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Effect of Training System and Fruit Load on Seed Production and Quality of Bell Pepper

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ABSTRACT

Keywords

Training system, Fruit load and Electrical conductivity of seed

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Study was conducted on effect of training system and fruit load on seed production and quality of bell pepper using cv. "Solan Bharpur" in the Department of Seed Science and Technology, Dr. Y S Parmar University of Horticulture and Forestry, Nauni, Solan (HP) during kharif season 2018. The experiment was laid out in Randomized Block Design (Factorial) in the open field and in Completely Randomized Design (Factorial) in laboratory. Three training systems (no training -Tr_1, two stem training -Tr_2, four stem training -Tr_3) and four fruit loads (retaining all fruits -FL_1, retaining ten fruits -FL_2, retaining twelve fruits -FL_3, retaining fourteen fruits -FL_4 plant^{-1}) were used with different treatment combinations. The treatment combination Tr_2FL_2 (two stem training with ten fruits plant^{-1}) proved superior in terms of ripe fruit weight (66.65g), ripe fruit length (6.56 cm), ripe fruit width (5.05 cm), number of seeds fruit^{-1} (187.77), 1000 seed weight (6.21 g), germination (96.50%), speed of germination (15.95), seed vigour index-I (1448.30), seed vigour index-II (284.77) and electrical conductivity of seeds (0.060 dSm^{-1}). Therefore, Tr_2FL_2 treatment combination can be recommended for quality seed production of bell pepper under mid hills of Himachal Pradesh.

Introduction

Bell pepper (*Capsicum annuum* L. var. *grossum* Sendt) and chilli (*Capsicum annuum* L. var. *longum*) are very important vegetable fruit crops cultivated for their edible botanical fruit. Both of these crops are members of the family Solanaceae. *Capsicum annuum* L. var. *grossum* Sendt is a native of Mexico with secondary centre of origin in Guatemala (5). Britishers introduced it in 19th Century in Shimla, Himachal Pradesh and Nilgiri hills of Tamil Nadu (7). In India, capsicum is known by the name Shimla mirch, especially in northern regions. Other names of capsicum are sweet pepper, bell pepper, bull nose or capsicum. Himachal Pradesh is a leading supplier of bell pepper fruits to the plains during summer and rainy seasons, hence good source of fetching a higher price due to off-season cultivation.

Seed is the basic input of agriculture and quality seed has been reported to improve yield by 10-20 per cent. Under Indian conditions, non availability of quality seed is the major constraint leading to low productivity. It is well said in manusmirti that "good seed on good land yields abundance produce". Green revolution in India was possible only due to quality seeds. The response of other inputs like irrigation, fertilizers depends on the quality of seed.

Two-stem training system in capsicum has been found best for most traits except, number of flowers plant^{-1} and days to first picking which were best under control i.e. on plants not trained at all (19). According to Ansari, 2012 (2) double stem training system can be recommended for commercial seed production of tomato. In bell pepper, studies by Thakur *et al.,* 2018 (21) revealed maximum fruit weight (175.91 g) and least number of days to first harvest (89.36 days), early flower initiation as well as 50 per cent flowering (52.71 days) under two shoots training level. Planting density of 45x30 cm in combination with two shoot training system can be recommended for commercial seed production of bell pepper (8). Nabi *et al.*, 2009 (14) observed that retaining 1st six fruits plant^{-1} in capsicum increased per cent seed germination, 1000-seed weight and seedling vigour indices (both I and II). Maboko *et al.*, (2012) (11) investigated that effect of plant population, flower and stem pruning of hydroponically grown peppers and concluded that quality can be effectively manipulated by plant population and stem pruning, while flower pruning had insignificant ($p<0.05$) effect.

