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Plant growth promoters on growth and yield of summer cherry tomato line (JP-27)

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ABSTRACT

An experiment was accomplished in the Horticulture Farm of Department of Horticulture, Sher-e-Bangla Agricultural University to evaluate the influence of different plant growth promoters on growth and yield of JP-27 summer cherry tomato line. Four different growth promoters including control viz. F_0= Control (Water), F_1= Flora (Nitrobenzene 20% w/w) @ 2.5ml/L, F_2= 4-CPA @ 2.5 ml/L and F_3= GA_3 @ 200ppm was used in this experiment arranged in a Randomized Completely Blocked Design (RCBD) with three replications. Maximum plant height, no. of leaves, no. of branches, days to first flower, no. of flowers, no. of fruits, fruit length, single fruit weight, yield/plant and yield/ha (194.5 cm, 28.7, 12.7, 18.0, 48.3, 34.7, 19.9 mm, 20.4 gm, 458.7 gm and 19.0 ton respectively) were found in F_3 treatment and maximum fruit diameter (40.7 mm) were found in F_2 whereas the minimum (179.7 cm, 13.1, 5.7, 27.3, 36.3, 22.3, 13.5 mm, 33.0 mm, 10.6 gm, 287.9 gm and 13.2 ton respectively) were observed in F_0. Thus application of plant growth promoters for improving overall performance of cherry tomato produced in summer can be recommended.

Key Words: *Cherry tomato, Growth promoters and Summer production*

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I. Introduction

Cherry tomato (*Solanum lycopersicum* L. var. Cerasiforme) commonly referred as garden tomato is becoming very popular to many small farmers, special gardeners and green house managers throughout the world (Abdel-Razzak et al., 2013) including Bangladesh. The cherry tomato can be characterized by small bilocular fruits with intense bright red color, higher productivity, superior quality and better sweet taste compared to table tomatoes (Kobryn and Hallmann, 2005; Menezes et al., 2012). Now-a-days it is more popular in the super markets due to its higher commercial value compared to regular tomatoes (Menezes et al., 2012; Mantur et al., 2014). But production of tomatoes including cherry tomatoes is usually limited in summer season due to the type of weather prevails in the summer season of Bangladesh (Ahmad, 2002). During this period, the temperature (both day and night), humidity, rainfall and light intensity which are actually the basic limiting factors of tomato production in the tropics, remain very high (Abdulla and Verkert, 1968). Fruit setting in tomato is

reportedly interrupted at temperature above 26^{0}C and 20^{0}C in day and night respectively with complete arrest above the temperature 38^{0}C and 27^{0}C in day and night respectively (Stevens and Rudich, 1978). Reduction in fruit setting due to high temperature is also reported in eggplant and bell paper (Erickson and Markhart, 2001; Sanwal et al., 1997). Plant growth regulators are known to impart parthenocarpy and promote fruiting in vegetables (Matlob and Kelly, 1975; Rappaport, 1957). So, use of growth promoters can be a cheap and easy way for the farmers to increase the summer production of tomato. Flora is a commercially available liquid fertilizer (Jamal Uddin et al., 2014) containing nitrobenzene which is an organic compound under aromatic group influences crop production by increasing the flower forming substances like amino acids, enzymes, vitamins, hormones, etc. It alters gibberellins, auxin, cytokinin, and ethylene ratio so as to increase the flowering by more than 60% and ultimately yield upto 50% (Lone, 2005). Reports indicated increased fruit size and fruit setting in tomato due to application of plant growth regulators such as 2, 4-dichlorophenoxy acetic acid (2,4-D), 4-chlorophenoxy acetic acid (4- CPA), and 1-Naphthaleneacetic acid (NAA) (Gemici et al., 2006). Similarly, gibberellic acid (GA3) at low concentration was reported to promote fruit setting in tomato (Sasaki et al., 2005). With these views in mind, the following experiment was conducted to evaluate the influence of growth promoters on growth and yield of JP-27 cherry tomato line in summer condition.

