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RESEARCH ARTICLE

STANDARDIZATION OF GROWING MEDIA FOR THE HYDROPONIC CULTIVATION OF TOMATO

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ABSTRACT

The tomato variety Anagha was raised in Ebb and flow hydroponic system (flood and drain system) at Department of Olericulture, College of Horticulture, Vellanikkara to evaluate the ideality of growing media (coco peat, expanded clay pellets and pebbles). Plants grown in coco peat medium performed the best, followed by pebbles. The coco peat medium contained comparatively high amount of potassium and also possessed high water holding capacity. Performance of plants grown in expanded clay pellets was very poor. Fruit quality in terms of total soluble solid content and titrable acidity was not significantly affected by the treatments.

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INTRODUCTION

Vegetables have a vital role in human diet. Since they provide the essential nutrients like vitamins and minerals to the body, they are known to be the protective food. Among vegetables, tomatoes have world wide popularity, they are low in calorie, fat and cholesterol. Therefore the production and consumption of fresh tomato is important. But the conventional soil cultivation of tomato is subjected to various problems like soil borne diseases, insects and weeds. Along with these the unavailability of productive land and the shortage of irrigation water have emerged as important constraints. In these circumstances modern production techniques like hydroponics gain importance. Hydroponics is an efficient technology for growing plants in nutrient solutions (water containing fertilizers), with or without the use of an artificial medium (sand, gravel, vermiculite, rockwool, perlite, peatmoss, coir, or sawdust) (Jensen and Collins, 1985). The main attraction of hydroponics is that, it does not demand any fertile soil for the production of crops. Since the soil is excluded from production process there will not be any problem related to soil born diseases, pests and weeds. By the exclusion of these problems, there will be minimum usage of harmful plant protection chemicals, so the yield from hydroponics is fresh and healthy (Bogovic, 2011). Eventhough, soil is excluded from hydroponics, most of the plants, demand a supporting medium for better holding in the structure. Based on this, hydroponics can be divided into liquid hydroponic systems (no other supporting medium for the plant roots) and aggregate hydroponic systems (have a solid medium of support) (Gorbe and Calatayud, 2013). In aggregate hydroponic systems inert substrates are used to support the plants. It consists mainly of natural inert matter or artificial substances. Different horticultural substrates vary with their physical and chemical properties, so from the beginning itself it is important to know these properties in order to adjust them for the different circumstances of use (Verdonck *et al.,* 1982). A growing medium do three main functions: 1) provide aeration and water to plants, 2) allow maximum root growth and 3) physically support the plant. Growing media should have large particles with adequate pore spaces between the particles (Bilderback *et al*., 2005). Now a days, in Kerala, more people from urban areas are showing interest towards modern techniques in agriculture. The changing health concern of people also demands high quality food. But in a state like Kerala, where there is severe shrinking of cultivable land and water, the production of fresh vegetables are great challenge. All these, forces the adoption of techniques which produce more yields from less area and techniques which does not demand productive soil for cultivation. Hence a preliminary

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study was carried out to standardize the ideal growing media for the hydroponic cultivation of tomato in rain shelter.

MATERIALS AND METHODS

The present investigation was carried out in the Department of Olericulture, College of Horticulture, Vellanikkara during September 2015 to January 2016. The objective of this study was to standardize an ideal growing media for the hydroponic cultivation of tomato under rain shelter. The experiment was laid out using Completely Randomized Design (CRD). There were three replications and 15 plants per replication. Seeds of the semi determinate tomato variety Anagha was sown in protrays during 2015, September and transplanted in 2015, October. For understanding the ideality of growing medium, three types of growing media were tested in ebb and flow hydroponic system (flood and drain system) by supplying Cooper's nutrient solution. In Ebb and flow technique, seedlings were directly transplanted in to brick structures filled with different growing media (coco peat, expanded clay pellets and pebbles) (Plate 1, Plate 2, Plate 3). There were five rows and ten plants in each row, with a total of 50 plants in each structure. The nutrient solution was pumped in to the structure in such a manner that, it should get completely flooded through the medium for 20 minutes. Then the nutrient solution was drained back into the main tank and the process was repeated continuously. The flood and drain time was controlled by a timer, for which the 'ON' time was 20 minutes and 'OFF' time was 10 minutes. Observations on growth characters, yield characters and quality characters were taken from the experimental plants during the course of experiment.

