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Response of Growth, Flowering and Fruiting Parameters of Bell pepper cv. Indra against different Levels of Plant Growth Regulators under Protected conditions

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ABSTRACT: Olericulture is a lucrative activity because of potential profits, opportunities to farmers for better income and support for the food processing industry. The lockdown posed challenges to this sector which will have implications for the future. Thus present experiment was carried out to examine the response of growth, flowering and fruiting parameters of bell pepper cv. Indra against different levels of plant growth regulators under protected conditions at Agriculture Farm, School of Agricultural Sciences & Technology, RIMT University, Mandi Gobindgarh, Punjab, India during 2020-21 by using cultivar Indra with three replications and obtained was subjected to statistical analysis by using RBD at 5% of CD. The experimental material for the study comprised of two plant growth regulators with three concentrations (GA_3 25, 50 & 75 ppm; NAA 50, 100 & 150 ppm) and a control. Under growth parameters, highest plant height (67.27 cm) and inter-nodal distance (6.73 cm) recorded with the application of NAA @ 150 ppm while, NAA @ 150 ppm resulted greater stem diameter (3.10 cm) and more number of branches per plant (16.33) whereas, maximum leaf length (16.67 cm) and leaf width (11.60 cm) were resulted by GA_3 @ 75 ppm and GA_3 @ 50 ppm, respectively. More number of cluster per plant (6.97), flower per plant (23.80), fruits per cluster (3.50), fruit length (9.93 cm) and greater fruit diameter (6.27 cm) were resulted when the plants of bell pepper treated with NAA @ 150 ppm. Thus, plant growth regulators have quicker impact on vegetative as well as yield of the crops. As it have various advantages like less time consuming to treat the plant and environment friendly. The physiological activity of vegetable crops regulates and after the application of growth regulator finally enhances the vegetable production.

Keywords: Plant growth regulators, GA_3, NAA, Bell pepper and Indra.

INTRODUCTION

Bell pepper (*Capsicum annuum* L.) is a member of family Solanaceae, commonly known as Shimla mirch. Bell peppers are native to Mexico with centre of diversity in South America (Gonzalez and Bosland, 1991). All the cultivated as well as wild species are diploid (2n=24). The bell pepper is a fruit vegetable well known for its high content in bioactive compounds and strong antioxidant capacity. All fresh peppers are excellent sources of vitamins C, K, carotenoids, and flavonoids (Dias, 2013). It was introduced in India by the Britishers in the 19th century in Shimla hills. It is commercially grown in Himachal Pradesh, Jammu Kashmir, Uttrakhand, Arunachal Pradesh and Darjeeling hills of West Bengal during summer months and as autumn crop in Maharashtra, Karnataka, Tamil Nadu and Bihar. Capsicum was grown on an area of 46 Tha with annual production of 288 TMT in India. In Punjab, bell pepper is grown on an area of 0.51 Tha with annual production of 4.81 TMT (Jindal and Dhaliwal 2019). Gibberellic acid (GA_3) is mainly used to promote plant height, weight of shoot and root of the plant. Gibberellins are often used for promotion of fruit set in some fruit vegetable production including tomatoes and yields can increase dramatically to four times (Singh and Singh 2019). Naphthalene acetic acid (NAA) is a synthetic plant hormone which is used in plant tissue culture, promotes growth and also adds to induce root formation in various plants. NAA is widely used in horticulture for various purposes (Pundir *et al*., 2020). The beneficial effect of NAA is being attributed to an increased rate of photosynthetic activity, accelerated transport and efficiency of utilizing photosynthetic products resulting in rapid cell elongation and cell division in the meristem. Thus growth and yield of crops were increased (Sarker *et al*., 2009). Hence, keeping in view all the facts an experiment was carried out see the effect of plant growth regulators on growth, flowering and fruiting parameters of bell pepper under protected conditions.