Materials and Methods

The experiment was laid down on 1st May 2018 at Pandah Experimental Farm of the Department of Seed Science and Technology, Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan (HP) located at an altitude of 1250 m above mean sea level with latitude of 35.50^{o} N and longitude of 77.80^{o} E in the mid-hill zone of Himachal Pradesh (India). Bell pepper cv. Solan Bharpur seedlings were transplanted in a Randomized Block Design (Factorial) comprising of twelve treatment combinations replicated thrice. The seeds harvested were tested for quality parameters in laboratory using Completely Randomized Design (factorial) with the same set of treatment combinations replicated four times. Different combinations of training systems and fruit load (Tr_1FL_1-No training and all fruits retained, Tr_1FL_2-No training and 10 fruits retained plant^{-1}, Tr_1FL_3-No training and 12 fruits retained plant^{-1}, Tr_1FL_4-No training and 14 fruits retained plant^{-1}, Tr_2FL_1-Two shoot training and all fruits, Tr_2FL_2-Two shoot training and 10 fruits retained plant^{-1}, Tr_2FL_3-Two shoot training and 12 fruits retained plant^{-1}, Tr_2FL_4-Two shoot training and 14 fruits retained plant^{-1}, Tr_3FL_1-Four shoot training and all fruits, Tr_3FL_2-Four shoot training and 10 fruits retained plant^{-1}, Tr_3FL_3-Four shoot training and 12 fruits retained plant^{-1}, Tr_4FL_4-Four shoot training and 14 fruits retained plant^{-1}) were used in the study.

On plot basis, observations recorded were plant height (cm) taken at the end of crop season before start of leaf senescence, ripe fruit weight (g), ripe fruit length (cm), ripe fruit width (cm), harvest durations (days), seed yield plant^{-1} (g) and number of seeds fruit^{-1}, determined on freshly harvested fruits from the healthy plant. Three replications were used in each case. 1000 seed weight (g), germination percentage, speed of germination, seed vigour index-I, Seed vigour index-II and electrical conductivity (dsm^{-1}) were determined after drying the seed to moisture content of <8% as per the ISTA guidelines (3). In case of laboratory experiment, 400 seeds in the form of four replications were used for each treatment. Germination was calculated by using the formula:

$$\text{Germination (\%)} = \frac{\text{Number of normal seedlings}}{\text{Total number of seeds used}} \times 100$$

Speed of germination was calculated as:

$$\text{Speed of Germination} = \frac{X_1}{Y_1} + \frac{X_2 - X_1}{Y_2} + \dots\dots\dots \frac{X_n - X_{n-1}}{Y_n}$$

where, X_1, X_2 and X_n are number of seeds germinated on first, second and n^{th} day, respectively and Y_1, Y_2 and Y_n are number of days from sowing to first, second and n^{th} count, respectively. Speed of germination was measured by using top of the paper method.

Seedling vigour index-I was calculated as per the formula given by Abdul-Baki and Anderson (1973) (1) as:

Seedling vigour index-I = Germination (%) × Seedling length (cm)

Seedling vigour index-II was calculated as per the formula given by Abdul-Baki and Anderson (1973) (1) as:

Seedling vigour index-II = Germination (%) x Seedling dry weight (mg)

Statistical analysis was done as per experimental design suggested by Panse and Sukhatme, 2000 (17).

