J. Hortl. Sci.
Vol. 6(1):59-61, 2011

Short communication

Studies on training systems and NAA application on bell pepper production in polyhouse

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ABSTRACT

Capsicum (*Capsicum annuum* L.) is an important off-season vegetable crops grown in the mid-hills of Himachal Pradesh. Production and productivity of this crop is low because of high flower and fruit drop. The present investigation was carried out to find out the best training system and an appropriate concentration of naphthalene acetic acid (NAA). Two-stem training system was the best for most traits except, number of flowers per plant and days to first picking which were best under control, i.e., on plants not trained at all. Two sprays of NAA @ 15 ppm proved best for plant height, total number of flowers per plant, per cent flower drop, per cent fruit set, days to first picking, number of fruits per plant, fruit weight and total yield per plant.

Key words: Bell pepper, training systems, NAA, yield.

Bell pepper (*Capsicum annuum* L.) popularly known as "Shimla mirch" is one of the most important vegetable crops of Himachal Pradesh. The state is a leading supplier of bell pepper fruits to the plains during summer and rainy seasons. The produce is off-season to the plains and fetches a higher price to vegetable growers. However, productivity and quality of produce is low because of the fluctuating environment during its cultivation in the open.Productivity of a crop is greatly affected by cultural and physiological factors, which are environment dependent. Auxins cause apical dominance, cell elongation by loosening of cell wall and, retard flower and fruit abscission. Extent of flower drop in capsicum is 50-95 per centdepending upon season of cultivation, soil fertility, soil moisture, and photoperiod, incidence of pest and diseases and endogenous hormonal levels. Training systems are known to open up the plant canopy which is helpful in maximizing solar interception, enhancing photosynthetic efficiency which results in increased yield. The present studies were, therefore, undertaken to study the effect of different concentrations of NAA and training systems in checking flower and fruit drop and improving yield in capsicum under polyhouse.

The present studies were carried out at the experimental research farm of Department of Vegetable Science, Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh in a naturally-ventilated polyhouse during March-September, 2008. The experimental farm is situated at Nauni, about 15 km away from Solan on the Solan-Rajgarh road, at about 30°51´ N latitude and 77°11´ E longitude. The elevation of the farm is 1,260 m above mean sea level, which falls under the mid-hill sub-temperate zone of Himachal Pradesh. The experiment was laid out in Factorial RBD with three replications. Three concentrations of Naphthalene Acetic Acid (N_1 - 5 ppm spray, N_2 - 10 ppm spray and N_3 - 15 ppm spray) with Control (no NAA application) were applied. NAA was applied as of two sprays, once at flower initiation and the second a month later. Three systems of training, *viz.* T_0 (No Training), T_1 (Two stem Training) and T_2 (Four stem training) were followed. Seedlings were transplanted on 6th March 2008 at a spacing of 60 x 45cm in plots of size 1.8m x 1.8m. The planting density was 37,000 plants/ha. Data were recorded on plant height, total number of flowers per plant, per cent flower-drop, per cent fruit-set, days to first picking, number of fruits per plant, fruit weight and total yield per plant. Standard cultural practices were followed to raise the crop as per the package of practices for vegetable srops developed by the University (Anonymous, 2008).

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Table 1. Effect of training systems and NAA on various horticultural traits of bell pepper

Training system	Plant height (cm)	Total number of flowers per plant	Per cent flower-drop	Per cent fruit-set	Days to first picking	Number of fruits pper lant	Fruit weight (g)	Total yield per plant (g)
T_0	136.5	28.1	62.8(51.8)*	37.9(38.0)	92.25	11.0	60.5	689.2
T_1	145.4	27.7	57.4(49.0)	42.8 (40.9)	97.50	12.2	72.2	908.1
T_2	141.4	27.7	59.4(50.3)	40.5(39.6)	95.50	11.6	66.7	794.2
NAA cocn.								
N_0	135.5	21.2	70.4(57.0)	29.5(32.9)	91.33	6.2	60.6	382.3
N_1	139.5	26.4	63.2(52.5)	36.7(37.4)	95.78	9.7	63.6	618.4
N_2	141.7	29.9	56.1(48.2)	43.8(41.7)	96.56	13.1	68.0	895.0
N_3	147.5	33.9	48.3(43.8)	51.6(46.1)	96.67	17.5	73.6	1292.9
C.D. $_{0.05}$(Training system)	6.34	NS	1.12	1.48	1.35	0.12	0.42	140
C.D. $_{0.05}$(NAA)	7.32	2.89	3.63	3.62	1.55	0.13	0.49	160

