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Original Research Article

Chemical and Physical Characteristics of Different Media and their Effects on the Growth and Development of Bell Pepper (*Capsicum annuum var. grossum*)

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Keywords

Soilless media, drip irrigation, bell pepper, physical characteristics, chemical characteristics

A B S T R A C T

The selected chemical and physical characteristics of seven types of growing media were selected viz., cocopeat, rice husk, sawdust, vermicompost, Cocopeat + vermicompost (1:1), Rice husk + vermicompost (1:1), Sawdust + vermicompost (1:1),were determined and their suitability as growing media was tested for bell pepper **(***Capsicum annuum* var. *grossum*) cv. Indira with sandy loam soil taken as a control. Data on water holding capacity, bulk density, particle density and porosity of the media were collected. The maximum (0.434 g/cc) bulk density was noticed in vermicompost and minimum (0.100 g/cc) was found in rice husk. In case of particle density maximum (1.112 g/cc) was noticed in cocopeat + vermicompost and the minimum (0.199 g/cc) was found in cocopeat and maximum porosity was noticed in cocopeat + vermicompost (73.56 %) and minimum was found in vermicompost (36.73 %). The highest water holding capacity was found in rice husk (88.00 %) and least was found in sawdust + vermicompost (42.20 %) considering the potential shortage of poor oxygen required for aerobic composting.

Introduction

In recently years some problems in soil culture (such as salinity and unsuitable soil characteristics) and limitation of water resources in many countries (Hassan Borji, *et al.*, 2010). Further, continuous cultivation of crops has resulted in poor soil fertility, which in turn has reduced the opportunities for natural soil fertility build up by microbes. This situation has lead to poor crop yield and quality. In some places like metropolitan areas, good quality soil is not available for crop cultivation. Another serious problem experienced in present condition is the difficulty to hire labour for conventional open field agriculture. To overcome these problems, new methods are being introduced such as soilless culture and cultivation of crops under protected environments. Soilless culture have many advantages such as increased yield, health and uniform product, conservation of water and land, better protect, control of environmental pollution and reduce of workers for cultivation.

Capsicum is variously called as green pepper, sweet pepper, bell pepper, etc. In shape and pungency it is different from chilli. It is fleshy, blocky of various shapes more like a bell and hence named bell pepper.

Almost all the varieties of green pepper are very mild in pungency and some of them are non-pungent and as such they can be used as stuffed vegetable. Pepper is an important crop not only because of its economic importance but also for the nutritional value of its fruits being a major source of natural colours and antioxidant compounds (Howard *et al.*, 1994). The intake of these compounds in food is an important health protecting factor, they have been recognized as being beneficial for prevention of widespread human diseases, including cancer and cardiovascular diseases when taken daily in adequate amounts (Brainley, 2000).

Materials and Methods

The experiments were conducted during *rabi,* season of 2013 to study the different soilless growing media on yield and quality parameters of bell pepper (*Capsicum annuum* var. *grossum*) cv. Indira under shade house.

Experimental layout

The experiments were carried out in a natural ventilated shade house of 28 m length and 8 m width with center height of the shade house of 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.

Main treatments

I1 - 100 per cent ET irrigation level
I2 - 80 per cent ET irrigation level

Sub treatment (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.

M1- Cocopeat, M2 - Rice husk, M3 - Sawdust, M4 - Cocopeat + vermicompost (1:1), M5- Rice husk + vermicompost (1:1), M6 - Sawdust + vermicompost (1:1), M7 - Sandy loam soil

Physical and chemical characteristics of different soil-less media

Physical properties

The selected growing media were analyzed for physical characteristics like bulk density, particle density and porosity by the below formula.

The bulk density was determined using pycnometer method. A empty container was weighed using digital balance. The container was filled with sample; the container and the sample were then weighed. The bulk density was calculated using following formula.

$$\text{Bulk Density (g/cc)} = \frac{\text{Mass of sample}}{\text{Volume of pycnometer}}$$

The particle density was determined using pycnometer method. A clean empty bottle was weighed using digital balance. Fill a 10g of sample in the container weight it and fill half of the water. Expel the entrapped air by shaking and gentle boiling of the contents. Allow the contents to cool to room temperature and fill the pycnometer to the brim with boiled and cooled distilled water. Remove the contents of the pycnometer clean it with filter paper and weight it.

$$\text{Particle Density (g/cc)} = \frac{\text{Weight of particle}}{\text{Final volume} - \text{Initial volume}}$$

$$\text{Porosity} = (1 - \frac{\text{BD}}{\text{PD}}) \times 100$$ (Murumkar *et al.*, 2013)

Water Holding Capacity (WHC) of different soilless media

The Water Holding Capacity (WHC) of different soilless media is determined by using procedure followed by Yahya *et al.*, 2009.