Results and Discussion

Fruit and seed yield parameters

The data pertaining to the effect of training systems and fruit load on fruit and seed yield parameters have been presented in Tables1 and 2. Significantly maximum plant height (63.99 cm) recorded in Tr_2 (two stem training system) might be due to the reason that removal of branches enhanced the apical dominance with great competition for space and light that forced the plants to grow taller. The lowest plant height (51.15 cm) recorded in Tr_3 (four stem training system) was statistically at par with Tr_1 (no training). These findings are in line with Udit and Girish, 2014 (22) and Singh and Kaur, 2017 (18) in bell pepper. Effects of fruit load and interaction were found to be non-significant. Highest significant ripe fruit weight (59.04 g) was obtained in Tr_2 (two stem training system) and Tr_1 (no training) resulted in lowest fruit weight (52.26 g). The reason for maximum fruit weight could be that pruning treatment resulted in increased fruit weight owing to more production of photosynthates due to better interception of solar radiation resulting in adequate supply of metabolites to limited number of fruits. These findings match with the work done by Shukla *et al.*, 2011 (19) in bell pepper. With regard to fruit load, significantly maximum fruit weight (62.47 g) was obtained in FL_2 (ten fruits plant^{-1}) and lowest fruit weight (48.62 g) was obtained in FL_1 (retaining of all fruits). These results are in line with the findings of Manjunatha *et al.*, 2007 (12) in bell pepper. In case of interaction effect, significantly maximum ripe fruit weight (66.65 g) was recorded in the treatment Tr_2FL_2 (two stem training with retaining of ten fruits plant^{-1}) and Tr_1FL_1 (no training and retaining all fruits) produced minimum ripe fruit weight (46.44 g). These results are in agreement with Chen-You, 2000 (6). Training system Tr_2 (two stems plant^{-1}) resulted in significantly maximum fruit length (6.12 cm) whereas minimum (5.32 cm) was recorded in Tr_1 (no training). Similar results were observed by Lal, 2013 (8) in bell pepper. For fruit load, maximum significant value (6.05cm) was noticed in treatment FL_2 (ten fruits plant^{-1}) whereas minimum fruit length (5.45 cm) recorded in FL_4 (14 fruits plant^{-1}) was statistically at par with FL_1 (all fruits retained). These observations are in conformity with Bhatt and Srinivasa Rao, 1997 (4) and Manjunantha *et al.*, 2007 (12) in bell pepper. For interaction effect, maximum fruit length (6.56 cm) was found in treatment combination Tr_2FL_2 whereas minimum value (5.00 cm) was recorded in Tr_1FL_1 (no training and retaining and all fruits) but with non-significant differences. The reason for maximum fruit length in Tr_2FL_2 might be due to higher source to sink ratio as in case of more sink, the accumulation of assimilates was low and it directly affected the length of fruit. Significantly maximum fruit width (4.74 cm) was observed in Tr_2 (two stem) and minimum (4.15cm) obtained in Tr_1 (no training) was statistically at par with Tr_3 (four stem training). Shukla *et al.*, 2011 (19) and Lal, 2013 (8) in capsicum also recorded similar observations. Maximum fruit width (4.61 cm) was attained in FL_2 (retaining of ten fruits plant^{-1}) (Manjunantha *et al.*, 2007) (12) whereas minimum (4.18 cm) was recorded in FL_4 (retaining of 14 fruits plant^{-1}) with non-significant differences with FL_1 (all fruits plant^{-1}) and FL_3 (retaining of twelve fruits plant^{-1}).

Table.1 Effect of training system and fruit load on seed on different fruit parameters

Particulars	Characters			
	Plant Height (cm)	Ripe fruit weight (g)	Ripe fruit length (cm)	Ripe fruit width (cm)
Main Effect (Training systems)				
Tr_1	52.97	52.26	5.32	**4.15**
Tr_2	63.99	59.04	6.12	**4.74**
Tr_3	51.15	54.74	5.63	**4.22**
CD at 5%	**8.71**	**0.96**	**0.21**	**0.17**
Main Effect (Fruit load)				
FL_1	55.91	48.62	5.51	**4.32**
FL_2	58.28	62.47	6.05	**4.61**
FL_3	56.07	57.31	5.76	**4.37**
FL_4	53.91	52.98	5.45	**4.18**
CD at 5%	**NS**	**1.10**	**0.24**	**0.19**
Interaction (Training system x Fruit load)				
Tr_1FL_1	52.90	46.44	5.00	**3.77**
Tr_1FL_2	51.66	57.23	5.61	**4.57**
Tr_1FL_3	48.05	53.80	5.45	**4.25**
Tr_1FL_4	59.29	51.57	5.24	**4.02**
Tr_2FL_1	66.99	50.89	5.97	**4.81**
Tr_2FL_2	67.53	66.65	6.56	**5.05**
Tr_2FL_3	60.89	62.62	6.22	**4.75**
Tr_2FL_4	60.59	56.02	5.77	**4.36**
Tr_3FL_1	47.84	48.55	5.58	**4.40**
Tr_3FL_2	55.65	63.53	5.99	**4.22**
Tr_3FL_3	59.27	55.51	5.60	**4.11**
Tr_3FL_4	41.85	51.36	5.36	**4.16**
CD at 5%	**NS**	**1.91**	**NS**	**0.34**

Table.2 Effect of training system and fruit load on harvest duration and seed yield parameters