II. Materials and Methods

The experiment was accomplished in the Horticulture Farm of Department of Horticulture, Sher-e-Bangla Agricultural University during the period of April to July, 2016. JP-27 cherry tomato line was used in this experiment and it was subjected to four different growth promoter treatments including control *viz.* F_0= Control (Water), F_1= Flora (Nitrobenzene 20% w/w) @ 2.5ml/L, F_2= 4-CPA @ 2.5 ml/L and F_3= GA_3 @ 200ppm. The experiment was arranged in a Randomized Completely Blocked Design (RCBD) with three replications. Foliar application of treatments was done using a hand sprayer from 15 days after transplanting up to flowering. Data on plant height, no. of leaves, no. of branches, days to first flower, no. of flowers, no. of fruits, fruit length, fruit diameter, single fruit weight, yield/plant and yield/ha were collected. The collected data were arranged accordingly and analysis was conducted using MSTAT-C computer program. Least Significant Difference (LSD) test was conducted to evaluate treatment differences at 5% level of significance (Gomez and Gomez, 1984).

III. Results and Discussion

Plant height

Plant height showed significant variation under different growth promoter treatment in JP-27 cherry tomato line produced in summer. Maximum plant height was observed in F_3 (194.5 cm) and the minimum was observed in F_0 (179.7 cm) with the F_1 and F_2 giving intermediate result with no statistical difference (184.3 cm & 184.1 cm respectively) (Table 01). GA_3 treatment causes cell enlargement (Buchanan et al., 2000) and cell division (Arteca, 1996; Liu and Loy, 1976; Moore, 1989) enhancing plant height.

No. of leaves

Different growth promoter treatment showed significant variation in case of JP-27 cherry tomato line under summer condition. Highest number of leaves were observed in F_3 (28.7) and minimum was observed in F_0 (13.1) (Table 01). GA_3 application showed highest number of leaves which might be due to the increased plant height with the hormonal effect on cell division and cell elongation. All the hormonal treatments gave better results compared to control. 4-CPA application also showed higher number of leaves which is in confirmation with the findings of Mehrotra et al. (1970) who showed that application of auxinic compounds increases the number of leaves and leaf size.

No. of branches

JP-27 cherry tomato line showed significant variation in case of no. of branches under different growth promoter treatments. Highest number of branches were observed in F_3 (12.7) and the lowest was observed in F_0 (5.7) (Table 01). Rai et al. (2006); Nibhavanti et al. (2006) observed that GA3 increased number of branches per plant as also observed by Tomar and Ramgiry (1997). Application of 4-CPA also showed higher number of branches compared to control. The increase in the number of primary branches due to auxins attributed to the activation of cell division and cell elongation in the axillary

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buds which had a promoting effect in increased number of primary branches and secondary branches (Kannan *et al.,* 2009).

Days to first flower

Significant inequality was observed in case of days to first flower in the cherry tomato line under study in different growth promoter treatments. Minimum days required for first flower was observed by F_3 (18.0 days) and the maximum days (27.3 days) required by F_0 (Figure 01). Foliar application of GA3 reduced days for first flowering in cherry tomato as observed by (Mehraj et al., 2014) and in gerbera (Jamal Uddin et al., 2014).