MATERIALS AND METHODS

A field experiment entitled "Response of growth, flowering and fruiting parameters of bell pepper cv. Indra against different levels of plant growth regulators under protected conditions" was conducted at Agriculture Farm, School of Agricultural Sciences & Technology, RIMT University, Mandi Gobindgarh,

Punjab, during 2020-21. In this investigation, the cultivar Indra treated with three levels of GA_3 at 25, 50 and 75 ppm and NAA at 50, 100 and 150 ppm along with a control (distilled water) (Plate 1). The experiment was laid out in a randomized block design with three replications. Observations on various growth, flowering and fruiting parameters were recorded. Results thus obtained, were subjected to statistical analysis by the use of Microsoft excel 2016.

Plate 1. A general view of preparation and application of solution.

RESULT AND DISCUSSION

The evidence of results is cited in Table 1. At the time of harvesting, the highest plant height (67.07 cm) was recorded from T_6 (GA_3 @ 50 ppm) and it was found statistically at par with all over the treatments except T_1. The findings obtained by Anolisa *et al*. (2020) were accordance the current findings. Plant height might be increased by the application of PGRs particularly GA_3 may be due to the effect on stem elongation by rapid stem elongation and multiplication of cells. The findings of the present study are in agreement with results of (Basra *et al*., 2006). The increase in plant height might be due to the fact that, Naphthalene Acetic Acid acts as growth promoter which, increases photosynthetic activities, efficient translocation and utilization of photo synthetics which might be causing rapid cell division in growth portion of the plant or stimulation of growth (Netam and Sharma, 2014). Pylypenko *et al.* (2021) recorded same finding in this line. Treatment T_7 (NAA @ 150 ppm) resulted grater stem diameter (3.10 cm) and T_7 was also found statistically at par with all over the treatments. Increase in stem girth might be due to cell elongation, cell division in cambium stimulates the growth processes. This might be occurs due to application of auxin at the time of growth and resulted increased stem diameter. This result is in agreement with the findings of (Tapdiya *et al*., 2018). The highest length of leaf (16.67 cm) was recorded by application of T_4 (GA_3 @ 75 ppm). T_4 was statistically at par with all over the treatments except T_5 and T_6.

This might be ascribed to more efficient utilization of food for reproductive growth in number of branches, higher photosynthetic efficiency and enhanced source to sink relationship of the plant, reduced respiration, enhanced translocation and accumulation of sugars and other metabolites. Inhibition of growth performance on exposure to the other PGRs occurred (Ouzounidou *et al*., 2008). The plant growth regulator significantly effect on width of leaf. The highest width of leaf (11.60 cm) was observed due to application of T_3 (GA_3 @ 100 ppm), T_7 was statistically at par with all over the treatments except T_1, T_2 (8.33 cm) and T_4 (9.67 cm). It might be due to the fact that, increased photosynthetic metabolic activities and width of leaf in plant was increased due to application of NAA as compared to other plant growth regulators (Vandana and Varma, 2014). Treatment T_6 (NAA @ 100 ppm) produced maximum intermodal distance (6.73 cm) and it was also found statistically significant with all over the treatments except T_3. Intermodal distance increased with the application of gibberellic acid.

Table 1: Response of growth, flowering and fruiting parameters of bell pepper cv. Indra against different levels of plant growth regulators under protected conditions.

Treatments	Plant height (cm)	Stem diameter (cm)	Leaf length (cm)	Leaf width (cm)	Inter-nodal distance (cm)	Number of branches per plant	Number of cluster per plant	Number of flower per plant	Number of fruits per cluster	Fruit length (cm)	Fruit diameter (cm)
Control	50.10	2.50	10.00	8.00	4.47	10.67	4.67	12.43	2.33	5.70	3.53
GA_3 @ 25 ppm	63.13	3.07	13.33	8.33	4.97	13.00	5.63	18.57	3.33	6.53	4.23
GA_3 @ 50 ppm	64.07	2.93	13.33	11.60	5.90	13.33	5.77	20.80	2.90	7.20	4.73
GA_3 @ 75 ppm	63.83	3.07	16.67	9.67	5.40	13.67	5.53	21.04	3.20	8.57	5.23
NAA @ 50 ppm	66.17	2.77	15.67	11.00	5.60	14.33	6.17	21.93	3.17	7.07	4.67
NAA @ 100 ppm	67.27	3.03	16.33	10.33	6.73	13.33	5.40	20.23	3.20	8.80	5.07
NAA @ 150 ppm	66.20	3.10	14.00	11.33	4.53	16.33	6.97	23.80	3.50	9.93	6.27
CD at 5%	**4.64**	**0.89**	**2.33**	**1.64**	**1.00**	**2.26**	**1.10**	**2.12**	**0.67**	**0.58**	**0.61**