Particulars	Characters		
	Harvest duration (days)	Seed yield plant^{-1} (g)	Number of seeds fruit^{-1}
Main Effect (Training systems)			
Tr_1	81.92	8.78	**159.62**
Tr_2	78.25	8.67	**172.22**
Tr_3	78.42	8.24	**164.38**
CD at 5%	**2.73**	**0.45**	**3.33**
Main Effect (Fruit load)			
FL_1	82.44	9.16	**158.81**
FL_2	76.89	8.43	**174.51**
FL_3	79.22	8.27	**166.52**
FL_4	79.56	8.40	**161.79**
CD at 5%	**3.15**	**0.52**	**3.84**
Interaction (Training system x Fruit load)			
Tr_1FL_1	85.00	10.34	**154.03**
Tr_1FL_2	78.66	8.26	**165.43**
Tr_1FL_3	81.32	8.21	**161.20**
Tr_1FL_4	82.68	8.34	**157.80**
Tr_2FL_1	80.30	8.40	**161.80**
Tr_2FL_2	75.67	9.16	**187.77**
Tr_2FL_3	77.69	8.52	**171.80**
Tr_2FL_4	79.32	8.58	**167.53**
Tr_3FL_1	82.00	8.73	**160.60**
Tr_3FL_2	76.31	7.88	**170.33**
Tr_3FL_3	78.64	8.07	**166.58**
Tr_3FL_4	76.67	8.27	**160.03**
CD at 5%	**NS**	**0.90**	**6.66**

Table.3 Effect of training system and fruit load on different seed parameters

Particulars	Characters		
	1000 seed weight (g)	**Germination %**	**Speed of germination**
Main Effect (Training systems)			
Tr_1	5.58	84.18 (9.23)	**9.40**
Tr_2	5.90	91.25 (9.60)	**12.31**
Tr_3	5.70	88.18 (9.43)	**10.42**
CD at 5%	0.06	0.04	**0.47**
Main Effect (Fruit load)			
FL_1	5.61	82.16 (9.12)	**9.13**
FL_2	5.86	92.16 (9.65)	**12.74**
FL_3	5.77	90.33 (9.55)	**10.81**
FL_4	5.68	86.78 (9.37)	**10.18**
CD at 5%	0.07	0.05	**0.55**
Interaction (Training system x Fruit load)			
Tr_1FL_1	5.53	81.75 (9.09)	**7.72**
Tr_1FL_2	5.63	88.00 (9.43)	**10.75**
Tr_1FL_3	5.62	85.00 (9.27)	**10.03**
Tr_1FL_4	5.54	82.00 (9.11)	**9.16**
Tr_2FL_1	5.63	82.75 (9.15)	**9.88**
Tr_2FL_2	6.21	96.50 (9.88)	**15.95**
Tr_2FL_3	6.00	94.00 (9.75)	**12.38**
Tr_2FL_4	5.78	91.75 (9.63)	**11.03**
Tr_3FL_1	5.66	82.00 (9.11)	**9.80**
Tr_3FL_2	5.73	92.00 (9.64)	**11.52**
Tr_3FL_3	5.68	92.00 (9.64)	**10.01**
Tr_3FL_4	5.70	86.75 (9.36)	**10.36**
CD at 5%	**0.12**	**0.05**	**0.95**

Table.4 Effect of training system and fruit load on different seed parameters

Particulars	Characters		
	SV-I	SV-II	Electrical conductivity (dSm^{-1})
Main Effect (Training systems)			
Tr_1	747.39	202.48	**0.123**
Tr_2	1066.05	243.90	**0.090**
Tr_3	926.45	221.54	**0.106**
CD at 5%	53.54	3.43	**0.008**
Main Effect (Fruit load)			
FL_1	757.05	187.93	**0.117**
FL_2	1112.29	257.09	**0.082**
FL_3	928.27	233.86	**0.112**
FL_4	855.57	211.67	**0.114**
CD at 5%	61.82	4.54	**0.009**
Interaction (Training system x Fruit load)			
Tr_1FL_1	664.56	173.13	**0.120**
Tr_1FL_2	823.42	231.98	**0.121**
Tr_1FL_3	774.20	208.40	**0.127**
Tr_1FL_4	727.37	196.39	**0.126**
Tr_2FL_1	846.95	199.14	**0.103**
Tr_2FL_2	1448.30	284.77	**0.060**
Tr_2FL_3	1021.56	253.79	**0.100**
Tr_2FL_4	947.38	237.90	**0.097**
Tr_3FL_1	759.64	191.52	**0.127**
Tr_3FL_2	1065.14	254.51	**0.067**
Tr_3FL_3	989.06	239.39	**0.110**
Tr_3FL_4	891.97	200.72	**0.120**
CD at 5%	**107.09**	**7.86**	**0.015**

