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Effect of Different Potting Medium on Growth and Yield Performances of Capsicum under Organic and Inorganic Management

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Abstract: A pot experiment was conducted to evaluate the effect of different potting medium on growth and yield performances of capsicum (*Capsicum annum* var. Hungarian Yellow Wax) under organic and inorganic management conditions. The experiment was carried out in Completely Randomized Design (CRD) with six replicates. Four potting medium combinations; cattle manure: topsoil 2:1, compost: topsoil 2:1, leaf mould: topsoil 2:1, topsoil only were used under organic and inorganic managements as treatments. For inorganic management, all management practices were uniformly performed based on the recommendations of Department of Agriculture, while for the organic management, farmers adopted practices were followed. Growth parameters such as leaf number, number of branches and plant height were measured in biweekly interval and yield parameters such as weight of fruit, length, circumference and average yield per pot were measured after harvesting. ANOVA and Duncan Multiple Range test were used for data analysis. There were significant differences observed in growth parameters; plant height and leaf number among the treatments, but there was no significant difference in number of branches. There were significant differences in yield parameters among the treatments. The highest fruit length, circumference and individual fruit weight were observed in compost: topsoil combination under organic management. The highest average fruit yield per pot was observed in compost: topsoil combination under inorganic management due to the production of higher number of fruits in inorganic management. It can be concluded that under organic management, rooting medium combination of compost: topsoil at the ratio of 2:1 can be recommended for small scale pot cultivation due to eco-friendly cultivation, whereas, under inorganic management, incorporation of compost with soil can be recommended for profitable commercial level cultivation in the field.

Keywords: Capsicum, Inorganic fertilizer, Organic fertilizer, Potting media, Yield

Introduction

Consuming vegetables provides many health benefits. People who eat more vegetables and fruits as part of an overall healthy diet are likely to have a reduced risk of some chronic diseases. Vegetables provide nutrients vital for health and maintenance of human body. Most vegetables are naturally low in fat and calories. None have cholesterol.

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Vegetables are important sources of many nutrients, including carbohydrate, protein, fats, potassium, dietary fiber, folic acid, vitamin A and vitamin C (Yawalker, 1985).

Capsicum is an important Solanaceae family crop of sup-tropics and tropics possessing 10 species. In Sri Lanka, this vegetable crop is cultivated in large extent due to its good market demand (Sarkar *et al.,* 2007). It has a unique place in Asian diet as spice and vegetable. Capsicum is consumed as fresh pod throughout the world. It is rich in proteins, lipids, carbohydrates, fibers, mineral salts; Ca, P, Fe and in vitamins A, D_3, E, C, K, B_2 and B_{12}. The fruits are a good source of health-related phytochemical compounds that are very important in preventing chronic diseases such as cancer, asthma, coughs, sore throats, toothache, diabetes, and cardiovascular diseases (Orobiyi *et al.,* 2013).The production of capsicum was 73,679 Metric tons and 62,666 Metric tons in 2014 and 2015, respectively in Sri Lanka. The reason for 14.6% of yield reduction from 2015 to 2016 might be adverse climatic condition and leaf curl complex.

It is easy to think of soil as a good medium, but most soils when used alone are very poor growing medium. The structure of the growing medium must be soft and porous enough, so that roots can easily penetrate widely into the material and it must also provide anchorage and support for the plants (Utobo *et al*., 2015). The physical, chemical and biological properties of a growing medium can be used as a basis of classifying the suitability of a growing medium in relation to the needs of the roots (Egunjobi and Ekundare, 1981). The materials used in a potting mix can be manipulated or processed to produce a growing medium with superior physical properties to the soil (George and Kelvin, 2004).

Organic farming is defined as the production system in which avoids or largely excludes the use of synthetically compounded fertilizers, pesticide, growth regulator and livestock feed additives. To the maximum extent feasible organic farming system rely upon crop rotations, crop residues, animal manures, legumes, green manure, off-farm organic wastes and aspects of biological pest control insets, pest weeds etc.

