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Kaushal S
Assistant Professor, Department of Agricultural Sciences, Sant Baba Bhag Singh University, Village- Khiala, Post office- Padhiana, District –Jalandhar, Punjab, India

Sharma V
Principle Scientist, Department of Agronomy, Forages and Grassland Management, COA, CSKHPKV, Palampur, Kangra (HP), India

Singh V
Assistant Professor, Department of Agricultural Sciences, Sant Baba Bhag Singh University, Village- Khiala, Post office- Padhiana, District –Jalandhar, (Punjab) India

Correspondence
Kaushal S
Assistant Professor, Department of Agricultural Sciences, Sant Baba Bhag Singh University, Village- Khiala, Post office- Padhiana, District –Jalandhar, Punjab, India

To study the impact of hybrids, growing media and fertigation on developmental stages and dry matter accumulation in tomato production under naturally ventilated polyhouse

Kaushal S, Sharma V and Singh V

Abstract
The investigation entitled "Standardisation of agro techniques for tomato production in naturally ventilated polyhouse" was conducted at the Research Farm of Department of Agricultural Engineering, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur during summer season of 2013 and 2014 in two separate experiments inside the naturally ventilated polyhouses. Treatments comprising three hybrids (Avtar, Rakshita and Naveen 2000 plus), three fertigation levels (NPK @ 20:20:20 g/m^2, NPK @ 25:25:25 g/m^2 and NPK @ 30:30:30 g/m^2) and two growing media (vermicompost and cocopeat: vermicompost) was laid out in a randomized block design with three replications. Hybrid Naveen 2000 plus, application of NPK @ 30 g/m^2 resulted in lesser number of days taken to flower initiation, 50% flowering stage, lesser number of days to first picking, longer harvest duration, maximum fruit set and accumulated significantly higher dry matter. Growing media resulted in non significant results expect in harvest duration and dry matter accumulation.

Keywords: NPK, hybrids, vermicompost, polyhouse and cocopeat

Introduction
Tomato is a warm season tropical crop and lacks adaptability to varied environmental conditions. Despite its economic importance, growers are not in a position to produce good quality tomato with high productivity due to various biotic (pest and diseases), abiotic (rainfall, temperature, relative humidity and light intensity) and crop factors (flower and fruit drop). Due to the behaviour of weather, the crops grown in open fields are often exposed to fluctuating levels of temperature, humidity, wind flow *etc*. which ultimately affect the crop productivity adversely (Sanwal *et al*. 2008) [1]. Besides this, limited availability of land for cultivation hampers the vegetable production. Hence to obtain a good quality produce and production during off season, there is a need to cultivate tomato under protected condition such as green houses or polyhouses. The area under tomato in the world is 44,21,734 hectares with an annual production of about 12,03,84,017 metric tons (Anonymous 2004) [2], whereas in India, tomato has become an important vegetable crop and occupies an area of 882 thousand ha with a production of 18735.9 thousand MT with a productivity of 21.2 MT/ha (Anonymous 2014) [3] whereas, in Himachal Pradesh, it is grown in about 10.37 thousand ha area with a production of about 430.79 thousand MT with a productivity of 41.5 MT/ha (Anonymous 2014) [3]. Important component of protected cultivation, which influences productivity and quality of tomato, is application of fertilizers with the irrigation water called fertigation. Fertigation seems to incorporate desirable features, which can improve water as well as nutrient use efficiency. It is a well established fact that macro nutrients such as nitrogen, phosphorus and potassium have profound effect on crop productivity and quality.

Materials and Methods
The experiment was conducted in naturally ventilated polyhouse during summer-season (March to August) in the year 2013 and 2014 at the Research Farm of the Himachal Pradesh Krishi Vishvavidyalaya Palampur. The area represents the sub-humid mid hill zone of Himachal Pradesh and is characterized by the sub-tropical climate. Mild summer and cool winter characterized the climate of Palampur. The seeds of the three hybrids were sown in plastic plug trays by using soilless media having cocopeat, perlite and vermiculite in the ratio

