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ASSESSMENT OF DIFFERENT GROWING MEDIA COMBINATIONS FOR CHERRY TOMATO (*Solanum lycopersicum* L.) PRODUCTION UNDER SOILLESS PROTECTED CULTIVATION

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ABSTRACT

A research experiment was conducted during the *Rabi* season at the Shade Net Unit, Department of Horticulture, Agricultural College, Bapatla, Andhra Pradesh, India, to evaluate the influence of different soilless culture media on yield attributes and yield of cherry tomato grown in grow bags under protected cultivation. The experiment was laid out in a Randomized Block Design (RBD) with eight treatments and three replications. Different combinations of cocopeat, vermicompost, perlite, vermiculite and compost were evaluated for cherry tomato production under shade net conditions. The crop was cultivated in grow bags with drip fertigation. Significant differences were observed among the treatments for fruit clusters per plant, fruits per cluster, fruit length, fruit diameter, average fruit weight, yield per plant, marketable yield, total yield and harvest duration. Among the treatments, T6 (Cocopeat + Vermicompost + Perlite in 50:25:25 ratio with 125% RDF through fertigation) recorded superior performance with maximum fruit clusters per plant (31.0), fruits per cluster (17.3), fruit length (3.51 cm), fruit diameter (3.17 cm), average fruit weight (17.4 g), yield per plant (9.35 kg), marketable yield (83.6 kg plot⁻¹) and harvest duration (95.0 days). The improved performance of T6 may be attributed to favourable physical properties of the growing medium, better nutrient availability and improved root-zone conditions. The study concluded that suitable soilless culture combinations in grow bags can enhance cherry tomato productivity under shade net cultivation.

Key words: Cherry tomato, soilless culture, grow bags, cocopeat, vermicompost, shade net, protected cultivation, yield.

Introduction

Cherry tomato (*Solanum lycopersicum* L.) is an important high-value vegetable crop cultivated worldwide due to its attractive appearance, excellent flavour, nutritional value and increasing demand among consumers. It is a rich source of bioactive compounds such as lycopene, carotenoids, vitamins and antioxidants, making it an important component of a healthy diet (Dorais *et al.*, 2008). The crop has gained importance in protected cultivation systems due to its suitability for intensive production and higher economic returns.

Protected cultivation technologies such as shade net houses provide a favourable microclimate by regulating temperature, radiation intensity, humidity and crop water

requirements. These conditions improve plant growth, flowering, fruit setting and yield potential compared with open-field cultivation (Heuvelink, 2005). However, successful protected cultivation depends on proper management of the root-zone environment and nutrient supply.

Soilless culture has emerged as an efficient production technology in protected horticulture because it allows better control over water, nutrients and root environment. In these systems, plants are grown in inert or organic substrates instead of soil, reducing problems associated with soil-borne pathogens, poor drainage and nutrient imbalance (Raviv and Lieth, 2008). Grow bag-based soilless cultivation is widely adopted for tomato production due to efficient use of space, water and nutrients.

The physical and chemical characteristics of growing media strongly influence plant performance. Cocopeat is widely used as a substrate because of its high water-holding capacity, porosity and suitability for root growth. Perlite improves aeration and drainage, while vermiculite enhances moisture retention and nutrient holding capacity (Raviv *et al.*, 2004). Organic amendments such as vermicompost improve nutrient availability and microbial activity, thereby promoting plant growth and yield (Gruda, 2009).

Nutrient management through fertigation is another important factor influencing productivity in soilless systems. Controlled nutrient delivery improves nutrient uptake efficiency and maintains optimum electrical conductivity and nutrient balance in the root zone (Adams, 2002; Sonneveld and Voogt, 2009). Optimizing substrate composition along with fertigation management is essential for achieving maximum yield and quality in greenhouse tomato production (Savvas and Gruda, 2018).

Considering the importance of substrate selection in protected cultivation, the present investigation was undertaken to study the effect of different soilless culture media combinations on yield attributes and yield of cherry tomato grown in grow bags under shade net conditions during the *Rabi* season at Agricultural College, Bapatla.

Materials and Methods

Experimental Site

The experiment was conducted during the *Rabi* season at the Shade Net Unit, Department of Horticulture, Agricultural College, Bapatla, Andhra Pradesh, India. The experiment was carried out under protected conditions using a shade net structure.