Although the vegetable production at present is mostly depending on the inorganic fertilizers, the organic production of vegetable is timely needed due to the problems associated with inorganic fertilizers. There were several studies carried out regarding effect of potting medium on growth and yield of capsicum, but only few studies have been carried out in Sri Lanka, especially in Kilinochchi. By considering this gap, this study was conducted to evaluate the effect of organic and inorganic management of capsicum among different potting media and its influence on growth and yield performances of capsicum by finding the suitable potting medium to optimize the yield and evaluating the impact of organic and

inorganic managements on growth and yield performance of capsicum.

Materials and Methods

An experiment was carried out in the Faculty of Agriculture, Ariviyal Nagar, Kilinochchi during the period of March to July 2018 to study the effect of different potting media on growth and yield performances of capsicum under organic and inorganic managements. The experiment was carried out in Completely Randomized Design (CRD) with six replications. Four growing media combinations (cattle manure: topsoil 2:1, compost: topsoil 2:1, leaf mould: topsoil 2:1, topsoil only**)** were used as treatments in organic and inorganic management for capsicum Hungarian Yellow Wax variety.

Capsicum Hungarian yellow wax variety was selected due to conical shape fruits, thick flesh, smooth and shiny surface and it has good market demand in Northern region of Sri Lanka. Seeds were treated with captan (3.75 g/kg) and sowed in a nursery tray (22.5 cm width and 52.5 cm length) with cells dimensions of 6.25 × 6.25× 6.25 cm each. Rooting media for nursery trays was prepared by using the sterilized coir dust and topsoil at the ratio of 1:1 and treated with captan (6 g/m^2). Regular watering was done by using a hand sprayer at morning and evening until the seeds are germinated.

One month after germination, uniform size capsicum seedlings were transplanted in plastic pots filled with rooting media as in the treatments and two seedlings were assigned in each pot. All pots were kept in a shade for one week to prevent the stress conditions. Thereafter, the pots were transferred to the field. After the successful establishment of the seedlings, one vigorous healthy seedling was allowed per pot. Capsicum pots were arranged according to recommended spacing of 30 cm ×15 cm.

Watering was done by using a watering can and the surface soil in each pot was kept in wet condition, but excess watering was avoided. All management practices were done as recommendation made by Department of Agriculture in inorganic management. In organic management, bio fertilizer (*Aspergillus spp.*) was used as a basal fertilizer at the rate of 125 g per pot, then, water was applied, next day seedlings were transplanted in the pot. Vermiwash liquid was used as foliar spray at the rate of 1: l mixed with 500 mL water and organic solution.

Five leaf solution (made-up with castor (*Ricinus communis*), gliricidia (*Gliricidia sepium*), Parvettai (*Pavetta indica*), Vandukolli (*Cassia alata*) and Ardathodai (*Justicia adhatoda*) was sprayed to control pest and disease incidences whenever observed. Harvesting was done 75 days after planting when the fruit reached yellowish green colour. Growth parameters such as leaf number, number of branches and plant height were measured biweekly interval commenced from 2 weeks after transplanting and yield parameters such as fruit weight, fruit length, fruit circumference and total yield of treatments were measured

after harvesting. Data were analyzed by using the SAS 9.1 and mean separation was done using Duncan's Multiple Range Test.

Results and discussion

Growth parameters

Number of leaves

There was significant difference among the treatments in the number of leaves per plant during their vegetative growth (Table 1). The highest leaf number was observed in compost: topsoil medium under inorganic cultivation (T_6) and the lowest leaf number in leaf mould: topsoil medium under organic management (T_3). There was significant difference between organic and inorganic management in the number of leaves per plant during their vegetative growth. Number of leaves was higher in inorganic management compared to organic management of each potting medium. The difference among the treatments would be due to the different composition of potting medium. Bilderback *et al*. (2005) stated that organic components decompose during crop production and may change both the physical and chemical composition of the medium. This may affect crop growth and development.

