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EFFECT OF PLANT SPACING AND PRUNING ON GROWTH AND YIELD OF CHERRY TOMATOES UNDER POLYHOUSE CONDITIONS IN KASHMIR

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ABSTRACT

An experiment was conducted at the Division of Vegetable Science, SKUAST- Kashmir to investigate the role of plant spacing and pruning in plant growth and yield of two cherry tomatoes. Data revealed that NS-6667 resulted in higher no. of fruits (484.41/plant) and fruit length (3.19cm) coupled with lower fruit TSS (6.58^{O}Brix) and AA (26.60.78mg/100g) contents compared to Solan red round. Closer plant density resulted in taller plant (466.89cm) associated with lesser no. of fruits (429.75/plant) and fruit yield (2.72kg/plant). Removal of branches (18.66!2.00) caused an increase no. of fruits (407!522/plant), fruit weight (6.0!6.85g) as well as fruit yield (2.41!3.59kg/plant) and decline of fruit TSS (8.27!7.38^{O}Brix). Possible interactions of various factors also verified that NS-6667 under wider spacing and pruning ($V_1 \times S_2 \times P_2$) produced maximum no. of fruits (596.33/plant) with greater fruit size (3.48 × 2.26cm), weight (7.28g) and yield (4.35kg/plant). Finally, for obtaining better yield of cherry tomato in Kashmir valley cultivation of NS-6667 should be practiced under polyhouse condition with a plant spacing of 100 × 60cm with only two branches supported with stacks.

INTRODUCTION

Cherry tomatoes (*Solanum lycopersicum* var. cerasiforme) are small (1.5 – 3.5cm dia.), round to oblong-shaped fruits of the same Solanaceae family grown commonly under polyhouse conditions. Although often associated with tossed green salads, cherry tomatoes have a variety of culinary uses and becoming popular in the retail chains and marketed at premium price chiefly due to the recognition of their high quality and good taste (Kobryn and Hallmann, 2005; Rosales *et al*., 2011). However, the area under cherry tomato is currently negligible in the country primarily due to the lack of suitable cultivation technique. Being an indeterminate crop, cherry tomato requires highly intensive management and improved production technology. Plant spacing and stem pruning are the most important factors influencing yield and quality (Amundson *et al*., 2012). Optimum plant spacing may help in efficient utilization of land and solar radiation (PAR) for obtaining good quality of fruits and yield (Charlo *et al*., 2007; Ara *et al*., 2007; Amundson *et al*., 2012; Mantur *et al*., 2014). On the other hand, stem pruning influences the quality and productivity of fruits by influencing the light utilization pattern as well as source-sink balance (Cockshull *et al*., 2001; Franco *et al*., 2009; Kumar *et al*., 2014). Productivity and marketable yield of tomato were increased by pruning of indeterminate tomatoes to two stems rather than one stem (Ara *et al*., 2007; Franco *et al*., 2009). However, pruning needs differ depending on the growth habit of the cultivar. Yield and quality of cherry tomatoes are also influenced by the genotypes (Mantur *et al*., 2014). Keeping the facts in mind, the present study was undertaken to investigate the effect of shoot pruning and plant spacing on plant growth, yield and quality of cherry tomatoes under Kashmir conditions.

MATERIALS AND METHODS

The present investigation was carried out under polyhouse at experimental farm, Division of Vegetable Science, SKUAST-Kashmir during three consecutive years (2011 – 2013). The experiment was laid out in randomised block design (RBD) with three replications of eight treatments. The treatments included two varieties *viz* NS-6667 (V_1) and Solan red round (V_2), two spacing *viz* 100 × 45cm (S_1) and 100 × 60cm (S_2) and two pruning levels *viz*. free growth *i.e*. no pruning and no stack (P_1) and two primary branches per plant with stacking (P_2). Uniform 30-days old and seedlings of both the varieties were planted as per the spacing plan. To shape the cherry tomato plants on two lateral branches all the new side branches were pruned at 10-day intervals during the growth period and supported with stacks. Observations were recorded on plant growth (height and no. of branches), fruit yield (no. of fruits, fruit length, fruit diameter and individual fruit weight) and quality (TSS and ascorbic acid) attributes. TSS (total soluble solids) of fruits (^{o}Brix) was determined using hand refractometer

(MR32ATC Milwaukee, 0-32 ±0.2%) by putting a drop of fruit juice upon the glass of refrectometer and visualizing clear cross mark inside graduated scale of refractometer. AA (ascorbic acid) content (mg/100g) was estimated by using the 2, 6-dichloroindophenol titrimetric method as described by AOAC (2006). Data obtained for all the three years were averaged and analyses (ANOVA) was performed to find out the significance of variation among the treatments while the significant difference between mean treatments was separated using least significance difference at 5% level of probability according to Snedecor and Cochran (1982).