Treatment combination Tr_2FL_2 gave significantly maximum fruit width (5.05 cm) being in conformity with Mitra *et al.*, 2014 (13), however, Tr_1FL_1 recorded minimum (3.77) which was statistically at par with Tr_1FL_4 (4.02 cm) and Tr_3FL_3 (4.11 cm). Treatment Tr_1 (no training) resulted in significantly better harvest duration (81.92 days). This is in conformity with Onis *et al.*, 2001 (15). In case of fruit load, FL_1 (all fruits retained plant^{-1}) recorded maximum harvest duration (82.44 days) being statistically at par with FL_4 (fourteen fruits retained) while minimum harvest duration (76.89 days) recorded in FL_2 (ten fruits plant^{-1} retained) was statistically at par with FL_3 (twelve fruits plant^{-1}) and FL_4. This might be due to less fruits plant^{-1} and more carbohydrates stored in two stem training system. The interaction effect for harvest duration was found to be non-significant. Training system Tr_1 (no training) recorded maximum significant seed yield plant^{-1} (8.78 g) which was statistically at par with Tr_2 (8.67 g) and minimum seed yield plant^{-1} (8.24 g) obtained in Tr_3 (four stem training system) was statistically at par with Tr_2. This might be due to fact that Tr_1 had more number of branches which produced more number of fruits plant^{-1} resulting in higher seed yield. Retaining all fruits on a plant (FL_1) resulted in significantly maximum seed yield plant^{-1} (9.16 g) whereas minimum (8.27 g) recorded in FL_3 (twelve fruits plant^{-1}) was statistically at par with FL_2 (8.43 g) and FL_4 (8.40 g). Treatment combination Tr_1FL_1 showed significantly maximum seed yield plant^{-1} (10.34 g) and minimum (7.88 g) observed in Tr_3FL_2 was statistically at par with Tr_2FL_1, Tr_3FL_3, Tr_1FL_2, Tr_1FL_3, Tr_2FL_3, Tr_3FL_1, Tr_1FL_4, Tr_2FL_4 and Tr_3FL_4. Significantly maximum number of seeds fruit^{-1} (172.22) observed in Tr_2 is in line with Osman and George, 1984 (16) and the minimum (159.62) was noticed in case of Tr_1 (no training). Significantly highest seed number (174.51) was found in FL_2 (ten fruits retained plant^{-1}) being in conformity with Manjunantha *et al.*, 2007 (12) in bell pepper. Minimum seed number (158.81) was observed in FL_1 (all fruits retained), being statistically at par with FL_4 (161.79).

In case of interaction, significantly maximum number of seeds fruit^{-1} in Tr_2FL_2 (187.77) might be due to large size of fruit with reduced sink load. Tr_1FL_1 resulted in minimum number of seeds fruit^{-1} (154.03), which was statistically at par with Tr_1FL_4 (157.80), Tr_3FL_1 (160.60) and Tr_3FL_4 (160.03).

Seed quality parameters

The data pertaining to the effect of training system and fruit load on different seed quality parameters have been presented in Tables 3 and 4. Training system Tr_2 (two stem training system) recorded significantly highest 1000 seed weight (5.90 g) whereas training Tr_1 (no training) resulted in the lowest 1000 seed weight (5.58 g). These studies are in agreement with and Lal *et al.,* 2016 (9) in capsicum. For fruit load, significantly maximum 1000 seed weight (5.86 g) was observed in FL_2 (ten fruits plant^{-1} retained) and minimum 1000 seed weight (5.61 g) recorded in FL_1 (retaining all fruits plant^{-1}) was statistically at par with FL_4 (5.68). This might be due to the fact that removal of flowers from bell pepper increased the concentrations of stored carbohydrates in stems making them available to developing seeds. Significantly maximum 1000 seed weight (6.21 g) was noticed inTr_2FL_2 whereas minimum 1000 seed weight (5.53 g) obtained in Tr_1FL_1 was statistically at par with Tr_1FL_2, Tr_1FL_3, Tr_1FL_4 and Tr_2FL_1. Tr_2 (two stem training system) resulted significantly higher germination (91.25 %) being in line with Ansari, 2012 (2) in tomato and Lal, 2013 (8) in bell pepper, however, Tr_1 (no training) lead to minimum germination (84.18 %). This might be due to more partitioning of carbohydrates to different stems. FL_2 (ten fruits plant^{-1}) recorded maximum seed germination (92.16 %) and FL_1 (all fruits) had minimum seed germination (82.16 %) (14). Significantly higher germination (96.50 %) noticed in Tr_2FL_2 might be due to less branches and fruits that lead to more photosynthates availability to developing fruits and seeds which can be correlated to higher seed germination. Minimum germination (81.75 %) observed in Tr_1FL_1 was statistically at par with Tr_1FL_4, Tr_2FL_1 and Tr_3FL_1. Training system Tr_2 (two stem) recorded significantly maximum speed of germination (12.31) while minimum speed of germination (9.40) was obtained in Tr_1 (no training). This is because of its correlation with high germination in two stem training system. As far as fruit load is concerned, FL_2 (ten fruits plant^{-1}) showed significantly maximum speed of germination (12.74) (20) and FL_1 (all fruits retained plant^{-1}) had minimum speed of germination (9.13).