Crop and Cultivation System

Cherry tomato plants were cultivated in grow bags under shade net conditions using a soilless culture production system. The plants were supplied with nutrients through drip fertigation throughout the crop period.

Experimental Design

The experiment was laid out in a Randomized Block

Design (RBD) consisting of:

- Number of treatments: 8
- Number of replications: 3
- Growing system: Soilless culture in grow bags under shade net.

Cultural practices

Nursery raising:

The seedlings were raised in portrays in the greenhouse at Agricultural College, Bapatla. Four weeks old seedlings were transplanted in the grow bags.

Transplanting:

Seedlings were transplanted at a spacing of 60 cm × 60 cm on sides of the growbags in each replication when they were 28 days old. A spacing of 30 cm was left from the borders of the plot at the time of planting. A light irrigation was given immediately after planting. Gap filling was done five days after planting.

Weeding and Irrigation:

The experimental site was kept free from weeds by periodical hand weeding. Irrigation was given at an interval of 7-8 days depending on the soil moisture condition.

Plant protection:

Timely and need based plant protection measures were taken up to protect the plants from incidence of pest and diseases. Neem oil @ 0.3 per cent and Chlorantraniliprole 18.5% w/w @ 0.05 per cent sprays were taken up to control the fruit borer incidence. COC (Copper oxy chloride) 50% WP @ 0.3 per cent was applied as foliar spray to control *Cercospora* leaf spot.

Observation Recorded

The observations on growth, yield and yield-attributing characters of cherry tomato were recorded from five randomly selected plants in each treatment per replication, excluding border plants. Measurements were taken at appropriate harvest stages, and the mean value of the selected plants was used for statistical analysis.



Plate 1: Good Yielders.



Plate 2: Field experimental plot.

- 1. Fruit clusters plant⁻¹:** The total number of fruit clusters produced on each selected plant throughout the harvesting period was counted and expressed as clusters plant⁻¹.
- 2. Fruits cluster⁻¹:** The number of fruits present in each cluster was counted from representative clusters, and the average was expressed as fruits cluster⁻¹.
- 3. Fruit length (cm):** Fruit length was measured from the pedicel end to the blossom end using a digital vernier caliper and expressed in centimetres.
- 4. Fruit diameter (cm):** The maximum transverse diameter of fully developed fruits was measured using a digital vernier caliper and expressed in centimetres.
- 5. Average fruit weight (g):** Fruits harvested at the appropriate maturity stage were weighed using a precision electronic balance. Average fruit weight was calculated by dividing the total weight of sampled fruits by their number and expressed in grams.
- 6. Yield plant⁻¹ (kg):** Fruits harvested from each selected plant during successive harvests were weighed separately and cumulatively summed to obtain total yield per plant, expressed in kilograms.
- 7. Marketable yield plot⁻¹ (kg):** Marketable fruits free from visible defects, cracking, pest and disease damage, and other non-marketable characteristics were separated at each harvest. Their cumulative weight was recorded for each plot and expressed in kilograms.
- 8. Total yield (t ha⁻¹):** The total fruit yield obtained from each experimental plot was converted to tonnes per hectare using the net plot area and expressed as t ha⁻¹.
- 9. Harvest duration (days):** Harvest duration was calculated as the number of days between the date of first harvest and the date of final harvest. The duration was expressed in days.

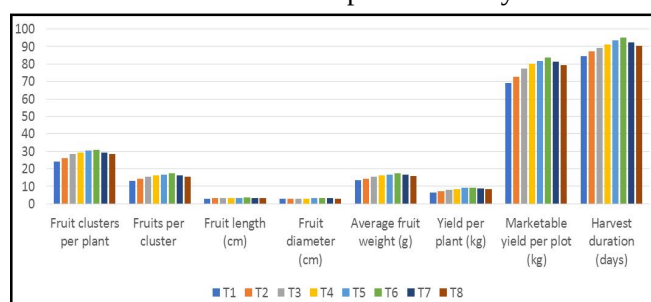


Fig. 1: Effect of different soilless culture treatments on yield attributes and yield of cherry tomato under shade net conditions.

Table 1: Treatment Details.