Plant Height

Plant height is an important growth parameter which is influenced by the genetic and the environmental factors. The results revealed that there were significant difference among the different treatments and management practices (Figure 1). Highest plant height was observed in compost: topsoil medium under inorganic management and the lowest plant height was recorded in leaf mould: topsoil under organic management. The reason may be the variation in nutrient contents in different types of rooting media. Akanbi *et al*. (2002) stated that in container or poly bags crop production, use of organic potting media substrate offers a great advantage over the conventional topsoil. George (2004) stated that compost is perhaps the most common potting mix

Table 1: Number of leaves of capsicum in different potting media in organic and inorganic management

	Treatment	2 weeks	4 weeks	6 weeks	8 weeks	10 weeks
Organic	Cattle manure+ topsoil	7.16 ^{d}	18.33 ^{d}	30.83 ^{c}	41.16 ^{ab}	45.66 ^{bc}
	Compost + topsoil	8.83 ^{c}	18.66 ^{d}	33.66 ^{a}	45.16 ^{a}	50.00 ^{ab}
	Leaf mould+ topsoil	6.33 ^{d}	17.16 ^{d}	26.33 ^{d}	34.33 ^{c}	37.66 ^{d}
	Topsoil	6.83 ^{d}	17.33 ^{d}	28.33 ^{cd}	34.83 ^{c}	39.5 ^{d}
Inorganic	Cattle manure+ topsoil	14.66 ^{b}	25.66 ^{a}	36.83 ^{a}	45.16 ^{a}	51.16 ^{a}
	Compost + topsoil	16.66 ^{a}	27.33 ^{a}	36.83 ^{a}	45.16 ^{a}	52.16 ^{a}
	Leaf mould+ topsoil	13.5 ^{b}	23.00 ^{c}	30.83 ^{bc}	37.00 ^{bc}	41.5 ^{cd}
	Topsoil	13.33 ^{d}	22.00 ^{c}	28.83 ^{cd}	35.33^{c}	41.00 ^{cd}

Each Colum values followed by the same letter are not significantly different by DMRT at p=0.05

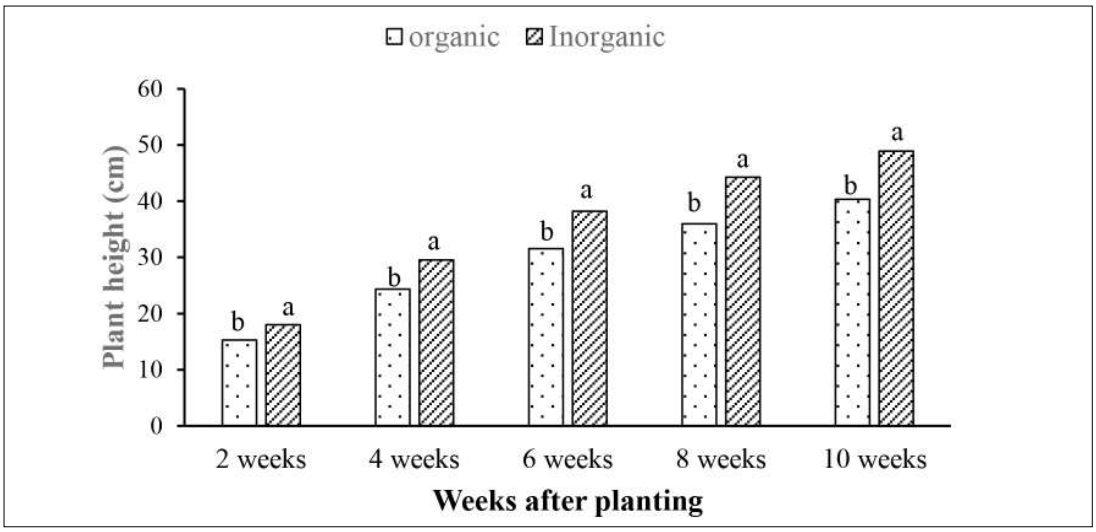

Figure 1: Plant height under organic and inorganic management

ingredient among organic products. Compost holds water well. This result was agreed with Edwards and Hailu (2011) reported that the application of compost at reasonable rates improved plant growth and soil physical properties and increased the available soil nutrient levels.

