

## GROWTH AND YIELD OF BELL PEPPER (*CAPSICUM ANNUUM* VAR. *GROSSUM*) IN SOILLESS MEDIA UNDER SHADE HOUSE

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### ABSTRACT

The experiment was laid out during 2013, to study the different soilless growing media on growth and yield parameters of bell pepper (*Capsicum annuum* var. *grossum*) cv. Indira under shade house. The experiment was laid out in a spilt plot design. The seven different soilless growing media were selected viz., cocopeat, rice husk, sawdust separately as M<sub>1</sub>, M<sub>2</sub> and M<sub>3</sub> treatments and these media mixed with 1:1 proportion of vermicompost on volume basis as M<sub>4</sub>, M<sub>5</sub> and M<sub>6</sub> treatments with sandy loam soil as M<sub>7</sub> (control) with two replications. The different observations on each treatment were taken such as number of days to flowering, number of 50 per cent flowering, plant height, number of branches and yield. The result shows that sandy loam soil was found best growth parameter. The highest yield was found in sandy loam soil (88.62 t ha<sup>-1</sup>) and lowest yield was observed sawdust (62.00 t ha<sup>-1</sup>).

### INTRODUCTION

Capsicum (*Capsicum annuum* L. var. *grossum* Sendt) is also called as bell pepper or sweet pepper and is one of the most popular and highly remunerative annual herbaceous vegetable crops. Capsicum is cultivated in most parts of the world, especially in temperate regions of Central and South America and European countries, tropical and subtropical regions of Asian continent mainly in India and China. India contributes one fourth of world production of capsicum with an average annual production of 0.9 million tonne from an area of 0.885 million hectare with a productivity of 1266 kg per hectare.

Soilless culture is an artificial means of providing plants with support and a reservoir for nutrients and water. The simplest and oldest method for soilless culture is a vessel of water in which inorganic chemicals are dissolved to supply all of the nutrients that plants require. It is often called "solution culture or water culture" and the method was originally termed as "hydroponics" (that is, "water working"). Over the years, hydroponics has been used sporadically throughout the world as a commercial means of growing both food and ornamental plants.

In recent years, a wide range of soilless culture techniques have been developed and commercially introduced for intensive production of horticultural crops, particularly in greenhouses. Reasons for replacing soils by soilless growing media is to overcome plant protection problems, soil borne pathogens and environmental regulations against groundwater pollution with nitrate and pesticides (Ahmad

Mohammadi Ghehsareh, 2013).

Some of the scientist reported based on previous work on different crops viz., tomato yield tends to be higher for the various growing media (Margit olle *et al.*, 2012). Bell pepper crop in peat growing media was obtained better quality and yield (Fatma gungor and Ertan yildirim, 2013) and *Pinus halepensis* crop was better yield in combination of peat + rice hull as compared other medias (Tsakaldimi marianthi, 2006). Vermicompost has high level of nutrients and was able to promote growth, advance flowering and fruiting in the lady's finger (Indirabai and Sujapratha, 2009, Sethi and Khan, 2009).

The present study was planned with hypothesis that the use of inorganic fertilizers have caused serious damage to soil health, ecology and caused decline in vitamin and mineral content of fresh fruits and vegetables. Organically grown shade house crops in general, have higher nutrient demands than field grown crops. In order to optimize production it is essential to focus on the growing media studies. Since capsicum is mostly consumed fresh or only partially cooked, it should be free from the residual effects of chemical fertilizers. Moreover organically grown crops are preferred for their flavour, taste, nutritive value and extended shelf life. Hence, the objective of this study was undertaken to identify a suitable soilless growing media on growth and yield.

### MATERIALS AND METHODS

Field experiments were conducted during the year 2012-13 in rabi season. The experiments were located at New Orchard of Main Agricultural Research Station, University of

Agricultural Sciences, Raichur. The climate is semi-arid and average annual rainfall is 722 mm. The maximum temperature and ET during the cropping period was 35.4°C and 3.93 mm day<sup>-1</sup> and the minimum was 24.4°C and 0.12 mm day<sup>-1</sup> respectively.

The experiment was carried out in a natural ventilated shade house of 28 m length and 8 m width with center height of the shade house was 4 m. The floor area of the shade house was divided in to 28 beds each of 3 m length and 1 m width and 40 cm depth. The pits were all lined with thick polyethylene sheet on all sides and small holes are provided for drainage purpose.