of 3:1:1, respectively inside the naturally ventilated polyhouse on 20th Feb 2013 and 2014 to get healthy and disease free seedlings of tomato. The seedlings were ready for transplanting after one month of sowing and were subsequently transplanted inside the naturally ventilated polyhouse equipped with drip irrigation system. Before transplanting, beds were prepared. These beds were thoroughly sterilized with 4 per cent formalin (1 litre of 40 per cent commercial formalin in 7 litre of water). Beds were covered with black polyethylene sheet for 7 days after formalin application. Then polyethylene sheet was removed and soil raked well for a week in order to remove the fumes of formalin. Before transplanting, beds were prepared with growing media comprising of vermicompost alone and mixture of cocopeat and vermicompost (1:1, v/v) up to 15 cm depth. The basal dose of N, P and K @ 100 kg/ha from straight fertilizers was applied in the form of urea (21.5 g/m^2), single super phosphate (62.5 g/m^2) and muriate of potash (16.5 g/m^2). Remaining dose of NPK was applied with water soluble fertilizer (polyfeed 19:19:19) starting from 3rd week after transplanting and up to 15 days prior to final harvest. Fertigation was done twice a week. The plants were irrigated daily with drip irrigation system, one dripper was provided for each plant. Plants were watered regularly before 12 noon or late evening. Other cultural practices and standard plant protection measures were also adopted from time to time to ensure healthy crop stand. After 30-35 days of transplanting, plants were trained to 2 stems and staked with the help of nylon threads connected to the wire inside the polyhouse. Other cultural practices and standard plant protection measures were also adopted from time to time to ensure good and healthy crop stand. There were eighteen treatment combinations comprising of three hybrids, two growing medium and three fertigation levels of NPK. Observations recorded were number of days taken to flower initiation, 50% flowering, number of days to first picking, harvest duration, fruit set and dry matter accumulation.

Results and Discussions

Days taken to flower initiation

It can be construed from Table 1 that the hybrids had significant effect on days taken to flower initiation. Hybrid Naveen 2000 plus was earliest in achieving days taken to flower initiation (34.4 days in 2013 and 36.4 days in 2014) which significantly differed with Rakshita and Avtar. Such variation in flower initiation among three hybrids is expected due to their varietal characters. Similar findings were also reported by Khalid *et al*. (2002) [4] and Pant *et al*. (2002) [5].

Application of different fertigation levels had significant effect on the days to flower initiatiom. Among different levels of fertigation, the crop fertilized with NPK @ 30 g/m^2 took significantly lesser number of days to flower initiation than NPK @ 25 g and 20 g/m^2. On an average, application of NPK @ 30g/m ^{2} took and lesser days to flower initiation than application of NPK @ 25 g and 20 g/m^2, respectively.

Growing media did not have any significant effect on days taken to flower initiation in the year 2013 and 2014 (Table 1).

Days to 50 per cent flowering

It can be construed from the Table (1) that the hybrids had significant effect on days taken to 50% flowering. Hybrid Naveen 2000 plus was earliest in achieving 50% flowering stage (40.4 days in 2013 and 42.4 days in 2014) which significantly differed with Rakshita (44.1 days in 2013 and 46.0 days in 2014) and Avtar (46.2 days in 2013 and 48.3 days in 2014). Such variation in 50% flowering among three hybrids is expected due to their varietal characters. Similar findings were also reported by Khalid *et al*. (2002) [4] and Pant *et al*. (2002) [5].

Application of different fertigation levels had significant effect on days taken to 50% flowering. Among different levels of fertigation, the crop fertilized with NPK @ 30 g/m^2 took significantly lesser number of days (41.0 days in 2013 and 43.0 days in 2014) taken to 50% flowering than NPK @ 25 and 20 g/m^2.

Growing media did not have any significant effect on days taken to 50% flowering in any of the year under study.

Days taken to first picking

A keen observation of the data (Table 1) revealed that hybrid Naveen 2000 plus took significantly lesser number of days (66.4 days in 2013 and 68.2 days in 2014) to first picking than Rakshita (70.2 days in 2013 and 73.5 days in 2014) and Avtar (72.4 days in 2013 and 74.8 days in 2014). Recording of lesser number of days to first picking in hybrid Naveen 2000 plus might be due to genetic expression and interaction of Naveen 2000 plus with greenhouse environment. The significant differences among the hybrids for days to first picking have also been observed by Gajc (2002) [6] in plastic tunnel who reported varietal variation among the tomato hybrids.

Different levels of fertigation also had significant effect on the days taken to first picking during both the years. Among different levels of fertigation, the crop fertilized with NPK @ 30 g /m^2 took significantly lesser number of days to first picking (66.1 days in 2013 and 69.0 days in 2014) than NPK @ 25 g/m^2 (70.5 days in 2013 and 72.9 days in 2014). Whereas NPK @ 20 g/m^2 took maximum number of days to first picking (72.4 days in 2013 and 74.6 days in 2014). Growing media did not have any significant effect on days to first picking in both the years.

