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Effect of spacing and training levels on growth and reproductive parameters of capsicum (*Capsicum annum* L.) variety Indra grown under polyhouse

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Abstract

An experiment was carried out to study the effect of spacing and training on growth and reproductive parameters of capsicum (*Capsicum annum* L.) variety Indra under polyhouse. The experiment comprised of three levels of spacing and three levels of training with Factorial Randomized Block Design (FRBD). The experimental results revealed that maximum leaf area (54.63 cm²) was recorded with closer spacing. Wider spacing S₃ (60 x 60 cm) was recorded highest plant height (83.07 cm), number of leaves (95.61), minimum days taken for flower initiation (32.11), minimum days taken for 50 percent flowering (46.22), maximum number of flowers (18.86) and number of fruits (16.50), minimum days taken for fruit set (36.77), maximum percent fruit set (83.53), minimum days for first harvest (48.11). Among the different training levels T₁ (two shoots) training recorded highest plant height (85.01 cm), minimum days for flower initiation (37.05), minimum days for 50 percent flowering (51.13), fruit set (41.76) and days for first harvesting (53.20). T₂ (three shoots) training recorded maximum leaf area (51.54 cm²). Maximum number of leaves (103.28), number of flowers (17.63), number of fruits (15.32) and percent fruit set (85.00) was recorded with T₃ (four shoots) training. Among all interactions S₁T₂ (60 x 30 cm and three shoot) training recorded highest leaf area (61.10 cm²). In contrast, wider spacing with two shoots training S₃T₁ (60 x 60 cm and two shoot) recorded highest plant height (87.43 cm), minimum days for flower initiation (24.66), days taken for 50 percent flowering (36.66) and days taken for fruit set (29.00) and days for first harvesting (40.66). Interaction of S₃T₃ (60 x 60 cm and four shoot) recorded maximum number of leaves (118.80), number of flowers (23.33), number of fruits (20.50) and percent fruit set (87.89).

Keywords: Spacing, training, capsicum, polyhouse, Indra

Introduction

Bell pepper (*Capsicum annum* L.) belongs to the family solanaceae under the genus capsicum. Bell pepper and chilli are native to Tropical South America. Five domesticated species are recognized: *Capsicum annum*, *C. frutescens*, *C. chinense*, *C. baccatum* and *C. pubescens*. The *annum* species includes eleven group which can be divided into two sub group Sweet and Hot peppers. The sweet pepper is relatively non pungent with thick flesh and it is the world's second most important vegetable after tomato. Capsicum, also known as sweet pepper, bell pepper or shimla mirch is one of the popular vegetables grown throughout India.

In green house cultivation main emphasis is given on appropriate cultural practices such as plant densities and training system in order to enhance the production per unit area by utilizing the available space and utilization of the resources. An appropriate training system will not only facilitate better management and uniform light to plants but also permit closer planting, early ripening of fruits, higher yield. Training system varies with different growth habits and plant densities. In India the use of agro-techniques has not been done yet on large scale for the production of capsicum under protected cultivation. Keeping in view the above facts the present investigation were planned to find out suitable plant spacing and optimum training level for production of capsicum under polyhouse condition.

Materials and Methods

To assess effect of spacing and training on growth and reproductive parameters of capsicum grown under polyhouse. An experiment was laid out at Department of Horticulture, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani during the year 2016-2017. The size of polyhouse was 28 m x 20 m (560 m²). The experiment was comprised of three levels of spacing i.e., 60 x 30 cm (S₁), 60 x 45 cm (S₂), 60 x 60 cm (S₃) and three levels of training Viz,

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two shoots (T₁), three shoots (T₂), four shoots (T₃). 40 days old seedlings at 4-5 leaf stage were transplanted at 60 x 30 cm, 60 x 45 cm, 60 x 60 cm according to different treatment combinations. All the management practices including hoeing; weeding and other horticultural operation were performed. The observation on plant height (cm), number of leaves, leaf area (cm²), days taken for flower initiation, number of flowers, days taken for 50 percent flowering, days taken for fruit set, number of fruits, percent fruit set, days taken for first harvest.