The experiment was laid out in a spilt plot design with 2 main treatments, 7 sub treatments and 2 replications. The details of treatment taken for present study are given below.

#### A) Main treatments

I<sub>1</sub> - 100 per cent ET irrigation level

I<sub>2</sub> - 80 per cent ET irrigation level

#### B) Sub treatments (growing media)

Seven different growing media were selected for the study and the sandy loam soil was taken up as control. The different combinations of media on volume basis are given below.

M<sub>1</sub> - Cocopeat, M<sub>2</sub> - Rice husk, M<sub>3</sub> - Sawdust, M<sub>4</sub> - Cocopeat + vermicompost (1:1), M<sub>5</sub> - Rice husk + vermicompost (1:1), M<sub>6</sub> - Sawdust + vermicompost (1:1) and M<sub>7</sub> - Sandy loam soil.

The irrigation system consists of mains, screen filter, sub mains, inline laterals and other accessories required for drip irrigation. J-turbo line emitting pipes of 16 mm diameter were used for laterals in drip irrigation treatments. Drippers at 2.6 litres per hour capacity were in the inline dripper at a spacing of 30 cm for drip irrigation treatments.

Amount of irrigation water applied to drip treatments were based on daily pan evaporation readings. The water requirement of the crop was calculated based on the following equation.

$$WR = \frac{A \times B \times C}{E}$$

**Table 1: Monthly amount of water applied to bell pepper under different levels of drip irrigation**

Month	Amount of water applied through drip irrigation at different irrigation levels, mm	
	I <sub>1</sub> (100 per cent ET)	I <sub>2</sub> (80 per cent ET)
October (21 days)	2.1	1.7
November	36.3	29.0
December	88.7	70.9
January	77.1	61.7
February	60.2	48.2
March (11 days)	22.7	18.2
Total	287.1	229.7

**Table 2: Irrigation capacity (duty) of 1m<sup>3</sup> of water and delta of water for different treatments for the crop period**

Treatment	Irrigation water applied (l plant <sup>-1</sup> )	Irrigation water applied (l plot <sup>-1</sup> )	Irrigation water applied (m <sup>3</sup> ha <sup>-1</sup> )	Irrigation capacity (ha m <sup>-3</sup> )	Delta (cm)
I <sub>1</sub>	287.1	2871.0	9570.1	0.00010	95.7
I <sub>2</sub>	229.7	2296.8	7656.1	0.00013	76.6

Where,

WR = Water requirement of a plant, (l day<sup>-1</sup>plant<sup>-1</sup>)

A = Reference Evapotranspiration (ET) in the shade house

ET = C [P (0.46 T + 8.18)]

Where,

T = mean daily temperature (°C)

P = Mean daily percentage of total annual day time hours (per cent)

C = n/N

n = actual sunshine hours (hr)

N = maximum sunshine hours (hr)

B = Amount of area covered with foliage (canopy factor), fraction

C = Crop co-efficient, fraction

E = Efficiency of drip irrigation, (considered as 90 per cent)

The reference evapotranspiration was calculated using Blaney-Criddle method (Michael, 1977).

For periodical field observations, five plants were selected randomly from each treatment and were tagged. Observations such as number of days to flowering, number of 50 per cent flowering, plant height, number of branches and yield.

## RESULTS AND DISCUSSION

Before start of the experiment as applicable to all the treatments the irrigation water was delivered under drip irrigation as per treatments and the crop was irrigated at variable frequency (100 per cent ET). The quantities of water delivered per day averaged on monthly basis are presented in Table 1.

For drip irrigation at 80 per cent ET the monthly water requirement varied from 1.7 l in October to 70.9 l in December, for 100 per cent ET the water requirement varied from 2.1 l in October to 88.7 l in December. The amount of water delivered to bell pepper crop under drip irrigation was maximum during the month of December. This may be attributed to growth stage of the crop and higher temperature, wind velocity and evaporation during this month. For bell pepper cultivated inside the shade house under different agro-climatic conditions. These comparisons were taken as partial validation of the water requirement of bell pepper grown in this study under semi-arid region. Not only do microclimatic parameters affect the crop water requirement, but also it depends very much upon crop variety, crop season and the method of bell pepper crop season and the method of bell pepper cultivation. A similar result has been reported on tomato (Harmanto *et al.*, 2005).