RESULTS AND DISCUSSION

Effect of individual treatments

Analysis of variance of all the characters (Table 1) revealed that two varieties of cherry tomato differed significantly in terms of no. of fruit per plant, fruit size (length × diameter), fruit TSS and fruit ascorbic acid contents. Data clearly indicate that NS-6667 (V_1) had higher fruit number (484.41/plant) and size (3.19 × 2.17cm) but lower fruit TSS (6.58 °Brix) and ascorbic acid (26.60mg/100g) contents as compared to lesser no. of fruits (444.25/plant) and fruit size (2.38 × 2.51cm) with higher values of TSS (9.07°Brix) and ascorbic acid (39.78mg/100g) contents in Solan red round (V_2) cherry tomato. Differences in individual fruit weight, no. of fruits, fruit yield and fruit TSS content among different varieties of cherry tomato have also been reported by Mantur *et al*. (2014) which can be attributed to the genetic makeup of varieties that primarily dictate the characters and do not influenced by the environment (Meena and Bahadur, 2014). Comparison of two plant densities clarified that wider spacing (S_2) consequenced in smaller plant height (414.11cm) but increased no. of fruits (498.91) and fruit yield (3.28kg) per plant as compared to closer plant spacing (S_1) which provided the grounds for taller plant height (466.89cm) with reduced no. of fruits (429.75) and fruit yield (2.72kg) per plant. An increased growth and yield attributes of individual plant under wider spacing have also been reported by earlier workers (Charlo *et al*., 2007; Mantur *et al*., 2014; Kumari *et al*., 2015). Wider plant spacing might helped in efficient utilization of soil nutrients and solar radiation (PAR) that has resulted in good quality of fruits and yield (Campillo *et al*., 2012; Klaring and Krumbein, 2013). Data on removal of branches (pruning) and stacking explained that two-stem pruning and stacking (P_2) resulted in greater no. of fruits (521.83/plant), individual fruit weight (6.85g) and fruit yield both in terms of kg/plat (3.59) as well as q/h (687.49) against the lesser no. of fruits (406.83/plant), individual fruit weight (6.00g) and fruit yield (2.41kg/plant or 466.34q/h) in non-pruned (P_1) plants. These results could be attributed to the high assimilate supply associated with the good light penetration and distribution into the canopy of pruned plants (Ambroszczyk *et al*., 2008) and also to a balance of source-sink ratio (Franco *et al*., 2009). The result was in agreement with the findings of those (Ara *et al*., 2007; Franco *et al*., 2009; Abdel-Razzak, *et al*., 2013). However, Snyder (2007) reported

Table 1: Individual effects of plant spacing and pruning treatments on growth and yield parameters of cherry tomato cultivars under polyhouse condition

Treatment	Plant height (cm)	No. of branches /plant	No. of fruits /plant	Fruit length (cm)	Fruit width (cm)	Individual Fruit weight (g)	Yield (kg/ plant)	Yield (qt/ha)	TSS (°Brix)	Ascorbic acid (mg/100g)
Variety										
NS-6667 (V_1)	447.72	10	484.41	3.19	2.17	6.55	3.2	615.35	6.58	26.6
Solan Red Round (V_2)	440.47	10.66	444.25	2.38	2.51	6.3	2.8	538.48	9.07	39.78
CD (0.05P)	NS	NS	29.51	0.62	NS	NS	NS	NS	1.13	10.22
Plant Density										
100 x 45cm (S_1)	466.89	10	429.75	2.81	2.34	6.34	2.72	606.19	7.49	32.2
100 x 60cm (S_2)	414.11	10.66	498.91	2.77	2.34	6.5	3.28	547.64	7.85	34.18
CD (0.05P)	25.06	NS	10.37	NS	NS	NS	0.51	NS	NS	NS
Stem Pruning										
No pruning (free growth) (P_1)	444.91	18.66	406.83	2.75	2.34	6	2.41	466.34	8.27	32.67
Two stem pruning +staking (P_2)	443.27	2	521.83	2.83	2.35	6.85	3.59	687.49	7.38	33.72
CD (0.05P)	NS	3.68	42.98	NS	NS	0.79	0.5	110.25	0.81	NS

Table 2: Interaction effects of plant spacing and pruning treatments on growth and yield parameters of cherry tomato cultivars under polyhouse condition

