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Impact of Some Phytohormones on Chilli cv. CH- 27 (*Capsicum annum* L.)

Jatinder Singh, Adarsh Lavane, Dipika Mal

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ABSTRACT

Background: Chilli is one of the commercial spice crops. It is widely used as universal spice and named as wonder spice. Various cultivars/varieties are grown for different uses like raw vegetable, pickles and spice condiments. But quality and quantity are main problems of the chilli cultivation which needs to addresses.

Methods: An experiment was conducted to assess the effect of phytohormones on quality and yield traits of chilli cv. CH-27. The trial was laid out in a randomized block design with two phytohormones *viz*. GA_3@ 25, 50, 100, 150 ppm and NAA @ 25, 50, 100, 150 ppm.

Result: Significant variations were recorded various parameters. Plant height was highest with GA_3 @ 50 ppm while better spread was highest in NAA @ 50 ppm. It was interesting to note that maximum leaves appeared when the plant was sprayed with NAA @ 150 ppm. Similarly, the number of branches was the highest in case of GA_3 @ 150 ppm. Above all, control treatment showed the earliest 50% flowering (almost) in comparison to other treatments. Improved fruit set was noted in NAA@ 100 ppm. Fruit characters *viz*. weight, length and the diameter of the fruit including yield per plant were significantly improved with NAA @ 50 ppm treatment. Concerning quality, the highest amount of ascorbic acid was recorded in GA_3 @ 50 ppm. Non-significant results were obtained in case of capsaicin content.

Key words: Chilli, Development, Growth, Phytohormones, Quality, Yield.

INTRODUCTION

Chilli (*Capsicum annuum* L.), 2n = 24, is an important annual and widely cultivated solanceous vegetable and spice crop in India and the world. India is the leading producer, consumer and exporting country of chilli crop. It was introduced from Peru (Patel *et al.* 2016) and from there it speeded to other parts of the world. Deep, loamy, fertile soil rich in organic matter and temperature ranging between 18 to 30°C, are considered ideal for satisfactory growth (Hazra *et al.* 2011). Mainly, it is a self-pollinated crop but a little percentage of cross pollination may occur also. The fresh and dried fruits of chilli contain phenolic acid compound “capsaicin”, in placenta which is responsible for the pungency in chilli. This pigment capsanthin also leads to bright red colour at the ripening stage of chilli fruit. Green chilies are supposed to be rich in vitamin A, C and the seed encompasses traces of starch. Besides this, fruits also contain vitamin A and carbohydrates. These are excellent sources of carotenoids, anti-oxidant, phenolic compounds which prevent cancer, diabetes, liver cirrhosis and cardiovascular diseases in the human body (Nwose, 2009). Many workers have revealed that the use of plant growth regulators showed a positive effect on productivity of chilli (Vandana and Verma, 2014). Singh *et al*., (2018) also concluded that the foliar application of various plant growth regulators like Kinetin, GA3 and NAA, positively impacted plant growth, development and seed yield traits such as plant height, primary branches, pods/plant, seeds/pod and 100-seed weight which led to increased growth, yield and quality parameters on garden pea variety (Pusa Pragati) under New Delhi climatic condition. Naphthalene acetic acid is one type of synthetic auxin, which plays an important role in stimulating cellular elongation in shoot, apical bud dominance, root initiation, control flowering, enhancement of growth and productivity. It is also involved in active cell division, cell amplification and cell elongation. flooding responses, enzyme induction and leaf and fruit senescence. Singh and Mukherjee (2000) revealed that different physiological and developmental processes, including plant vegetative growth, sex expression, yield and yield components in several vegetable crops, have been established to be influenced by foliar application of GA_3. Rawat *et al.* (2002) also advocated that use of plant growth regulator has significantly increased the quality and yield of various vegetables. They proved that Napthalene Acetic Acid (NAA) is an important hormone, which tended to encourage the vegetative growth and increase yield of chilies. Results from Nazeer *et al*, (2020) in pea crop also indicated that pea cultivars can respond positively and favourably to growth, yield and quality attributes when plant growth regulators like NAA, GA3 and IAA, are applied. Thus, the present investigation was designed to find out the effects of plant growth regulators on chilli cultivar CH-27.

