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Effect of different growing media and bio-fertilizers on tomato production in plastic greenhouses

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ABSTRACT

A greenhouse experiment was conducted with three different levels and type of growing media (soil: vermicompost: sand; 2:1:1, 1:2:1 and vermicompost: sand, 2:1) alongwith two bio-fertilizers (*Azotobacter* and phosphate solubilizing bacteria) in factorial randomized block design with three replications to standardize agro-technique for tomato production under protected conditions. Out of different treatment combinations, soilless growing media comprising of vermicompost: sand; 2:1 alongwith seedling treatment with *Azotobacter* recorded the highest number of fruits per plant (58.95 & 54.00), average fruit weight (84.89 & 81.56 g), fruit yield per plant (5.01 and 4.40 kg), total soluble solids (5.18° & 5.21°B), ascorbic acid (36.45 & 33.88 mg per 100 g) and lycopene content mg per 100 g (5.21 & 5.22 mg per 100 g) during both the years.

Key words: Tomato, growing media, bio-fertilizers and greenhouse.

INTRODUCTION

Tomato (*Solanum lycopersicum* L.) is an important commercial crop of mid-hills in Himachal Pradesh and widely cultivated for off-season produce in the state. The cultivation is mainly confined to outdoor production and the crop faces many biotic and abiotic stresses due to the incidence of monsoon rains during fruit production. This not only results in declining the production but also deteriorates the quality of the produce. Under such circumstances, the only alternative with the growers is to go for growing crops under protected conditions. The recent trends indicate that productivity and fertility of soils are globally declining due to degradation and intensive use of soils without the consideration of proper soil management practices (Cakmak, 3). Tomato production under greenhouses has become more popular worldwide because of many advantages. Growing media is an important component for commercial production of crops in the greenhouses. Soilless culture is also increasingly becoming popular for cultivation because of less soil-borne disease problems. Bio-fertilizers beside having their role in atmospheric nitrogen fixation and phosphorus solubilization, also helps in stimulating the plant growth hormones providing better nutrient uptake and increased tolerance towards drought and moisture stress. Further, supplementing growing media with bio-fertilizers also provides greater means to achieve the targets of eco-friendly growing and reducing more use of chemical fertilizers. Therefore, an experiment was conducted to investigate the productivity potential of soil based and soilless growing media alongwith bio-fertilizer application for tomato under naturally ventilated plastic greenhouses for yield and quality traits.

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MATERIALS AND METHODS

The experiment was conducted in a plastic greenhouse with natural ventilation at research and experimental farm of the Department of Vegetable Science, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, for two consecutive years. Seeds of tomato (*Solanum lycopersicum* L. variety Naveen 2000 +) obtained from M/s Indo American Hybrid Seeds Pvt. Ltd., were sown in temperature cum humidity controlled mist chamber for raising healthy and disease-free seedlings. The seeds were sown in formalin (5%) treated nursery beds consisting of soil: farmyard manure and sand (2:1:1). Further, the seedlings were transplanted in three different growing media (soil: vermicompost: sand; 2:1:1, 1:2:1 and vermicompost: sand, 2:1). Before transplanting, seedlings were exposed to bio-fertilizers (*Azotobacter* and phosphate solubilising bacteria) application through seedling dip method for a period of half an hour @ 1 kg per ha. The irrigation regime was kept at 20 kpa with the help of tentiometer. The observations were recorded on the number of fruits per cluster, number of fruits per plant, avg. fruit weight (g), fruit yield (kg/plant), fruit yield (kg per m^2), total soluble solids (°B), ascorbic acid (mg per 100 g), lycopene content (mg per 100 g). In

order to study the effect of growing media and bio-fertilizers on yield and quality of tomato, data were processed by analysis of variance (ANOVA), and least significance difference (LSD) test were also performed for the comparison of means. Factorial RBD was used an experimental design.

RESULTS AND DISCUSSION

Among different growing media, soilless growing media, *i.e*. vermicompost: sand (2:1) recorded significantly higher number of fruits per cluster (5.65 and 5.22) and fruits per plant (58.58 and 53.72) during two years. Inden and Torres (5), and Teo and Tan (13) also reported the higher number of fruits per cluster and fruits per plant from soilless media. Highest number of fruits was also reported by Premuzic *et al.* (8) and Samawat *et al.* (10) on vermicompost based growing media. Data presented in Table 1 also revealed that soilless growing media recorded the maximum avg. fruit weight (84.67 and 81.44 g), maximum fruit yield (4.96 and 4.37 kg/plant) and fruit yield (24.81 and 21.88 kg/m^2) during both the years. This corroborates with the findings of Janet *et al.* (6) who also reported the higher mean fruit weight from soilless growing media. Similarly for parameters like total soluble solids, soilless growing media also recorded the maximum value (5.17° and 5.20°B) during both the years, which has a support of Zhang and He (14). Ascorbic acid content was also recorded high in soilless growing media (35.65 and 33.51 mg/100 g) during both the years, which is in agreement with Rodica *et al.* (8). Lycopene content was also significantly influenced by growing media during both the years. The present findings were in close proximity with the findings of Bisignano *et al.* (2).

In case of bio-fertilizers, seedling application of *Azotobacter* recorded the maximum number of fruits per cluster (5.64) and fruits per plant (55.91 and 51.02) during the two years. The present findings corroborates with the findings of Shukla *et al.* (12), and Sharma and Thakur (11). Similarly, *Azotobacter* treatment also recorded the maximum average fruit weight (84.17 and 80.84 g), fruit yield (4.71 and 4.13 kg/plant) and fruit yield (23.54 and 20.63 kg/m^2) during both the years. Increase in fruit weight with the application of *Azotobacter* was also reported by Gajbhiye *et al.* (4). *Azotobacter* treatment recorded the highest ascorbic acid content of 33.19 mg/100 g in comparison to PSB treatment during first year. The present findings are in close line with Bhadoria *et al.* (1).