Number of Branches

Number of branches is important growth parameter which influenced by genetic and environmental factors and affects the flower and fruit number. Although the differences in number of branches were not significant among treatments, the result showed that the branch production under inorganic management was higher than in the organic management.

Yield Parameters

Fruit Length

Fruit length was insignificant among treatments except leaf mould: topsoil in organic management. Maximum fruit length was observed in the compost: topsoil media in organic management and the lowest fruit length was observed in the leaf mould: topsoil in organic management.

Fruit Circumference

There was a significant difference in fruit circumference among different potting medium in organic and inorganic management. The highest fruit circumference was observed in compost: topsoil medium in organic management and the lowest fruit circumference was observed in leaf mould: topsoil medium in organic management. There was no significant difference in cattle manure: topsoil medium and topsoil medium in organic management and cattle manure: topsoil in inorganic management. Utobo *et al.* (2015) stated that the potting media mixture significantly affected all the vegetative growth parameters and yield parameters in plants.

Individual Fruit Weight

There was a significant difference in fruit weight among different potting medium in organic and inorganic management (Figure 2). Highest average fruit weight of 26.5 g was observed in compost: topsoil medium in organic management and the lowest fruit weight (15.8 g) was observed in leaf mould: topsoil medium in organic management.

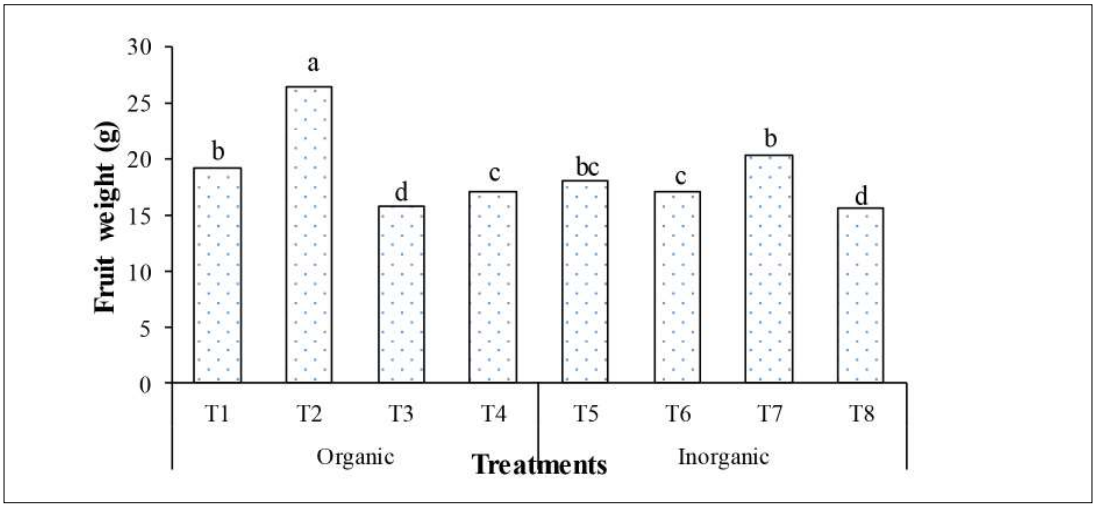

Figure 2: Average fruit weight of capsicum in different potting medium under organic and inorganic management

T_1, T_5 - cattle manure + topsoil
T_2, T_6 – compost + topsoil
T_3, T_7- leaf mould + topsoil
T_4, T_8 - topsoil