Department of Fruit Science, Lovely Professional University, Phagwara-144 001, Punjab, India.

Corresponding Author: Jatinder Singh, Department of Fruit Science, Lovely Professional University, Phagwara-144 001, Punjab, India. Email: jatinder.19305@lpu.co.in

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METHODS AND MATERIALS

Experimental site and experimental materials

Present investigation was conducted at the Horticultural Farm of Lovely Professional University, Phagwara (situated in the central plain zone of Punjab state) during July 2019. The farm is situated at 31.240 and 75.701 latitude and longitude respectively and MSL is 252 meters. Maximum and minimum temperatures during the growing season were 42°C and 15°C respectively, whereas relative humidity varied between 60 to 85 per cent. The experimental material comprised chilli plants cv. CH- 27 along with two phytohormones (GA_3 and NAA). Out of both phytohormones, different treatment of NAA was designed asT_1, T_2, T_3 and T_4 (sprayed @ 25, 50, 100 and 150 ppm, respectively) and GA_3 treatment as T_5, T_6, T_7 and T_8 @ 25, 50, 100 and 125 ppm, respectively), while T_9 was considered as control.

The experimental layout and data analysis

The experiment was laid out in factorial RBD with 9 treatments and 3 replications. Total twelve qualitative and quantitative characters were accessed. Seeds of chilli cv. CH-27 were sown in protrays (coco peat + perlite + vermiculite) in polyhouse on 15/07/2019. Recommended/ suggested cultural practices including and plant protection measures were followed (as per Punjab Agricultural University, Ludhiana). Immediately after sowing a light irrigation was given. Seedlings were transplanted in the main field after 35 days of sowing with spacing of 60 cm × 45 cm.

Data recorded

For recording plant height plant measuring tape was used from the ground level to the tip of the plant at 30, 60 and at last harvesting. Total no. of leaves per plant was recorded at 90 days after transplanting on the tagged plants and then average was calculated. The no. of branches per plant was recorded by taking actual counting at 30, 60 and 90 days after transplanting. It was also noted down when 50% flowers appeared in a particular plot. Fruit set (%) was worked out in relation to the number of flowers, originally present in labelled plants with the number of hermaphrodite flowers which set fruits. Plant spread, north to south and east to west was measured at 60-90 days after transplanting with the help of meter scale in centimeter and mean of the tagged plants were calculated.

Similarly, for calculation of average fruit weight (g), five fruits were randomly selected from the tagged plants in each replication and added and then average was calculated in grams. Length of fruit (cm)was calculated from the bottom to the tip of the fruit by using the vernier caliper from randomly selected fruit and their average was calculated in cm. For measurement of fruit diameter 'same' five fruits were used, measurement was taken at the widest portion of the fruit with a vernier caliper in centimeters. For recording yield per plant (g), fruits harvested and weight were recorded plant wise from every picking and in the last total yield per plant and express in gram. Similarly for Estimated yield per hectare (q/ha), harvested fruits were weighed (after each picking) and then they are divided with total area of the field plot and summed up. Ascorbic acid content of the fresh, randomly selected fruits was calculated by using 2, 6 Dichlorophenol indophenol dye titration method (AOAC, 1990). Capsaicin content of chilli fruit was calculated by adding 2 g of chilli powder into 20 ml methanol, after that this solution was placed in a water bath at a temperature of 60°C for 2 hours. After that it was removed from the water bath and cooled at room temperature. At the rate of 5000 ppm for 5 minutes centrifugation of the sample was done. Supernatants were filtered and dilution was done using methanol. After that it was injected into the HPLC system at standard concentration. Calibration curve was prepared and SHU units were determined by coefficient corresponding to the heat value for pure capsaicin and corrected for sample extraction efficiency according to the formula: 18 × µg.g.

RESULTS AND DISCUSSION

Table 1 reveals that maximum height of the plant was seen in T_4 at 30 days after transplanting (38.83 cm) while T_9 showed minimum height *i.e.*, 25.84 cm. During 60 DAT and at the time of last harvesting maximum plant height was noted in T_5 *i.e.*, 83.62 cm and 141.73 cm, respectively while control exhibited minimum *i.e.*, 64.03 cm and 126.00 cm,

Table 1: Effect of different phytohormones on various parameters of chilli var. CH- 27.