Treatment	Treatment Details
T1	Control – Cocopeat alone + standard fertigation (100% RDF)
T2	Cocopeat + Vermicompost (75:25) + standard fertigation
T3	Cocopeat + Perlite (75:25) + standard fertigation
T4	Cocopeat + Vermicompost + Perlite (60:20:20) + standard fertigation
T5	Cocopeat + Vermicompost + Vermiculite (60:20:20) + standard fertigation
T6	Cocopeat + Vermicompost + Perlite (50:25:25) + 125% RDF through fertigation
T7	Cocopeat + Perlite + Vermiculite (60:20:20) + standard fertigation
T8	Cocopeat + Compost + Perlite (60:20:20) + 100% RDF

Statistical analysis

The recorded observations were averaged replication-wise and subjected to analysis of variance appropriate for a Randomized Block Design (RBD). The significance of treatment differences was assessed using the critical difference (CD) at the appropriate probability level.

Analysis of variance

Analysis of variance of helps in sorting out the variance due to different sources of variation and to provide the basis for the test of significance (Singh and Chaudhary, 1985).

Data was analysed by the methods outlined by Panse and Sukhatme (1967) using the mean values of random plants in each replication from all treatments to find out the significance of treatment effect. The significance was tested by referring to the values of F table (Fisher and Yates, 1963).

$$Y_{ij} = \mu + g_i + r_j + e_{ij}$$

Where,

Y_{ij} = Phenotypic observation of i^{th} genotype in j^{th} replication

μ = General mean

g_i = Effect of i^{th} genotype

r_j = Effect of j^{th} replication

e_{ij} = Random error associated with i^{th} genotype and j^{th} replication.

Results and Discussion

The yield attributes of cherry tomato were significantly influenced by different soilless culture media combinations under shade net conditions. The variation

Table 2: Analysis of variance for Randomized Block Design.

Sources of variation	Df	SS	MSS	F ratio
Replications	r-1	RSS	RMSS	RMSS/EMSS
Treatments	t-1	TrSS	TrMSS	TrMSS/EMSS
Error	(r-1)(t-1)	ESS	EMSS	
Total	(rt-1)	TSS		

Where, R = Number of replications; T = Number of genotypes or treatments; Df = degrees of freedom; SS = sum of squares; MSS = Mean sum of squares; RSS = Replication sum of squares; TrSS = Treatment sum of squares; ESS = Error sum of squares; TSS = Total sum of squares; RMSS = Mean squares due to replications; TrMSS = Mean squares due to treatments; EMSS = Mean squares due to error; Significance of treatment MSS was assessed by F test at 5 per cent level of significance.

among treatments indicates that the composition of the growing medium and nutrient availability played an important role in improving crop productivity.

Fruit clusters per plant

The number of fruit clusters per plant varied from 24.3 to 31.0 among different treatments. The highest number of fruit clusters per plant was recorded in T6 (31.0), followed by T5 (30.3) and T7 (29.3), whereas the lowest value was observed in T1 (24.3). The higher cluster production in T6 may be attributed to the combined effect of cocopeat, vermicompost and perlite, which improved root aeration, moisture availability and nutrient supply. A balanced root-zone environment promotes vegetative growth and reproductive development, resulting in increased flower production and fruit clusters. Similar observations regarding the influence of substrate properties on crop growth and yield were reported by Raviv *et al.*, (2004) and Gruda (2009).

Fruits per cluster

The number of fruits per cluster ranged from 13.3 to 17.3. The maximum number of fruits per cluster was recorded in T6 (17.3), followed by T5 (16.7), while the minimum was recorded in T1 (13.3). Improved fruit retention under T6 may be due to better nutrient availability, especially during flowering and fruit development stages. Organic components such as vermicompost provide slow nutrient release and improve microbial activity, whereas perlite improves oxygen availability around roots, supporting continuous plant growth (Maher *et al.*, 2008)

Fruit length and fruit diameter

Significant differences were observed among treatments for fruit dimensions. Fruit length ranged from 2.98 to 3.51 cm, while fruit diameter varied from 2.77 to 3.17 cm. The highest fruit length (3.51 cm) and fruit

Table 3. Effect of different soilless culture treatments on yield attributes and yield of cherry tomato under shade net conditions.