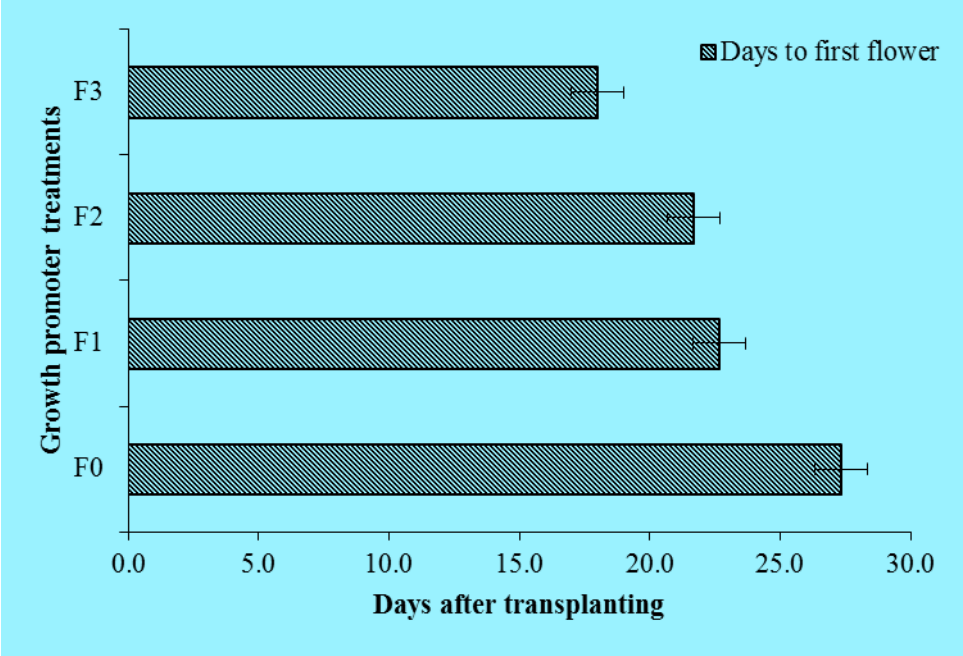

Figure 01. Influence of different growth promoters on days to first flower of JP-27 cherry tomato line. F_0= Control, F_1= Flora (Nitrobenzene 20% w/w), F_2= 4-CPA and F_3= GA_3.

No. of flowers per plant

Variation in no. of flowers/plant was observed in different treatments in JP-27 cherry tomato line under study. Maximum number of flower was observed in F_3 treatment (48.3) and the minimum was observed in F_0 (36.3) (Figure 02). Highest number of flower in F_3 might be caused that GA3 promoted flower primodia production in tomato plant (Ranjeet et al., 2014). F_1 and F_2 treatment showed comparatively higher number of flowers than F_0 (40.7 & 42.0 respectively). Application of GA_3 and auxinic compounds causes increased synthesis of cytokinin and auxins and transport them to auxiliary buds that help boost transformation from vegetative phase to reproductive phase (Kannan et al., 2009). Similar earliness in case of chilli was observed by Singh and Mukherjee (2000).

No. of fruits per plant

No. of fruits/plant showed significant variations in case of different treatments in JP-27 cherry tomato line under study. Highest no. of fruits were found in F_3 (34.7) whereas the lowest was obtained from F_0 (22.3) (Figure 02). GA_3 causes significant vegetative growth that culminates to higher photosynthates manufacturing and in presence of this food stock, GA_3 leads to produce more fruit. The findings are in agreement with that of Udden et al. (2009). Among the other treatments, F_2 showed higher number of fruits compared to control (29.4). 4-CPA application increases number of fruits in tomato as observed by Ozguven et al. (1997) and Sasaki et al. (2005).

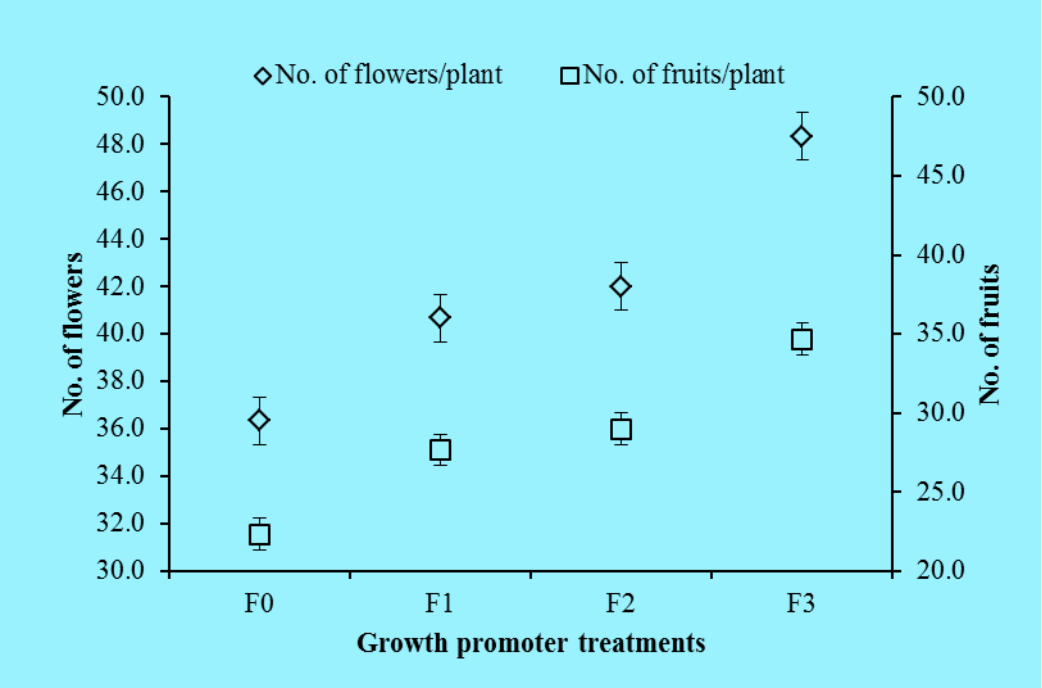

Figure 02. Influence of different growth promoters on no. of flowers and fruits/plant of JP-27 cherry tomato line. Here, F_0= Control, F_1= Flora (Nitrobenzene 20% w/w), F_2= 4-CPA and F_3= GA_3.