The plant height was measured in centimeter from ground level to extreme growing tip of the main stem with the help of meter scale at the time of final harvest. Total number of leaves per plant was counted at the stage of final harvesting. Leaf area was measured at final harvesting time using portable leaf area meter and expressed in sq.cm. Number of days taken for first flower appearance in each treatment was recorded from the date of transplanting. The days from date of transplanting to 50 percent of total plant population initiate flowering for each treatment was recorded as days taken for 50 percent flowering. Number of flowers that bloomed were recorded at regular intervals from commencement of flowering to final harvest and total number of flowers per plant was recorded from five randomly selected plants from each treatment. Number of days taken from the date of transplanting for the first fruit set appearance were counted and recorded. The number of set fruit from tagged plants were recorded from 60, 90, 120, 150, 180 days after transplanting. Days to first harvest was calculated from the date of sowing to the date of the attainment of edible fruit maturity stage. The difference of the amount of flower produced and number of fruit set was counted and accordingly percentage of fruit set was calculated.

Results and Discussion

Data (Table -1) revealed that maximum leaf area (54.63 cm²) was recorded at closer spacing i.e, treatment S₁ (60 x 30 cm) that might be due to increase in plant population, reduced PAR at fruiting level. These findings were in conformity with the work of Dasgan and Abak (2003) ^[6] in capsicum. Maximum plant height (83.07 cm) was recorded with wider spacing treatment S₃ (60 x 60 cm) these findings were in conformity with Aminifard *et al.* (2012) ^[3], maximum number of leaves (95.61), minimum days taken for flower initiation (32.11), maximum number of flowers per plant (18.86), maximum number of fruits (16.50) and minimum days for first harvesting (48.11) were recorded with wider spacing treatment S₃ (60 x 60 cm). This may be due to availability of more space where in plant were able to exploit more nutrients from the soil and light source favouring fast growth under polyhouse condition. These findings are in similar with the findings of Kumar and Chandra (2014) ^[8]. Minimum days

taken for 50 percent flowering (46.22), minimum days taken for fruit set (36.77), maximum percent fruit set (83.53), were recorded at widest spacing i.e, treatment S₃ (60 x 60 cm). These findings are were in conformity with the work of Kishor (2015) ^[7], Zende (2008) ^[10] and Alam *et al.* (2016) ^[2], respectively for each parameter as mentioned above. That might be due to fact that the availability of more photosynthesis and induction of early flowering which results in early fruit set and highest percent of fruit set.

Among the methods of training, maximum plant height (85.01 cm), minimum days taken for flower initiation (37.05), minimum days taken for 50 percent flowering (51.13), minimum days taken for fruit set (41.76), minimum days for first harvesting (53.20) was observed with training T₁ (two shoots). That might be due to the reason that removal of branches enhanced the apical dominance, where great competition for space and light thereby forcing the plants grow taller and early shift in vegetative to reproductive stage in training level T₁ (two shoots) and early initiation in flowering results in early fruit set and minimum days for first harvesting. The availability of more photosynthesis because of only two shoots was maintained. These findings are in similar with the work of Zende (2008) ^[10], Kumar and Chandra (2014) ^[8] and Lal *et al.* (2014) ^[9] in capsicum. While maximum number of leaves (103.28), maximum leaf area (51.54 cm²), maximum number of flowers (17.63), maximum number of fruits (15.32), maximum percent fruit set (85.00) were recorded with training T₃ (three shoots). That might be due to the fact that more number of shoots under training level T₃ than other training level. These findings were in conformity with the work of Cebula (1995) ^[5], Zande (2008) ^[10], Kumar and Chandra (2014) ^[8] and Alam *et al.* (2016) ^[2] in capsicum.

Among the treatment combinations, combination S₃T₁ (60 x 60 cm and two shoot) recorded maximum plant height (87.43 cm), minimum days taken for flower initiation (24.66), minimum days taken for 50 percent flowering (36.66), minimum days taken for fruit set (29.00), minimum days taken for first harvesting (40.66). The present results are supported by the findings of Lal *et al.* (2014) ^[9], Zende (2008) ^[10], Kumar and Chandra (2014) ^[8].