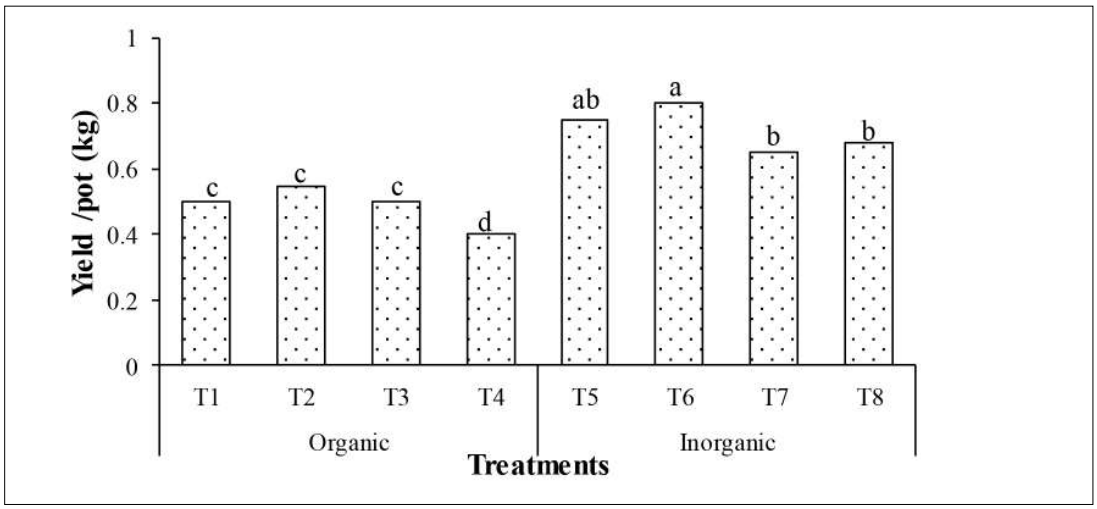

Figure 3: Average yield/Pot of capsicum in different potting medium in organic and inorganic management.

T1 , T5 - cattle manure + topsoil
T2 , T6 – compost + topsoil
T3 , T7- leaf mould + topsoil
T4 , T8 - topsoil

Average Yield / Pot

The yield was significant among treatments and the highest yield of 0.805 kg/pot was recorded in compost: topsoil medium under the inorganic management and the lowest yield was obtained in topsoil medium under the organic management (Figure 3). There was no significant variation between leaf mould and topsoil medium and cattle manure and topsoil medium and compost and topsoil under the organic management. The highest yield in compost: topsoil medium could be coupled to the production of higher number of fruits than the other treatments

Griffin and Porter (2004) and Elisabetta and Nicola (2009) stated that compost application to the soil has several beneficial effects on crop yield and soil fertility by improving and increasing soil organic matter, water holding capacity, nutrient contents, soil aggregation and microbial activity. Bilderback *et al.* (2005) stated growing media have three main functions as; provide aeration and water, allow for maximum root growth and physically support the plant.

Growing media should have large particles with adequate pore spaces between the particles. Appropriate particle size selection or combination is critical for a light and fluffy (well-aerated) medium that promotes fast seed germination, strong root growth and adequate water drainage. Due to its multiple positive effects on the physical, chemical and biological soil properties, compost contributes to the stabilization and increase of crop productivity and crop quality (Amlinger *et al*., 2007; Tayebeh *et al.*, 2010). Long-term field trials proved that compost has an equalizing effect of annual/seasonal fluctuations regarding water, air and heat balance of soils, the availability of plant nutrients and thus the final crop yields (Amlinger *et al*., 2007). An integrated approach, combing application of compost with an application of artificial fertilizer is a good strategy for sustainable crop production (Gete *et al.,* 2010)

Conclusions

All growth parameters such as number of leaves and plant height were significantly differed among treatments and the highest was obtained in compost: topsoil media under inorganic management and the lowest was in leaf mould: topsoil media under organic management. There was insignificant difference in number of branches among the treatments. There was a significant difference in all yield parameter among treatments.

The fruit length, fruit circumference and fruit weight were highest in compost: topsoil media under organic treatment, but the highest average yield was recorded in the compost: topsoil media under inorganic management due to higher number of fruits. It can be concluded that compost: topsoil in 2:1 ratio under organic management can be recommended for home garden container cultivation with eco-friendly manner and incorporation of compost with soil under inorganic management can be recommended for profitable commercial level cultivation in the farmers' field.

Suggestions

This experiment should be carried out by using other locally available materials; wood shavings, partially burnt paddy husk as rooting media and the experiment can be repeated in both *Maha* and *Yala* seasons with same and other varieties of capsicum to get consistency. Further, the same experiment should be repeated with chemical analysis of media at different growth stages of capsicum.

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