The capacity of unit quantity of water to irrigate a crop is an important factor for any irrigation system. Table 2. presents the capacity of one m<sup>3</sup> of water to irrigate bell pepper crop

**Table 3: Yield and yield parameters of bell pepper as influenced by different drip irrigation levels and growing media**

Treatment	Yield (t ha <sup>-1</sup> )
M: Drip irrigation levels	
I <sub>1</sub> :100 % ET	50.75
I <sub>2</sub> :80 % ET	45.5
Mean	
S.Em. ±	0.31
C.D. (5 %)	3.98
S: Media	
M <sub>1</sub> :Coco peat	62
M <sub>2</sub> :Rice husk	25.37
M <sub>3</sub> :Sawdust	20.87
M <sub>4</sub> :Coco peat + Vermicompost	56
M <sub>5</sub> :Rice Husk + Vermicompost	55.75
M <sub>6</sub> :Sawdust + Vermicompost	43.12
M <sub>7</sub> :Sandy loam soil	88.62
Mean	
S.Em. ±	5.29
C.D.at 5 %	16.32
Interaction	
I × M	
S.Em. ±	7.49
C.D.at 5 %	NS
I at the same or different M	
S.Em. ±	10.6
C.D.at 5 %	NS

during its growth period

It can be seen from the table that, with increase in the level of irrigation the amount of water applied also showed an increasing trend, whereas the irrigation capacity was found on a decreasing pattern. It was also observed that, the irrigation capacity was lowest (0.00010 ha m<sup>-3</sup>) for 100 per cent ET irrigation. The highest irrigation capacity of 0.00013 ha m<sup>-3</sup> was obtained for the treatment water application at 80 per cent ET.

Delta is the depth of irrigation (expressed in cm) required during the crop period. Delta of water for different treatments is presented in Table 2. It is observed from the table that delta was highest (95.7 cm) for 100 per cent ET irrigation and lowest (76.6 cm) for water application at 80 per cent ET.

### Growth parameters

The effects of different drip irrigation levels and soilless media on the growth (biometric) parameters of bell pepper crop are presented below.

Days taken for flower initiation and days to 50 per cent flowering: The results on the number of days taken for flower initiation and 50 per cent flowering as influenced by irrigation levels and soilless growing media are shown in Fig.1.

### pepper

Among the different soilless media, the maximum number of days (33.0) to taken for flower initiation was observed in sandy loam soil (M<sub>7</sub>) and least number of days to taken flower initiation was in (19.5) in bell pepper was noticed in case of rice husk (M<sub>2</sub>) and the data regarding to number of days taken for 50 per cent flowering as influenced by irrigation levels and soilless growing media, the maximum number of days (50.5) to 50 per cent flowering was observed in sandy loam soil (M<sub>7</sub>),

followed by cocopeat (M<sub>1</sub>) (49.5). The least number of days to 50 per cent flowering was in (40.3) in bell pepper was noticed in case of rice husk (M<sub>2</sub>).

Plant height: The data on plant height (cm) at different stages (30, 60, 90,120 DAT and at final harvest) of crop growth as influenced by different drip irrigation levels and soilless media are shown in Fig. 2.

Among the soilless media, the sandy loam soil (M<sub>7</sub>) appeared to be better as exhibited in the highest plant height (31.7, 68.3, 81.9, 107.2 and 119.4 cm respectively at 30, 60, 90,120 and 150 DAT), followed by cocopeat (M<sub>1</sub>) (28.2, 59.8, 65.7, 92.5 and 96.1 cm respectively). The lowest plant heights (5.1, 9.0, 14.2, 18.2 and 21.8 cm respectively) were observed in the treatment of rice husk (M<sub>2</sub>) at different stages of plant growth. The maximum plant height was found in sandy loam soil and followed by cocopeat. As a result of this may be due to the potassium nutrient increase the plant height. Higher potassium uptake in sandy loam soil is an evidence for this. Similar results were found by Ranawana *et al.* (2008).

Number of branches per plant: The data on number of branches per plant at 30, 60, 90, 120 DAT and at final harvest of the crop as influenced by different drip irrigation levels and soilless media are shown in Fig. 3.

Among the soilless media, the number of branches of bell pepper per plant with sandy loam soil (M<sub>7</sub>) was highest (11.2, 13.8, 15.3, 16.8 and 18.3), followed by cocopeat (M<sub>1</sub>) (9.2, 10.7, 12.7, 13.2 and 16.0) at 30, 60, 90, 120 and 150 DAT respectively. The least number of branches (1.5, 2.4, 3.0, 3.4 and 3.5 respectively) at all growth stages in bell pepper was noticed in case of rice husk (M<sub>2</sub>).