While combination S₃T₃ (60 x 60 cm and four shoots) recorded maximum number of leaves (118.80), maximum number of flowers (23.33), maximum number of fruits (20.50), maximum percent of fruit set (87.89) these results are in accordance with the findings of Zende (2008) ^[10], Kumar and Chandra (2014) ^[8] in capsicum. The treatment combination S₃T₂ (60 x 60 cm and three shoots) recorded highest leaf area (61.10 cm²) compared to other treatment combinations. The similar results were recorded by Dasgan and Abak (2003) ^[6].

Table 1: Effect of spacing and training on growth and reproductive parameters of capsicum

Particulars	Characters									
	Plant height (cm)	No. of leaves	Leaf area (cm ²)	Days for flower initiation	Days taken for 50 % flowering	Days taken for fruit set	No. of flowers	No. of fruits	Percent fruit set (%)	Days taken for first harvesting
Main effect of spacing (S)										
S ₁ (60 x 30 cm)	74.38	61.61	54.63	54.64	68.44	58.33	10.09	8.78	73.49	69.57
S ₂ (60 x 45 cm)	80.87	83.61	48.34	42.30	57.40	46.96	14.80	12.15	79.09	58.60
S ₃ (60 x 60 cm)	83.07	95.61	41.92	32.11	46.22	36.77	18.86	16.50	83.53	48.11
SE ±	0.63	1.52	0.88	1.04	1.19	0.97	0.34	0.29	1.39	0.96
CD @ 5 %	1.90	4.52	2.63	3.12	3.57	2.93	1.02	0.89	4.18	2.89
Main effect of training levels (T)										
T ₁ (two shoots)	85.01	78.17	42.93	37.05	51.13	41.76	13.25	9.79	69.04	53.20
T ₂ (three shoots)	79.65	92.39	51.54	42.27	55.13	46.98	13.75	12.32	82.07	58.37
T ₃ (four shoots)	73.65	103.28	50.42	54.64	65.80	53.32	17.63	15.32	85.00	64.71
SE ±	0.63	1.52	0.88	1.04	1.19	0.97	0.34	0.29	1.39	0.96
CD @ 5 %	1.90	4.56	2.63	3.12	3.57	2.93	1.02	0.89	4.18	2.89
Interaction effect of spacing and training (S x T)										
S ₁ T ₁	82.21	61.61	49.20	47.20	63.33	52.00	8.72	5.67	56.19	63.33
S ₁ T ₂	77.24	83.61	61.10	50.20	60.66	55.00	11.10	9.34	80.51	66.20
S ₁ T ₃	63.68	95.61	53.60	66.53	81.33	68.00	13.10	11.34	83.76	79.20
S ₂ T ₁	85.39	81.43	46.20	39.30	53.40	43.96	13.46	10.20	72.72	55.60
S ₂ T ₂	80.31	93.43	48.33	42.30	57.40	46.96	14.46	12.13	81.20	58.60
S ₂ T ₃	76.91	95.43	50.50	45.30	61.40	49.96	16.46	14.13	83.35	61.60
S ₃ T ₁	87.43	91.46	33.40	24.66	36.66	29.00	17.56	13.50	78.23	40.66
S ₃ T ₂	81.41	100.13	45.20	34.33	47.33	39.00	15.70	15.50	84.49	50.33
S ₃ T ₃	80.37	118.80	47.16	37.33	54.66	42.00	23.33	20.50	87.89	53.33
SE ±	1.09	2.63	1.52	1.80	2.06	1.69	0.59	0.51	2.41	1.67
CD @ 5 %	3.29	7.89	4.56	5.40	6.19	5.07	1.77	1.54	7.24	5.01

Conclusion

From the present investigation it can be concluded that the combination S₃T₃ (plant spaced at 60 x 60 cm and trained four shoots) performed best for the characters like number of leaves, number of flowers, number of fruits and percent fruit set which is an ultimate goal of any experiment

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