Application of GA_3 showed a positive effect among the different combination. The GA_3 induced increase in Intermodal distance was attributed to the role of gibberellins in increasing cell elongation and division (Erickson and Markhart, 2007). More number of branches/plant (16.33) were counted under T_7 (NAA @ 150 ppm) and which was also found statistically significant with all over the treatments except T_5. The findings of Anolisa *et al*. (2020) were accordance with the obtained results. The increase in number of branches might be due to the fact that, Naphthalene Acetic Acid acts as growth promoter which, increases photosynthetic activities, efficient translocation and utilization of photo synthetics which might be causing rapid cell division in growth portion of the plant or stimulation of growth in chilli (Chaudhary *et al*., 2006). The present findings are accordance with the results of Leelavathi *et al*. (2021). In concern with flowering characters, more number of clusters/plant (6.97) were recorded with the application of T_7 (NAA

@ 150 ppm) and it is also found statically at par all the treatments except T_5. This induction of number of cluster per plant is may be due to the fact that GA act as a "florigen" or enable the production and transport of other signals. It was also reported earlier that GA plays an important role in promotion of number of cluster per in some plants (King *et al*., 2006). Treatment T_7 (NAA @ 150 ppm) produced maximum number of flowers/plant (23.80) and which was also reported statistically significant with all over the treatments except T_5.

The increase number of flowers per plant might be due to the facts that, these hormones might be involvement in transition of vegetative apices to floral apices which would remained physiologically more active to build up sufficient food reserve for developing flower (Moniruzzaman *et al*., 2013). Treatment T_7 (NAA @ 150 ppm) was noticed with maximum number of fruits/cluster (3.50). T_7 was statically at par with all the treatments except T_1. The obtained results were also supported with the findings of Anolisa *et al*. (2020). This might be increased due to the application of 4-CPA enhance flower per cluster and fruit setting by reducing flower and fruit abscission that contributed higher number of flower per cluster per plant and fruit per plant (Chaudhary *et al*., 2006).

The highest length of fruit (9.93 cm) was recorded by application of T_7 (NAA @ 150 ppm) and T_7 is statically significant with all the treatments. The maximum fruit diameter (6.27 cm) was recorded with the treatment T_7 (NAA @ 150 ppm) and T_7 was found statically significant with all the treatments except. It might be due to plant growth regulators promote the cell wall loosening processes providing a state of extensive flexibility within the cell leading ultimately in plant growth (Prasad and Kumar 2003). Plant growth regulators have possibility to increase fruit length and diameter by promoting the cell wall loosening processes providing a state of extensive flexibility within the cell leading ultimately in plant growth (Sarkar *et al*., 2014). Leelavathi *et al*. (2021) also find same results. The present findings were accordance with the results obtained by Pylypenko *et al*. (2021) (Plate 2).

Plate 2. A general view of crop during growth, flowering and fruiting.

CONCLUSION

On the basis of present study it may be conclude that micronutrients significantly increased overall growth and development of bell pepper plant. It was found that effect of treatment T_7 (NAA @ 150 ppm) was excreted significant effect on growth, flowering and fruiting parameters of bell pepper cv Indra.

FUTURE SCOPE

Research gives the ability to form a stance on the subject and take sides and expands views about individuals related to the subject being researched. Appropriately undertaken research, in whatever field of study, will open doors of understanding and knowledge that would otherwise remain hidden from human awareness.

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Conflict of Interest. None.

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