Among the interactions, treatment combination Tr_2FL_2 produced significantly maximum speed of germination (15.95), however, Tr_1FL_1 resulted in minimum speed of germination (7.72). Significantly maximum seed vigour index-I (1066.05) was obtained in Tr_2 (two stem) whereas minimum (747.39) was observed in Tr_1 (no training). Maximum SVI-I in Tr_2 could be due to the fact that two stems plant^{-1} had less number of fruits and there was less competition among the fruits for photosynthates, thereby resulting in bigger sized fruits with bolder seeds (8). In case of fruit load, maximum SVI-I (1112.9) was recorded in FL_2 (ten fruits plant^{-1}) whereas the minimum SVI-I (757.05) was obtained in FL_1 (all fruits retained). Amongst interactions, Tr_2FL_2 resulted in significantly maximum SVI-I (1448.30) while minimum SVI-I (664.56) observed in Tr_1FL_1 had statistical similarity with Tr_1FL_4 and Tr_3FL_1. Seed vigour index-II was significantly maximum (243.90) in Tr_2 (two stem training system) and minimum (202.48) in Tr_1 (no training).

For fruit load, significantly maximum SVI-II (257.09) was found in FL_2 (ten fruits plant^{-1}) and minimum (187.93) was observed in FL_1 (all fruits plant^{-1}). Interaction Tr_2FL_2 recorded significantly maximum SVI-II (284.77) and minimum (173.13) was obtained in Tr_1FL_1. Two stem training system (Tr_2) registered significantly minimum EC (0.090 dSm^{-1}) whereas in case of Tr_1 (no training at all), it was maximum EC (0.123 dSm^{-1}). This might be due to more partitioning of photosynthates in case of no training. On the other hand, fruit load FL_2 (ten fruits) recorded significantly minimum EC (0.082 dSm^{-1}) which has conformity with Vasudevan *et al.*, 2008 (23) in methi and Lakshmi *et al.*, 2015 (10) in fenugreek. Fruit load FL_1 (all fruits) had maximum EC (0.117 dSm^{-1}) being statistically at par with FL_4 and FL_3. Interaction Tr_2FL_2 had minimum EC (0.060 dSm^{-1}) of seed being statistically at par with Tr_3FL_2. This might be due to effective translocation of phtotosythates from source to sink which is evident from high seed weight, high germination (%), high dry weight and more seed vigour index. The maximum EC (0.127 dS m^{-1}) observed in case of Tr_1FL_3 (no training and twelve fruits plant^{-1}) and $Tr_3FL_1$was statistically at par with, Tr_1FL_4, Tr_1FL_2, Tr_1FL_1 and Tr_3FL_4.

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References

1.Abdul-Baki AA & Anderson JD.1973. Vigour determination in soyabean seed by multiple criteria. Crop Science 13:630-633.

2.Ansari G. 2012. *Studies on effect of planting density and training system on seed production in tomato (Solanum lycopersicum L.).* M.Sc. Thesis, Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan. 68p.

3.Anonymous.1985. ISTA (International Seed Testing Association). International rules for seed testing. *Seed Science and Technology* 13:300-520.