Table 1: Developmental stages as influenced by different treatments

Treatments	Flower initiation		Days taken to 50% flowering		Days taken to first picking		Harvest duration		Fruit set (%)	
	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
Hybrids										
Rakshita	38.1	40.0	44.1	46.0	70.2	73.5	53.3	56.5	75.3	77.5
Naveen 2000 plus	34.4	36.4	40.4	42.4	66.4	68.2	57.9	59.3	79.2	80.4
Avtar (7711)	40.2	42.3	46.2	48.3	72.4	74.8	49.2	51.8	71.5	73.4
SEm±	1.1	1.0	1.1	1.2	0.7	0.6	0.2	0.2	0.5	0.6
CD (P=0.05)	3.0	2.7	3.0	2.7	2.1	1.8	0.6	0.6	1.5	1.7
Fertigation levels										
NPK @ 20 : 20 : 20 g/m^2	39.2	41.4	45.2	47.4	72.4	74.6	48.2	50.2	75.3	76.9
NPK @ 25 : 25 : 25 g/m^2	38.5	40.3	44.5	46.3	70.5	72.9	55.1	57.8	75.8	77.9

NPK @ 30 : 30 : 30 g/m^2	35.0	37	41.0	43.0	66.1	69.0	57.1	59.6	74.9	76.6
SEm±	1.1	1.0	1.1	1.0	0.7	0.6	0.2	0.2	0.5	0.6
CD (P=0.05)	3.0	2.7	3.0	2.7	2.1	1.8	0.6	0.6	NS	NS
Growing media										
Vermicompost	38.7	40.7	44.7	46.7	70.1	73.2	51.9	54.5	75.7	77.6
Cocopeat: Vermicompost (1:1)	36.4	38.4	42.4	44.4	69.2	71.1	55.0	57.2	75.0	76.6
SEm±	0.9	1.0	0.9	1.0	0.6	0.5	0.2	0.2	0.2	0.3
CD (P=0.05)	NS	NS	NS	NS	NS	NS	0.5	0.5	NS	NS

Table 2: Dry matter accumulation at harvest as influenced by different treatments

Treatment	Dry matter accumulation (g/plant)	
	2013	**2014**
Hybrids		
Rakshita	195.2	197.8
Naveen 2000 plus	212.7	215.2
Avtar (7711)	164.3	166.2
SEm±	4.6	4.8
CD (P=0.05)	13.8	14.4
Fertigation levels		
NPK @ 20 : 20 : 20 g/m^2	162.9	165.5
NPK @ 25 : 25 : 25 g/m^2	197.4	199.4
NPK @ 30 : 30 : 30 g/m^2	211.9	214.3
SEm±	4.6	4.8
CD (P=0.05)	13.8	14.4
Growing media		
Vermicompost	1. 183.6	2. 185.8
Cocopeat : Vermicompost (1:1)	3. 197.9	4. 200.3
SEm±	5. 4.3	6. 4.4
CD (P=0.05)	7. 12.9	8. 13.0

Harvest duration (days)

Longest harvest duration is most desirable trait for continuous supply of fresh tomato to the market over longer period and to avoid market glut. A keen observation of the data (Table 1) indicated that the hybrids differed significantly with respect to harvest duration. Significantly longer harvest duration was observed in hybrid Naveen 2000 plus (57.9 days in 2013 and 59.3 days in 2014) than Rakshita (53.3 days in 2013 and 56.5 days in 2014) and Avtar hybrid (49.2 days in 2013 and 51.8 days in 2014). Such increase in harvest duration is attributed to the different growth behavior of the three tomato hybrids. Singh (2005) [7] also reported that the varieties grown under polyhouse condition generally exhibited longer harvest duration because of indeterminate growth habit and environment interaction.

Different levels of NPK through fertigation also had significant influence on harvest duration during both the years. Among different levels of NPK application, longer harvest duration (57.1 days in 2013 and 59.6 days in 2014) was observed at NPK @ 30 g/m^2 which differed significantly with NPK @ 25 g /m^2 and NPK @ 20 g/m^2. Such increase in harvest duration due to higher dose of NPK (NPK @ 30 g /m^2) is because of increased production of photosynthetic area and efficient photosynthate transport mechanism. Similar observations have also been reported by Sharma *et al*. (2001) who revealed that higher dose of NPK (200 kg N, 150 kg P_2O_5 and 110 kg K_2O) resulted in longest harvest duration in tomato.

Different growing media have exhibited varied responses to harvest duration of tomato and the growing media consisting of cocopeat: vermicompost (1:1, v/v) recorded significantly longer harvest duration (55.0 in 2013 and 57.2 in 2014) than growing media consisting of vermicompost. The longer harvest duration of tomato plants grown in cocopeat+ vermicompost mixture might be ascribed to the fact that this media have provided better physico-chemical properties besides maintaining a requisite biological balance which have contributed to the better growth of plants in comparison to the other growing media used. These findings also got the support from the earlier reports of Yau and Murphy (2000) [9].