Fruit length

Different growth promoters showed significant variation in case of fruit length of JP-27 cherry tomato line grown in summer. Maximum fruit length was observed in treatment F_3 (19.9 mm) and the minimum was found in F_0 (13.5 mm) (Table 01). This increase may be due to greater accumulation of carbohydrates owing to greater photosynthesis which caused the fruit to increase in length. Other hormonal treatments also showed increase in fruit length compared to control. (F_1= 16.9 mm, F2= 17.3 mm).

Fruit diameter

Significant variation was observed in case of different growth promoter treatments applied on JP-27 cherry tomato line. Maximum diameter was observed in F_2 (40.7 mm) and the lowest was observed in F_0 (33.0 mm) (Table 01). The increase in fruit girth maybe attributed to increase in the number of cells as well as elongation of cells which is characteristic action of any auxinic group of chemicals as observed by Sharma et al. (1999) and Kannan et al. (2009).

Single fruit weight

Single fruit weight of JP-27 cherry tomato line showed significant variation under different growth promoting treatments including control. Highest single fruit weight was observed in F_3 (20.4 gm) and the lowest weight was obtained from F_0 (10.6 gm) (Table 01). Gibberellins application increases membrane permeability (Aloni *et al.*, 1968) that facilitate absorption and utilization of mineral nutrients (Khan et al., 1998; Crozier and Turnbull, 1984; Al-Wakeel et al., 1995) and transport of assimilates (Mulligan and Patrick, 1973) which may result in higher weight of fruits.

Yield per plant

JP-27 cherry tomato line showed significant in equality in case of different growth promoter treatments. Maximum yield /plant was observed in F_3 (458.7 gm) and minimum yield/plant was observed in F_0 (287.9 gm) (Table 01). GA_3 has promoting effect on DNA, RNA and protein synthesis (Broughton and McComb, 1971; Johri and Varner, 1968; Mozer, 1980; Pain and Dutta, 1977; Roth and Lips, 1970) and ribose and polyribosome multiplication (Evins and Varner, 1972) that contributes towards increased biomass production of vegetative parts as well as fruits that leading to increased yield.

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Yield perha

Significant variation was observed in case of calculated yield/ha of JP-27 cherry tomato line under different growth promoter treatments. Highest yield/ha was found in F_3 (19.0 ton) and the lowest was found in F_0 (13.2 ton) (Table 01).

Table 01. Influence of different plant growth promoters on growth and yield related attributes of JP-27 cherry tomato line*

Treatment	Plant height (cm)	Days to first flower	No. of leaves	No. of branches /plant	Fruit length (mm)	Fruit diameter (mm)	Single fruit weight (g)	Yield/ plant (g)	Yield/ ha (ton)
F_0	179.7 c	27.3 a	13.1 c	5.7 c	13.5 c	33.0 c	10.6 c	287.9 c	13.2 c
F_1	184.3 b	22.7 b	22.6 b	8.3 b	16.9 b	37.1 b	15.2 b	410.1 b	17.5 b
F_2	184.1 bc	21.7 b	23.0 b	8.5 b	17.3 b	40.7 a	15.7 b	410.6 b	17.7 b
F_3	194.5 a	18.0 c	28.7 a	12.7 a	19.9 a	37.7 b	20.4 a	458.7 a	19.0 a
CV %	1.2	3.3	3.4	8.1	2.3	2.2	3.6	1.3	3.6
LSD (0.05)	4.6	1.5	1.5	1.4	0.8	1.6	1.1	10.0	1.2

* In a column the means having similar letter(s) are statistically identical while those having dissimilar letter(s) differ significantly at the 0.05 level of probability. Here, F_0= Control, F_1= Flora (Nitrobenzene 20% w/w), F_2= 4-CPA and F_3= GA_3

IV. Conclusion

Application of GA_3 as foliar spray at 200ppm showed significant positive effect on most of the parameters under study. Compared to control, all the growth promoter treatments showed beneficial effect on growth and yield of the studied tomato line. Thus application of growth promoters particularly GA_3 for improvement of cherry tomato production in summer condition can be recommended.

V. References

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