Treatment	Height of plant (cm)			Plant spread	Leaf number per plant	Number of branches			Days to fifty per cent flowering	Fruit set (%)
	30 DAT	60 DAT	At last harvest			30 DAT	60 DAT	90 DAT		
T_1	35.3	70.1	132.5	45.1	136.2	7.0	12.4	18.8	45.3	50.4
T_2	36.1	74.0	138.0	52.8	138.8	7.0	13.2	20.1	41.1	54.3
T_3	37.0	80.6	136.1	50.0	139.7	8.4	12.3	18.4	45.4	55.1
T_4	38.3	76.9	134.7	49.2	143.4	7.1	11.0	20.0	43.8	51.1
T_5	26.8	68.6	135.0	50.7	134.5	7.5	12.3	19.3	43.2	48.7
T_6	29.8	83.6	141.7	51.5	134.8	8.3	11.6	19.3	43.1	49.9
T_7	31.7	66.5	137.2	50.5	136.5	8.6	13.0	20.0	45.9	48.5
T_8	30.5	66.3	131.5	44.5	136.8	9.1	13.4	21.2	46.1	47.4
T_9	25.8	64.0	126.0	42.9	130.0	7.2	9.83	16.9	48.0	43.9
C.D. (5%)	1.7	3.5	2.8	1.8	2.9	0.6	1.6	2.1	1.1	2.6
SE(m)	0.5	1.1	0.9	0.59	0.9	0.2	0.5	0.6	0.3	0.8

respectively. Significant variations were found during the course of study. Above all, T_2 is statistically at par with T_7 at the time of last harvesting. Maximum plant height was seen in T_6 which may be due to the fact that GA3 may increase the movement of xyloglucan endotransglycosylase (XET) which has loosened the cell wall and enhanced cell permeability which in turn increases the plant height. Similar findings have been submitted by Sharma (2014) in brinjal and Merentoshi *et al.* (2016) in cucumber.

Maximum plant spread was observed in T_2 followed by T_6 whereas minimum in control (T_9) (Table 1). Chilli plants spread inclined because auxin may expand photosynthetic metabolic rate and dry matter content. Results were found significant. Similar findings were contributed by Chandiniraj *et al.* (2016) in chilli.

Significant variations have been depicted from Table 1 and T_4 exhibited maximum leaf number in chilli followed by T_3 whereas minimum in control (T_9). Maximum leaf per plant may be due to NAA that increased the cell elongation and multiplication of cells and ultimately resulted in plant development. Vegetative stage may have incited better developing conditions that resulted in higher no. of leaves per plant. A related effect of increase in growth due to application of NAA was also recorded by Kalshyam *et al*. (2012) in chilli.

It may be concluded from Table 1 that T_8 increased the number of branches and followed by T_2 treatment whereas minimum was observed in T_9 *i.e*., control. Significant results were recorded. It is interesting to note that highly significant results were noted during 90 DAT. It has been established that NAA plays a crucial role in numerous physiological processes, in turn inclined photosynthetic rate, respiration rate, transfer of compound *viz*, photosynthesis, respiration, energy store transfer, cell division and ultimately increased the branches of the chilli plant. This result was analogous with the result of Hilli *et al*. (2010).

At first, 50% flowers were observed in T_9 followed by T_8 whereas minimum in T_2 (table 1). Early blooming in NAA treatment may be because of its involvement in the change of vegetative apices to flower apices remained physiologically highly active to develop adequate food save for creating blossom. Moreover, results were also significant and research findings are matched with the earlier study of Hilli *et al*. (2010) in chilli.

Maximum fruit setting *i.e*., 55.1% was found T_3 followed by T_2 *i.e*., 54.3% whereas minimum in control (Table 1). Similar findings were obtained in the study of Tapdiya *et al*. (2018) in chilli. Revanappa (1998) also advocated that GA3 and NAA reduces the flower drop because it inhibits the activity of cellulose and pectinase and reduces abscission production. They are also playing a major role in the development of ovaries during the seed filling process in chilli.