Fruit set (%)

The data in Table 1 showed that fruit set (%) was significantly influenced by hybrids. Amongst the different hybrids, the hybrid Naveen 2000 plus showed maximum fruit set (79.2% in 2013 and 80.4% in 2014) which differed significantly from both the hybrids. The hybrid Avtar recorded minimum fruit set of 71.5% and 73.4% during 2013 and 2014, respectively. The significant variation for fruit set (%) reflects interaction of individual genetic potential of the different hybrids with greenhouse environment. These results are supported by the work of Pant *et al*. (2002) [5].

It is apparent from the Table 1 that neither the fertigation level nor the growing media significantly influenced the fruit set (%) in either of the years.

Dry matter accumulation (g/plant)

An examination of data in Table 2 revealed that the hybrids differed significantly with respect to dry matter accumulation (g/plant). Hybrid Naveen 2000 plus accumulated significantly higher dry matter (212.7 g/plant in 2013 and 215.2 g/plant in 2014) over hybrid Rakshita (195.2 g/plant in 2013 and 197.8 g/plant in 2014) and Avtar (164.3 g/plant in 2013 and 166.2 g/plant). Among the latter two hybrids, Rakshita produced significantly more dry matter compared to hybrid Avtar. The difference among the hybrids in dry matter production may be due to differences in number of leaves per plant which form the photosynthetic area and number of branches. Nagalakshmi *et al*. (2001) [10] and Khalid *et al*. (2002) [4] reported similar findings.

Dry matter accumulation by plants was also influenced significantly and consistently by different fertigation levels.

Application of NPK @ 30 g/m^2 resulted in significantly highest dry matter accumulation followed by NPK @ 25 g/m^2. This might be due to more availability of nitrogen, phosphorus and potassium to plants, more synthesis of protein, fats and carbohydrates resulting in higher dry matter production. Similar were the findings of Kumar (2001) [11].
Different growing media have exhibited varied responses to dry matter accumulation (g/plant) and the growing media consisting of cocopeat: vermicompost (1:1, v/v) accumulated significantly more dry matter (197.9 g/plant 2013 and 200.3 g/plant in 2014) than growing media consisting of vermicompost.

Conclusions

- Tomato hybrid Naveen 2000 plus took significantly lesser number of days to initiate flowering and dry matter accumulation as comparison to Rakshita and Avtar during both the years respectively.
- Fertigation with NPK @ 30:30:30 g/m^2 took significantly lesser number of days for flowering and dry matter accumulation than NPK @ 25 g/m^2 and NPK @ 20 g/m^2.
- Growing media comprising cocopeat: vermicompost (1:1, v/v) produced significantly longer harvest duration and dry matter accumulation.

References

1. Sanwal SK, Patel KK, Yadav DS. Vegetable production under protected conditions in Neh region: problems and prospects. ENVIS Bulletin. 2008; 12:1-7.
2. Anonymous. Quarterly Bulletin of Statistics. Food and Agriculture Organization, Rome (Italy), 2004.
3. Anonymous. Indian Horticulture Database, National Horticulture Board (NHB), 2014.
4. Khalid MK, Hussain SI, Mahmood T, Hidaytullah, Laghari MH. Winter production of tomatoes under plastic tunnel. Asian Journal of Plant Sciences. 2002; 1:659-660.
5. Pant T, Joshi RP, Verma GS, Bhoj AS, Kumar N. An estimate of yield and nutritive parameters of hybrid tomato (*Lycopersicon esculentum*) in hydroponics using rain water in Uttaranchal. Indian Journal of Agricultural Sciences. 2002; 72:486-487.
6. Gajc WJ. Yield and physical properties of fruit of some tomato cultivars in greenhouse conditions. Folia Horticulturae. 2002; 14:45-51.
7. Singh B. Standardizing cultivars and growing media for raising tomato crops in naturally ventilated poyhouse. MSc. Thesis. Department of Vegetable Science, Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, India, 2005.
8. Sharma DK, Choudhary DR, Verma TS. Growth and seed yield of tomato (*Lycopersicon esculentum* Mill.) Cv. Roma as influenced by levels of nitrogen and plant spacing. Haryana Journal of Horticulture Science. 2001; 30:95-96.
9. Yau PY, Murphy RJ. Biodegraded cocopeat as a horticultural substrate. Acta Horticulturae. 2000; 577:75-278.
10. Nagalakshmi S, Nandakumar N, Palanisamy D, Sreenarayanan VV. Naturally ventilated polyhouse for vegetable cultivation. South Indian Horticulture. 2001; 49:345-346.
11. Kumar S. Response of hybrid tomato (*Lycopersicon esculentum* Mill.) to plant geometry and training on growth, yield and quality. M.Sc, Thesis, RAU, Bihar, 2001.