* Values in parentheses are arc sine transformed values

Data on plant height, total number of flowers per plant, per cent flower-drop, per cent fruit-set, days to first picking, number of fruits per plant, fruit weight and total yield per plant is depicted in Table1. In general, maximum values for these traits were observed when plants were trained to two stems (T_1). Training systems are known to open up the plant canopy, thus maximizing solar interception and enhancing photosynthetic activity. Apart from this, training systems also provide a convenient and efficient way for spraying and easy harvesting, besides optimizing space in the greenhouse and improving commercial quality of the fruits, resulting in increased yield (Cochran, 1933).

Plant height (145.42 cm) and number of flowers per plant (28.19) were maximum in plants trained to two stems. Flower-drop was minimum (57.14) in the two-stem training system. Fruit-set (42.86%), number of fruits per plant (12.26) and total yield per plant (908.12g) was also maximum in the two-stem training system. Those Plants trained to two stems may have increased interception of solar radiation and better air circulation, resulting in improved plant height, number of fruits and fruit yield. Vertical training system improved thickness of the fruit wall by 14%, produced more numerous and large-sized fruits and increased early and total yield of commercial fruits as observed by Salas *et al* (2003). Similar findings have also been reported by MaCraw and Greig (1986). However, minimum value for days to first picking (92.25 days) was observed in plants that were not trained at all (Control).

Maximum values for traits under study were observed when plants were sprayed with 15ppm NAA (N_3). Maximum plant height was observed in N_3 (147.56 cm). Increase in plant height due to application of auxins may be attributed to increased plasticity of the cell wall, which is a irreversible process, resulting in cell elongation. Maximum number of flowers per plant (33.93) were recorded in plants sprayed with 15ppm NAA (N_3). Auxins have been reported to increase the total number of flowers through fundamental physiological processes such as nucleic acid synthesis, accumulation of metabolites and activation of enzymes. Similar results were reported by Yamgar and Desai (1987) in chilli under Rahuri conditions. Flower-drop was found to be minimum (48.35 %) when plants were sprayed with 15ppm NAA (N_3). A possible reason may be the low auxin content of flowers which induces dissolution of the cell wall in abscission layer of the pedicel leading to flower and fruit drop. Maximum (51.65 %) fruit-set was recorded with 15ppm NAA spray. It is possible that the level of endogenous auxins was insufficient and became optimal or beneficial only after receiving an optimum NAA dose. Number of fruits was recorded to be maximum (17.51) in plants sprayed with 15ppm NAA. Higher number of fruits here may also be due to higher fruit-set, which is directly related to reduced flower-drop. Results of the present findings are in line with those of Doddamani and Panchal (1989), Rao *et al* (1990), Lata and Singh (1993), Barai and Sarkar (1999) and Sharma *et al* (1999). Maximum fruit-weight (73.67g) and maximum total yield per plant (1292.93 g) was recorded with 15ppm NAA spray. However, minimum value for days to first picking (91.33 days) was observed in plants not sprayed with NAA (Control) and maximum value (96.67 days) was recorded in plants sprayed with 15ppm NAA (N_3). The possible cause of delay in first picking may be the result of extended physiological processes, stimulated by auxins, thus activating RNA-directed protein synthesis. This may have delayed maturation of their fruits physiologically on the plant. Similar findings were reported by Verlodt (1976).

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(MS Received 21 September 2009, Revised 13 April 2011)