at harvested time**		
	Number of fruits plant^{-1}	Weight of fruits plant^{-1} (g)	Weight of fruits plant^{-1} (g) /Number of fruits plant^{-1}
Control (T_1)	22.33	17.93	0.8
Chicken manure liquid fertilizer (T_2)	77.33	98.33	1.27
Cowdung manure liquid fertilizer (T_3)	58.33	75.60	1.30
Combined liquid fertilizer (T_4)	98.33	137.63	1.40
NPK liquid fertilizer (T_5)	75.33	97.67	1.30
F-test	**	**	
LSD (5%)	1.11	1.95	
cv (%)	0.9	1.2	

**=significant at 1% level of LSD, *=significant at 5% level of LSD, ns=not significant, wk= week after transplanting

Table 7. The climatological data of experimental site during chilli plant cultivation

Parameters	**Monthly mean temperature, relative humidity and rainfall from March to July, 2022**					
		March	**April**	**May**	**June**	**July**
Temperature (ºC)	Minimum temperature	26.1	30.0	27.8	24.4	25.6
	Maximum temperature	32.0	34.0	30.6	29.0	31.0
Relative humidity(%)		70.10	64.87	81.68	84.52	86.54
Rainfall (inches)		0.03	0.03	0.28	0.51	0.24

Source: Department of Meteorology and Hydrology, Taungoo

Discussion and Conclusion

This study revealed that erect herbs and much branched chilli plant with the berries fruit. The fruits are narrow, conical, 1 - 2.5cm long and 0.5cm wide and contain numerous pale yellow, flattened seeds. Based on morphological characters, scientific name is *Capsicum frutescens* L. in Solanaceae family. It agreed with C. Azurdia, 2020 and *Carvalho, 2014).* Height of Plants, number of leaves and number of branches were highest in combined liquid fertilizer (T_4) treatment of chilli plant. Irwan A W and Nurmala T, 2018 found that the combination of applying organic fertilizers and inorganic fertilizers to chilli plants can make efficient use of inorganic fertilizers as well as increase the availability of nitrogen in the soil and nitrogen uptake in plants will be minimize nutrients lost because organic fertilizers are able to bind nutrients. Moreover, number of flowers and fruits and fruits weight in combined liquid fertilizer (T_4) treatment were higher than other treatments and closely followed by chicken manure liquid fertilizer (T_2) and NPK liquid fertilizer (T_5) in chilli cultivation. The nutrient balance for plant was better growth and yield. The leaves of chicken manure liquid fertilizer (T_2) treatment were thicken and margin roll upward but formed many fruits in this treatment. Cowdung manure liquid fertilizer (T_3) treatment was higher than control and later fruit setting than other treatments. The flowers was shed from 6week to 8week in NPK liquid fertilizer (T_5) treatment and then the fruit setting was at 9week after transplanting. Combined liquid fertilizer (T_4) treatment was earlier flower initiation and fruit formation of chilli plant. The use of liquid organic fertilizers is expected to reduce the use of inorganic fertilizers in order to achieve environmentally friendly and sustainable agriculture.

The transplanted chilli plants was grown from Apirl to June in hottest season of Myanmar. The chilli plants were developed by using liquid fertilizer throughout the growing period. Rizqiani, 2006 found that liquid organic fertilizers have several benefits, including being able to encourage and increase the formation of leaf chlorophyll and the formation of root nodules in plants, thereby increasing the ability of plant photosynthesis and absorption of nitrogen from the air, can increase plant vigor so that plants become sturdy and strong, increase plant resistance to drought, weather stress and attack by disease-causing pathogens, stimulate the growth of production branches, and increase the formation of flowers and ovaries, and reduce the loss of leaves, flowers and ovaries.

In conclusion, combined liquid fertilizer (T_4) treatment was the best suitable treatment due to the improvement of plant growth parameters and yield in hot season of Myanmar. Based on the benefits and advantages of liquid organic fertilizers, the results of this study can be used as additional information to expand the use of organic fertilizers, especially liquid organic fertilizers, as a nutrient source at the farm level so as to support sustainable agriculture.



Figure 6. Five treatments of chilli plant during growing periods

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