	FCP	FPC	FL	FD	AF	YP	MY	HD
T1	24.3	13.3	2.98	2.77	13.5	6.51	69.1	84.3
T2	26.3	14.3	3.10	2.88	14.4	7.11	72.8	87.3
T3	28.3	15.3	3.22	2.97	15.3	7.89	77.2	89.3
T4	29.3	16.3	3.34	3.05	16.1	8.50	80.2	91.3
T5	30.3	16.7	3.42	3.11	16.8	9.01	81.7	93.3
T6	31.0	17.3	3.51	3.17	17.4	9.35	83.6	95.0
T7	29.3	16.3	3.40	3.10	16.7	8.96	81.2	92.3
T8	28.3	15.3	3.30	3.02	15.9	8.38	79.4	90.3
SEM	0.58	0.33	0.22	0.01	0.12	0.06	0.62	0.58
CV	3.23	3.33	0.86	0.63	1.15	1.11	1.28	1.05

FCP: Fruit clusters per plant; FPC: Fruits per cluster; FL: Fruit length (cm); FD: Fruit diameter (cm); AF: Average fruit weight (g); YP: Yield per plant (kg); MY: Marketable yield per plot (kg); HD: Harvest duration (days)

diameter (3.17 cm) were recorded in T6, followed by T5 and T7. The lowest values were recorded in T1. The improvement in fruit size under T6 may be attributed to better nutrient absorption and improved water availability in the root zone. Substrate mixtures having optimum water holding capacity and aeration improve root activity and enhance assimilate translocation towards developing fruits (Raviv and Lieth, 2008)

Average fruit weight

Average fruit weight showed considerable variation among treatments. The highest average fruit weight was recorded in T6 (17.4 g), followed by T5 (16.8 g) and T7 (16.7 g). The lowest fruit weight was observed in T1 (13.5 g). The increased fruit weight under T6 could be due to improved nutrient availability and better physiological activity of plants. Adequate potassium and balanced nutrition supplied through fertigation enhance fruit enlargement and quality development in tomato crops (Adams, 2002; Sonneveld and Voogt, 2009).

Yield per plant

The yield per plant ranged from 6.51 kg to 9.35 kg. The maximum yield per plant was recorded in T6 (9.35 kg), followed by T5 (9.01 kg) and T7 (8.96 kg). The minimum yield was recorded in T1 (6.51 kg). Higher yield in T6 was the result of combined improvement in fruit number and fruit weight. The favourable physical properties of cocopeat, vermicompost and perlite mixture provided an ideal root environment, resulting in enhanced nutrient uptake and higher productivity. Similar results were reported by Savvas and Gruda (2018), who stated that properly selected soilless substrates improve crop performance through efficient management of water and nutrients.

Marketable yield per plot

Marketable yield varied from 69.1 to 83.6 kg plot⁻¹. The maximum marketable yield was recorded in T6 (83.6 kg plot⁻¹), followed by T5 (81.7 kg plot⁻¹) and T7 (81.2 kg plot⁻¹). The lowest marketable yield was recorded in T1 (69.1 kg plot⁻¹). The higher marketable yield under T6 indicates better fruit quality and reduced proportion of non-marketable fruits due to improved crop nutrition and favourable growing conditions.

Harvest duration

Harvest duration varied from 84.3 to 95.0 days. The maximum harvest duration was recorded in T6 (95.0 days), followed by T5 (93.3 days) and T7 (92.3 days). The minimum duration was recorded in T1 (84.3 days). The extended harvesting period under T6 may be due to better plant vigour and continuous nutrient availability throughout the cropping period. Efficient fertigation and suitable substrate conditions help maintain prolonged flowering and fruiting in protected tomato cultivation (Heuvelink, 2005).

Conclusion

The present investigation revealed that different soilless culture media combinations significantly influenced yield attributes and yield of cherry tomato under shade net conditions during the *Rabi* season. The use of suitable growing media in grow bags improved crop performance by providing favourable root-zone conditions, better nutrient availability and efficient water management.

Among the eight treatments evaluated, T6 (Cocopeat + Vermicompost + Perlite in 50:25:25 ratio with 125% RDF through fertigation) recorded the highest values for all major yield parameters, including fruit clusters per plant (31.0), fruits per cluster (17.3), fruit length (3.51 cm), fruit diameter (3.17 cm), average fruit weight (17.4 g), yield per plant (9.35 kg), marketable yield (83.6 kg plot⁻¹) and harvest duration (95 days).

The superior performance of T6 may be attributed to the combined advantages of cocopeat, vermicompost and perlite, which provided optimum moisture retention, improved aeration, enhanced nutrient availability and better root development. The results indicate that optimized soilless culture media along with suitable fertigation management can significantly improve cherry tomato productivity under shade net cultivation.

Therefore, T6 can be recommended as an effective soilless culture treatment for commercial cherry tomato production under protected cultivation conditions, subject to validation under different agro-climatic conditions.

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