Treatment combinations	Plant height(cm)	No. of branches /plant	No. of fruits /plant	Fruit length (cm)	Fruit width (cm)	Individual Fruit weight(g)	Yield (kg/plant)	Yield (qt/ha)	TSS (°Brix)	Ascorbic acid (mg/100g
$V_1 \times S_1 \times P_1$	415.11	17.00	439.00	3.22	2.15	5.36	2.33	517.72	7.00	23.80
$V_1 \times S_1 \times P_2$	500.67	2.00	494.00	3.04	2.01	7.02	3.47	771.75	6.00	29.17
$V_1 \times S_2 \times P_1$	432.22	19.00	408.33	3.03	2.26	6.55	2.68	446.86	7.57	28.00
$V_1 \times S_2 \times P_2$	442.89	2.00	596.33	3.48	2.26	7.29	4.35	725.07	5.77	25.43
$V_2 \times S_1 \times P_1$	487.67	19.00	337.00	2.53	2.61	6.62	2.23	496.45	9.47	38.03
$V_2 \times S_1 \times P_2$	464.11	2.00	449.00	2.44	2.59	6.37	2.87	638.86	8.77	37.8
$V_2 \times S_2 \times P_1$	444.67	19.67	443.00	2.21	2.32	5.48	2.43	404.35	9.07	40.83
$V_2 \times S_2 \times P_2$	365.44	2.00	548.00	2.35	2.53	6.73	3.69	614.29	9.00	42.47
CD (0.05P)	92.58	4.52	31.42	0.41	0.34	1.12	0.59	123.96	1.45	13.01

that indeterminate greenhouse tomato plants pruned to one stem (by removing all side shoots) was better as compared to un-pruned plants. Further, Azevedo *et al*. (2010) reported that the 'free growth' treatment yielded similarly to the two branches per plant treatment. These findings support the view that pruning needs differ depending on the growth habit of the cultivar.

Effect of interaction treatments

Results with regard to effect of interaction of various factors on growth yield and quality of cherry tomato (Table 2) specified that all the parameters were influenced significantly due to the fusion of various treatment factors. Perusal of the data exposed that $V_1 \times S_1 \times P_2$ resulted in highest plant height (500.67cm) followed by $V_2 \times S_1 \times P_1$ (487.67cm) and $V_2 \times S_1 \times P_2$ (464.11cm) against the minimum plant height (365.44cm) in $V_2 \times S_2 \times P_2$. No. of branches also differed significantly among non-pruned plants due to varietal as well as spacing effects and $V_2 \times S_2 \times P_1$ recorded highest no. of branches (19.67/ plant) in opposed to least no. of branches (17.00/plant) in $V_1 \times S_1 \times P_1$. So far as treatment combination $V_1 \times S_2 \times P_2$ is concerned, it had recorded highest no. of fruits (596.33/plant), individual fruit weight (7.29g) as well as fruit yield (4.35) in terms of kg/plant followed in descending order by $V_2 \times S_2 \times P_2$ which produced 596.33 no. of fruits/plant with individual fruit weight of 6.73g and fruit yield of 3.69kg/plant. However, the highest fruit yield in terms of q/h (771.75) was recorded with $V_1 \times S_1 \times P_2$ combination that was at par (725.07q/h) with $V_1 \times S_2 \times P_2$ followed by $V_2 \times S_1 \times P_2$ (638.86q/h) and $V_2 \times S_2 \times P_2$ (614.29q/h) against the minimum yield (404.35q/h) recorded in $V_2 \times S_2 \times P_1$ combination. Data also tell that the highest TSS (9.47°Brix) and ascorbic acid (42.47mg/100g) contents were obtained with $V_2 \times S_1 \times P_1$ and $V_2 \times S_2 \times P_2$, respectively followed by $V_2 \times S_2 \times P_1$ (TSS - 9.07°Brix; AA-40.83mg/100g) against the minimum TSS (6.00°Brix) and ascorbic acid (28.00mg/100g) contents in $V_1 \times S_1 \times P_2$ and $V_1 \times S_2 \times P_1$, respectively. The superior performance of $V_1 \times S_2 \times P_2$ followed by $V_2 \times S_2 \times T_2$ may be attributed to better light distribution and utilization pattern due to wider spacing and pruning (Ambroszczyk *et al*., 2008) and availability of more nutrients per unit of biomass (Jiang *et al*., 2013). However, the differences between $V_1 \times S_2 \times P_2$ and $V_2 \times S_2 \times T_2$ may be explained as the difference in the genetic constituent of two varieties.

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