Water holding capacity was determined by using a pressure plate apparatus. Ten grams of fresh media was placed in a retaining ring. The samples were saturated for 24 h by keeping the water level just below the edge of the ring in a tray. The plates with media sample were then placed inside the corresponding pressure chamber connected to an outflow tube. Different levels of pressure were applied on each sample. The samples were taken out when there were no dripping detected. The samples were then weighted and oven-dried for 24 h and their dry weights recorded. The water holding capacity expressed as a percentage.

Chemical characteristics

The media samples were collected from each treatment plot. The samples were dried under shade, powdered and sieved through 2 mm sieve and analysis was done using following procedure.

Total NPK status

The various soilless media samples were analyzed for available NPK content as per the standard procedure. Available nitrogen was estimated by using alkaline potassium permanganate method (Subbiah and Asija, 1956). Available phosphorus was estimated by using Klett Summerson Calorimeter with red filter at 600 nm (Olsen *et al.*, 1954). Available potassium was estimated using neutral normal ammonium acetate.

Results and Discussion

Physical characteristics

Bulk density, particle density and porosity

Bulk density, particle density and porosity of different medias were analyzed and the results are presented in Table.1. The maximum (0.434 g/cc) bulk density was noticed in vermicompost followed by sawdust + vermicompost (0.356 g/cc) and minimum (0.100 g/cc) was found in rice husk.

In case of particle density maximum (1.112 g/cc) was noticed in cocopeat + vermicompost followed by sawdust + vermicompost (0.902 g/cc) and the minimum (0.199 g/cc) was found in cocopeat.

The maximum porosity was noticed in cocopeat + vermicompost (73.56 %) followed by rice husk + vermicompost (67.34 %) and minimum was found in vermicompost (36.73 %).

Bulk density affects the choice of media in many ways. Low bulk density media may be required for frequently irrigated shade house to avoid oxygen deficiency.

Mixing and transportation of low bulk density media are much easier than those of high bulk density. However, media with a low bulk density may not provide adequate support for the plant and the plant may be heavy at the top.

Table.1 Bulk density, particle density and porosity of different media

Growing media	Bulk density (g/cc)	Particle Density (g/cc)	Porosity (%)
Cocopeat	0.115	0.199	42.21
Rice husk	0.100	0.279	64.20
Sawdust	0.260	0.660	60.60
Vermicompost	0.434	0.686	36.73
Cocopeat + Vermicompost (1:1)	0.294	1.112	73.56
Rice husk + Vermicompost (1:1)	0.280	0.857	67.34
Sawdust + Vermicompost (1:1)	0.356	0.902	60.53