The data on interaction effect is presented in Tables 2 and 3. Interaction effect of growing medium with bio-fertilizer was found significant for number of fruits per cluster during second year; however, it was significant during first year for number of fruits per plant. Soilless growing media along with PSB treatment recorded the maximum number of 5.26 fruits per cluster, which was further statistically at par with all treatment combinations except M_1B_2 (Table 2). Maximum number of fruits per plant was exhibited by the soilless growing media alongwith *Azotobacter* treatment. The same treatment combination (M_3B_1) also recorded the maximum avg. fruit weight. The increase in yield might be due to better nutrient utilization in the vermicompost rich

Table 1. Effect of growing media and bio-fertilizers on fruit yield and quality traits of greenhouse tomato.

Treatment	No. of fruits per cluster		No. of fruits per plant		Avg. fruit wt. (g)		Fruit yield (kg/plant)		Fruit yield (kg per m^2)		Total soluble solids (°B)		Ascorbic acid (mg per 100 g)		Lycopene content (mg per 100 g)	
(Growing medium)	1st year	2nd year	1st year	2nd year	1st year	2nd year	1st year	2nd year	1st year	2nd year	1st year	2nd year	1st year	2nd year	1st year	2nd year
M_1	5.54	5.13	52.83	48.06	83.35	80.02	4.41	3.85	22.03	19.23	5.00	5.04	30.48	28.24	4.94	4.91
M_2	5.61	5.21	55.37	50.38	83.44	80.11	4.62	4.04	23.17	20.18	5.06	5.14	30.60	28.36	5.05	5.05
M_3	5.65	5.22	58.58	53.72	84.67	81.44	4.96	4.37	24.81	21.88	5.17	5.20	35.65	33.51	5.21	5.20
$CD_{(0.05)}$	0.0	0.08	0.64	0.63	0.76	0.74	0.09	0.08	0.43	0.39	0.08	0.13	0.30	0.12	0.06	0.08
(Biofertilizer)	1st year	2nd year	1st year	2nd year	1st year	2nd year	1st year	2nd year	1st year	2nd year	1st year	2nd year	1st year	2nd year	1st year	2nd year
B_1	5.64	5.20	55.91	51.02	84.17	80.84	4.71	4.13	23.54	20.63	5.11	5.14	33.19	30.62	5.08	5.08
B_2	5.56	5.17	55.28	50.42	83.47	80.21	4.62	4.05	23.12	20.23	5.04	5.11	31.29	29.45	5.05	5.03
$CD_{(0.05)}$	0.06	NS	0.52	0.52	0.62	0.61	0.07	0.06	0.35	0.32	NS	NS	0.24	NS	NS	NS

Table 2. Interaction effect of growing media and bio-fertilizers on fruit yield and component traits of greenhouse tomato.

Treatment	No. of fruits per cluster				No. of fruits per plant				Avg. fruit wt. (g)				Fruit yield (kg/plant)			
	1st year		2nd year		1st year		2nd year		1st year		2nd year		1st year		2nd year	
BF GM	B_1	B_2	B_1	B_2	B_1	B_2	B_1	B_2	B_1	B_2	B_1	B_2	B_1	B_2	B_1	B_2
M_1	5.62	5.47	5.19	5.07	53.44	52.22	48.33	47.78	84.30	82.40	80.96	79.07	4.51	4.31	3.91	3.78
M_2	5.61	5.60	5.24	5.17	55.33	55.41	50.73	50.04	83.33	83.56	80.00	80.22	4.61	4.63	4.06	4.02
M_3	5.69	5.61	5.17	5.26	58.95	58.21	54.00	53.44	84.89	84.44	81.56	81.33	5.01	4.92	4.40	4.35
$CD_{(0.05)}$	NS		0.11		0.90		NS		1.08		1.05		0.12		NS	

Table 3. Interaction effect of growing media and bio-fertilizers on fruit yield and quality traits of greenhouse tomato.

Treatment	Fruit yield (kg per m^2)				Total soluble solids (°B)				Ascorbic acid (mg per 100 g)				Lycopene content (mg per 100 g)			
	1st year		2nd year		1st year		2nd year		1st year		2nd year		1st year		2nd year	
BF GM	B_1	B_2	B_1	B_2	B_1	B_2	B_1	B_2	B_1	B_2	B_1	B_2	B_1	B_2	B_1	B_2
M_1	22.53	21.52	19.57	18.90	5.08	4.91	5.13	4.94	29.83	31.13	27.26	29.22	4.98	4.89	4.98	4.85
M_2	23.07	23.27	20.30	20.07	5.07	5.04	5.07	5.21	33.29	27.91	30.72	26.01	5.05	5.04	5.04	5.06
M_3	25.03	24.58	22.02	21.73	5.18	5.17	5.21	5.19	36.45	34.84	33.88	33.13	5.21	5.20	5.22	5.19
$CD_{(0.05)}$	0.61		NS		NS		NS		0.42		NS		NS		NS	

medium in presence of bio-fertilizers and better development of root system and possible higher synthesis of plant growth hormones. Highest yield from vermicompost rich medium in combination with *Azospirillum* treatment was also reported by Kannan *et al.* (7). Similar treatment combination, *i.e.* M_3B_1 recorded the highest ascorbic acid content of 36.45 mg/100 g, which was statistically higher than all other treatment combinations during first year. It may be due to the combined effect of soilless growing media along with seedling treatment with *Azotobacter*. Based on the present findings it can be concluded that soilless growing media alongwith *Azotobacter* treatment of seedlings can be used for greenhouse tomato production.

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