Fruit weight is an important criterion for determining yield. During study, it was recorded that fruit weight was increased in case of T_2 followed by T_6 (Table 2). Tiwari and Singh (2014) established that by application of auxin *i.e*., NAA it increases the average fruit weight. Maximum translocation of nutrients and increased photosynthesis increased the average fruit weight. Ultimately it maximizes the yield as well as acceptance by consumers.

It has been revealed in Table 2 that fruit length was increased in T_2 (9.03 cm). Similar findings were obtained in the study of Tapdiya *et al*. (2018) in chilli while on the contrary, small fruit was recorded in control. NAA was an important plant growth regulator that increased the fruit length. Increased cell number as well as cell elongation may be possible reasons for this increase.

Maximum yield per plant *i.e.,* 567.06 g was found in T_2 (Table 2) and the minimum in control (352.00 g). NAA may be responsible for higher photosynthesis in plants ultimately which resulted in better root and shoot growth.

Maximum yield *i.e*., 152.89 q/ha was recorded in T_2 followed by T_6 whereas minimum in control (Table 2). Present study displays that plant growth regulators, particularly NAA@ 50 ppm (T_2) positively affected the yield per plant and yield per hectare. The improvement in yield related attributes may be due to the fact that NAA improves the physiology of plants and as a result, they become more active to make enough food to increase the flowers, fruit weight and yield characters. Moreover, such traits are responsible for increasing the yield of plants. Mahindre *et al*. (2018) also stated that application of 50 ppm NAA significantly increased all parameters of growth at later stages which in turn reflected higher fruit yield per hectare**.**

Table 2: Effect of different phytohormones on various parameters of chilli var. CH- 27.

Treatment	Average fruit weight (gm)	Length of fruit (cm)	Fruit diameter (cm)	Yield per plant (g)	Estimated yield per hectare (q/ha)
T_1 (NAA 25 ppm)	4.10	7.83	3.49	381.33	141.14
T_2 (NAA 50ppm)	7.64	9.03	3.93	567.06	152.89
T_3 (NAA 100 ppm)	4.41	7.93	3.70	404.00	143.18
T_4(NAA 150 ppm)	4.22	7.78	3.32	390.66	141.07
T_5 (GA3 25 ppm)	4.93	8.16	3.23	447.66	146.79
T_6 (GA3 50 ppm)	5.29	7.84	3.23	489.00	148.83
T_7 (GA3 100 ppm)	4.01	7.66	3.20	374.00	139.99
T_8 (GA3 150 ppm)	3.91	6.63	3.16	362.00	139.75
T_9 (Control)	3.74	6.71	2.90	352.00	139.24
C.D. (5%)	0.50	0.55	0.31	12.08	3.33
SE (m)	0.16	0.18	0.10	3.99	1.10

Table 3: Effect of different phytohormones on various parameters of chilli var. CH- 27.

Treatment	Quality parameters	
	Ascorbic acid content (mg/100mg)	Capsaicin contents coville heat units
T_1	79.68	0.34
T_2	81.08	0.34
T_3	80.08	0.34
T_4	79.05	0.35
T_5	82.58	0.35
T_6	85.64	0.34
T_7	80.03	0.36
T_8	79.76	0.35
T_9	77.35	0.34
C.D. (5%)	2.43	NS
SE(m)	0.80	0.00

During study, ascorbic acid content of the fruit was significantly increased (85.64 mg/100 g) in case of T_6 (82.58) (Table 3). Application of GA_3 might help in synthesis of ascorbic acid and thereafter, it reduces the activity of enzyme ascorbic acid oxidase along with protection of the oxidation process of formed ascorbic acid. The results are in agreement with the findings of Chaudhary *et al*. (2006) in chilli.

Capsaicin, an important component of chilli responsible for pungency and irritant effect, is found highest (0.36) in treatment T_7. Whereas the lowest value of capsaicin content (0.34) was found in treatment T_1, T_2, T_3 and T_9 (control) (Table 3).

CONCLUSION

From above studies may be concluded that application of NAA@ 50 ppm (T_2) had contributed significantly for increasing yield and yield contributing characters. Therefore, application of NAA@ 50 ppm may be recommended for chilli cultivation for field/commercial cultivation.

Conflict of interest: None.

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