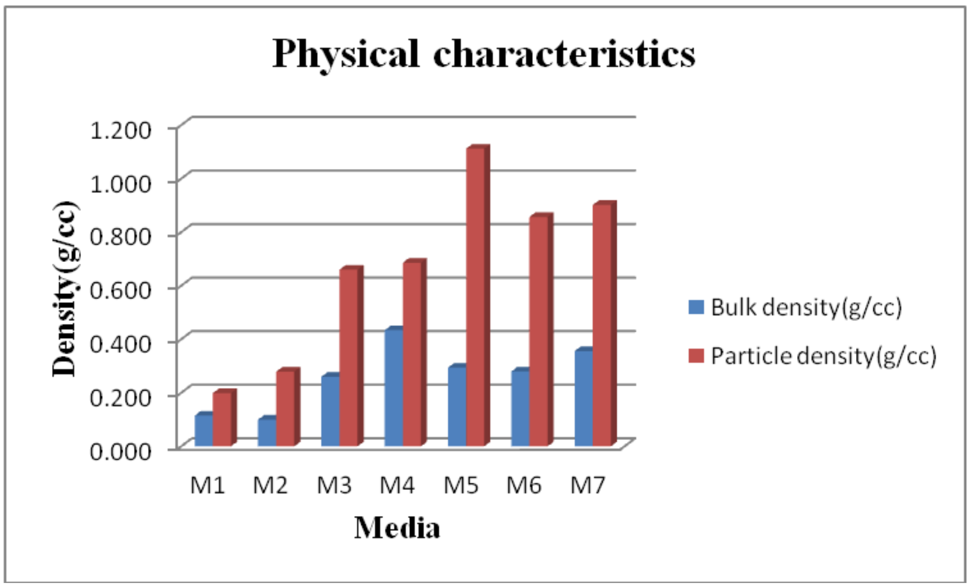

Table.2 Water holding capacity of different media

Growing media	Water holding capacity (per cent)
Cocopeat	49.05
Rice husk	88.00
Sawdust	75.40
Vermicompost	45.00
Cocopeat + Vermicompost	56.31
Rice husk + Vermicompost	67.24
Sawdust + Vermicompost	42.20

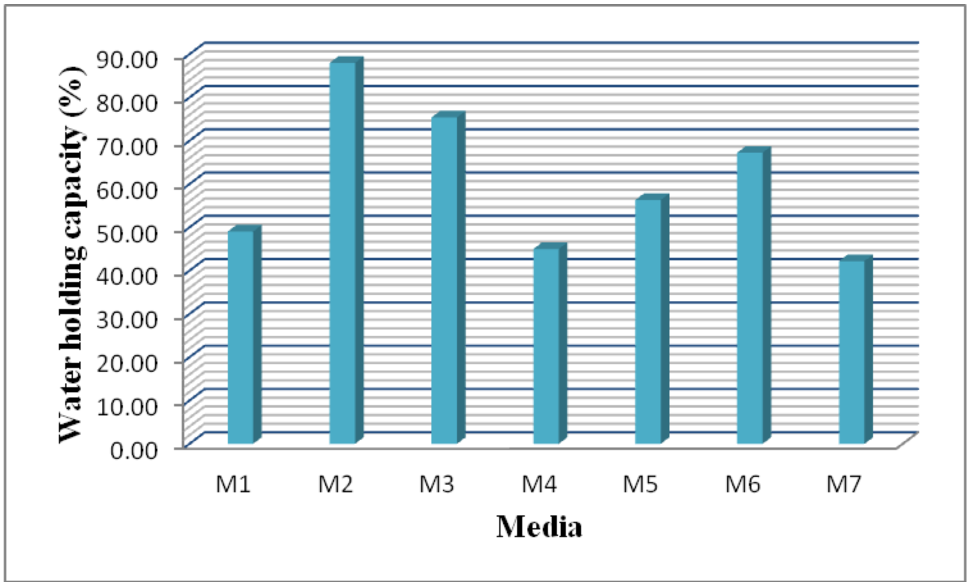

Table.3 N, P and K values of different growing media

Growing media	N (ppm)	P (ppm)	K (ppm)
Cocopeat	0.490	0.071	0.493
Rice husk	0.350	0.013	0.313
Sawdust	0.238	0.054	0.089
Vermicompost	0.518	0.093	0.179
Soil	128.8	363.12	483

Water holding capacity of different media

The water holding capacity of different growing media was analyzed and results are presented in Table.2. The highest water holding capacity was found in rice husk (88.00 %) followed by sawdust (75.40 %) and least was found in sawdust + vermicompost (42.20 %). Water holding capacity was more in rice husk generally more water and less aeration considering the potential shortage of poor oxygen required for aerobic composting and also there is a problem of fungus.

Chemical characteristics

N, P and K analysis

The N, P and K of the different medias were analyzed and results are presented in Table.3. The highest nitrogen was found in sandy loam soil (128.8 ppm) followed by vermicompost (0.518 ppm) and least was found in sawdust (0.238 ppm).

In the phosphorus highest was found in sandy loam soil (363.12 ppm) followed by vermicompost (0.093 ppm) and least was found in rice husk (0.013 ppm) and lastly in case of potassium the highest potassium was found in soil (483 ppm) and least was found in sawdust (0.089 ppm).

Physicochemical properties affect the air content and retain the volume of available water. It also adsorbs the rate of nutrients in substrate. There was a slight difference in the physical and chemical properties of the studied growing media. More bulk density was find in vermicompost and less density was found in rice husk. However, media with a low bulk density may not provide adequate support for the plant.

The highest water holding capacity was found in rice husk (88.00 %) followed by sawdust (75.40 %) and least was found in sawdust + vermicompost (42.20 %).

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