Treatment details

F_1- Ebb and flow method
S_1 – Cooper's nutrient solution
M_1 – Coco peat medium
M_2 – Expanded clay pellet medium
M_3 – Pebble medium

Treatment combinations

$F_1S_1M_1$ - Ebb and flow method + Cooper's nutrient solution + Coco peat medium
$F_1S_1M_2$ - Ebb and flow method + Cooper's nutrient solution + Expanded clay pellet medium
$F_1S_1M_3$ - Ebb and flow method + Cooper's nutrient solution + Pebble medium

Plate 1. Tomato plant in coco peat medium

Plate 2. Tomato plant in expanded clay pellet medium

Plate 3. Tomato plant in pebble medium

RESULTS

Growth characters

The data on growth characters are presented in Table 1. The nature of growing media significantly influenced the plant height. Maximum plant height was observed coco peat (69.36 cm). This was followed by pebbles (66.40 cm). The plant height was the lowest in expanded clay pellets (63.00 cm). The minimum days to first flower appearance was observed in coco peat medium (22.06 days), which was followed by pebble medium (24.36 days). Since the first flower appearance was minimum in coco peat medium, the days to first fruit set (25.73 days) and first harvest (51.73) was also minimum in this medium. The influence of growing media on the duration of the crop was significant. Tomato plants in coco peat medium had the highest duration (85.73 days).

Yield characters

The data on yield characters are presented in Table 2. Growing media significantly influenced fruits per plant. In coco peat plants produced maximum number of fruits (36.50). This was followed by pebbles (34.36). Fruits per plant was minimum in expanded clay pellets (20.10). Influence of growing media on the number of harvest was significant. Number of harvest was the highest in coco peat medium (20.16), followed by pebble medium (16.03). The nature of growing media significantly influenced yield per plant. The highest yield per plant was observed in coco peat medium (1.67 kg). The average fruit weight was significantly influenced by growing media. It was observed to be the highest in coco peat medium (45.86 g) and the lowest in expanded clay pellets medium (25.73 g).

Table 1. Growth characters of tomato in Ebb and flow system

Medium	Plant height at 60th day (cm)	Days to first flower appearance	Days to first fruit set	Days to first harvest	Duration of the crop
Coco peat	69.36	22.06	25.73	51.73	85.73
Expanded clay pellets	63.00	25.73	29.40	56.06	82.50
Pebbles	66.40	24.36	27.70	54.40	84.13
CD (0.05)	2.21	1.23	1.30	1.57	1.12

Table 2. Yield characters of tomato in Ebb and flow system

Medium	Fruits per plant	Number of harvests	Yield per plant (kg)	Average fruit weight (g)
Coco peat	36.50	20.16	1.67	45.86
Expanded clay pellets	20.10	9.83	0.51	25.73
Pebbles	34.36	16.03	1.48	43.43
CD (0.05)	1.30	0.97	0.05	1.11

Table 3. Quality characters of tomato in Ebb and flow system

Medium	TSS (◦Brix)	Acidity (%)
Coco peat	7.50	0.56
Expanded clay pellets	7.83	0.59
Pebbles	7.73	0.56
CD (0.05)	NS	NS

Quality characters

The data on quality characters are presented in Table 3. The nature of growing media did not influenced the TSS and acidity of fruits significantly. The TSS and acidity varied from 7.50-7.83 and 0.56-0.59 respectively.

DISCUSSION

The better performance of tomato plants in coco peat medium may be due to, the high water holding capacity, aeration and slightly high potassium content in this medium. The studies conducted by various researchers also reported that, growing media had significant effect on the growth and yield of crops growing in it (Padem *et al*., 1994; Peyvast *et al*., 2007; Peyvast *et al*., 2010). The study carried out by Noguera *et al.* (2000), revealed that coconut waste was the best medium for growing horticultural crops under hydroponics. They observed that this medium was light in weight and had high total porosity (94 per cent of total volume). Coco peat also exhibited high air content. pH was found to be slightly acidic and EC varied between 0.4 and 6.0 dS/m. Cation exchange capacity ranged from 32 to 95 m.e./100 g and C/N ratio averaged to 117.The amount of naturally-occurring available nutrients like mineral nitrogen, calcium and magnesium was low but phosphorus and potassium contents were high. Yau and Murphy (2000), reported that when composted coco peat was used as the growing medium for tomato plants under soilless culture, they produced higher dry root weight (22%), fruit number (43%) and total yield (64%). In an experiment conducted by Colla *et al.* (2003) on soil less cultivation of cucumbers, it was observed that under coir pith and perlite media the overall yield was high. The average number of fruits, yield per plant and average fruit weight were found to be higher in these media. When coconut fiber was used as the growing medium in hydroponics, tomato crop yielded the heaviest fruits (128g) (Carrijo *et al*., 2004). The NPK analysis carried out for coco peat during the experiment revealed that it contained 0.32 % of nitrogen, 0.01 % of phosphorus and 0.36 % of potassium. Handreck (1993) also reported that, the higher percentage of potassium in coco peat improved the performance of tomato plants in soilless culture.

The high potassium content in coconut coir dust improved the fruit size in tomatoes. According to Cresswell (2002), coconut coi dust can be used as an alternative for peat in soil less culture, due to its properties like high amount of potassium, less acidic nature, high air filled porosity, high water holding capacity, better capillary wetting and physical stability.

Conclusion

The above findings revealed that, when coco peat was used as the growing medium tomato plants produced higher vegetative growth and yield per plant, providing that the quality of growing substrates greatly matters when crops are grown under hydroponically. The higher potassium content and better water holding capacity of coco peat medium significantly influenced the performance of plants under hydroponics.

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