The soil media was more fertile as compare to soilless media. This may be due to the macro and micro nutrients, as well as the improved soil condition which conduced to stimulate metabolic processes and encourage growth, synthesis and accumulation of more metabolites in plant tissue. The result showed a tendency to produce more number of branches per plant. Several investigators mentioned similar results on different plants such as Kumar and Kohli (2005) in capsicum, Natarajan (2005) in tomato, Bairwa *et al.* (2009) in okra and Sumita Roy *et al.* (2011) in capsicum.

### Yield of the crop

The results on total yield per hectare are presented in Table 3. Among the different drip irrigation levels, the highest yield was observed in the treatment 100 per cent ET (50.75t ha<sup>-1</sup>), followed by 80 per cent (45.50 t ha<sup>-1</sup>) which were statistically significant with each other.

Among the soilless media, the sandy loam soil was recorded significantly the highest yield (88.62 t ha<sup>-1</sup>) followed by cocopeat (62.00 t ha<sup>-1</sup>) which were statistically significant difference and other treatments are on par each other. On the contrary, the least yield was observed in sawdust (20.87 t ha<sup>-1</sup>) which was on par with that of rice husk (25.37 t ha<sup>-1</sup>).

This may be due to maximum air temperature during the growing season which affects the substrate temperature and increasing the difference between day and night temperatures at the root zone may negatively affect the substrate yields. That is because roots rely upon aerial part for photosynthates,

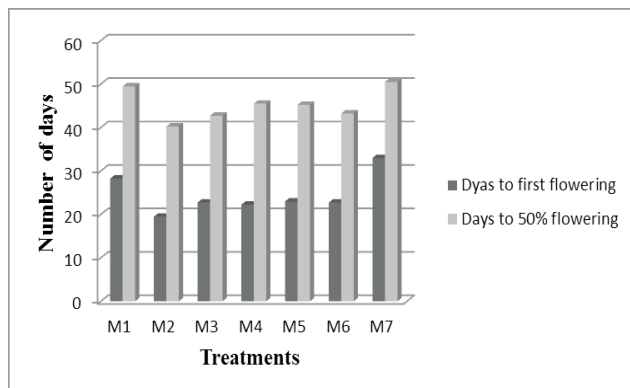


Figure 1: Effect of soilless media on number of days taken for flowering and days to 50 per cent flowering of bell pepper

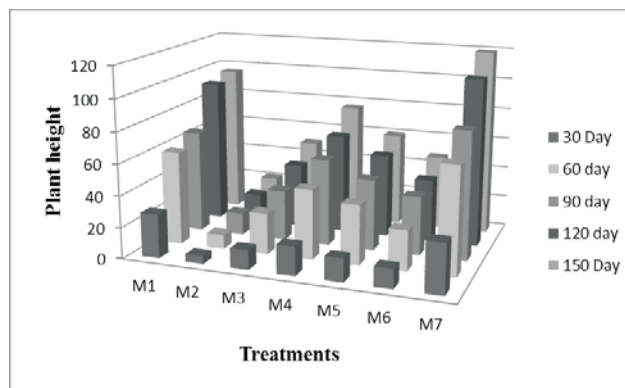


Figure 2: Effect of soilless media on plant height for bell pepper

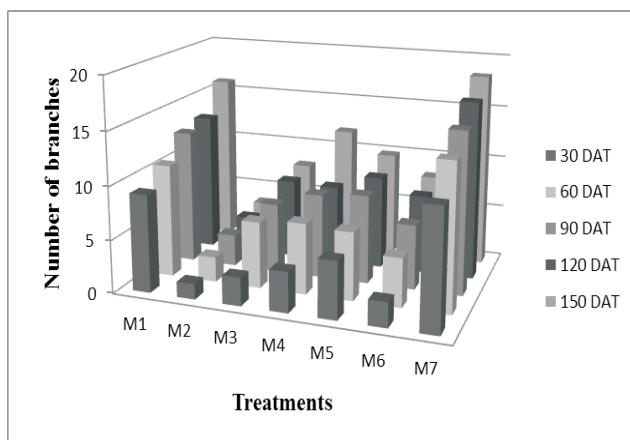


Figure 3: Effect of soilless media on number branches for bell pepper

while aerial parts rely on the root for water and nutrients (NeSmith and Duval, 1998). This delicate balance can be upset when the root temperature affects plant growth. Similar results were found in Majid Fandi *et al.* (2008).

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