4.Bhatt RM and Srinivasa Rao NK. 1997. Growth and photosynthesis in bell pepper as affected by sink manipulation. *Biologia Plantarum* 39:437-439.

5.Bukasov SM. 1930. The cultivated plants of Mexico, Guatemala and Columbia. *Bulletin of Applied Botanical Genetics and Plant Breeding Supplement* 47:261-273.

6.Chen-YouYuan. 2000. Effects of different training methods on yield and quality of some netted melon varieties in soilless culture. *Acta Agriculturae Shanghai* 16:60-64.

7.Greenleaf WH. 1986. Pepper Breeding. In: *Breeding Vegetable Crops*. (MJ Bassett ed.), AVI, West port. pp. 67-134.

8.Lal M. 2013. *Studies on planting density and* *training on seed production of bell pepper (capsicum annuum L.) under protected conditions.* M.Sc. Thesis, Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan. 74p.

9.Lal M, Kanwar HS, Kanwar R and Negi C. 2016. Effect of planting density and training on plant health and seed quality of bell pepper (*Capsicum annuum* L.) under protected conditions. *Journal of Applied and Natural Science* 8:1219-1222.

10.Lakshmi J, Gowada R, Parashivmurty M, Narayanaswamy S and Shivanandam. 2015. Influence of pre flowering pinching and maleic hydrazide spray on plant growth, seed yield and quality attributes in fenugreek. *Legume Research-An International Journal* 38: 353-357.

11.Maboko MM, Du Plooy CP and Chiloane S. 2011. Effect of plant population, fruit and stem pruning on yield and quality of hydroponically grown tomato. *African Journal of Agricultural Research* 6:5144-5148.

12.Manjunatha KC, Yogeesha HS, Rame G, Prasanna KPR. 2007. Influence of fruit load on seed yield and quality in bell pepper (*Capsicum annuum* L.). *Seed-Research* 35:238-239.

13.Mitra S, Sarker K, Alam MS, Islam S and Rabbani MG. 2014. Effects of stem pruning and fruit thinning on yield components and yield of tomato. *Bangladesh Journal of Progressive Science and Technology* 12:101-104. O

14.Nabi A, Sharma SK, Shukla YR. 2009. Effect of fruit load on seed yield and quality of okra. *Annals of Biology* 25:147-149.

15.Onis A, Lopez Camelo A and Gomez P. 2001. Effect of pruning to two and four branches on bell peppers production in a non heated greenhouse. *Revista de la Facultey de Agrnomia Universidad de Buenos Aires* 21:5-11.

16.Osman OA and George RAT. 1984. The effect of mineral nutrition and fruit position on seed yield and quality in sweet pepper (*Capsicum annuum* L.). *Acta Horticulturae* 143:133-141.

17.Panse VG and Sukhatme PV. 2000. Statistical Methods for Agricultural Workers. ICAR, New Delhi 345p.

18.Singh I and Kaur A. 2017. Effect of pruning systems on growth and yield traits of greenhouse grown bell pepper (*Capsicum annuum* L. var. *grossum*). *Indian Journal of Agricultural Research* 52:414-418.

19.Shukla YR, Sharma D and Upasna T. 2011. Studies on training systems and NAA application on bell pepper production in polyhouse. *Journal of Horticultural Science* 6:59-61.

20.Tabasi A, Nemati H, Tehranifar A and Akbari M. 2011. The effects of shrub pruning and fruit thinning on seed germination and seedling of tomato in the next generation *(Lycopersicon esculentum* Mill*). Journal of Biological and Environment Science* 5:105-110.

21.Thakur G, Singh AK, Patel P, Maurya PK and Kumar U. 2018. Effect of training level on growth and yield of capsicum (*Capsicum annuum* L) hybrid buffalo under natural ventilated polyhouse. *Journal of Pharmacognosy and Phytochemistry* SP1:82-85.

22.Udish K and Girish C. 2014. Effect of spacing and training level on growth and yield of capsicum under polyhouse in North-Bihar condition. *Journal of Hill Agriculture* 5:9-12.

23.Vasudevan SN, Sudarshan JS, Kurdikeri MB and Dharmatti PR. 2008. Influence of pinching of apical bud and chemical sprays on seed yield and quality of fenugreek. *Karnataka Journal of Agricultural Sciences* 21:26-29.

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