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Efficacy of Foliar Application of Plant Growth Regulators on Growth and Yield of Chilli (*Capsicum annuum* L.)

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ABSTRACT: The experiment was undertaken in the University of Science and Technology, Meghalaya, during Rabi season, to examine the response of different levels of foliar application of Naphthalene acetic acid (NAA), Chlorocholine chloride (CCC) and Gibberellic acid (GA) on chilli (*Capsicum annuum* L.) cv. Pusa Jwalaon growth and yield. Application of these plant growth regulators can increase the yield by reducing the flower drop, increasing the fruit set and dry matter accumulation. In this experiment, the treatments considered were NAA at 10ppm and 50ppm, GA 10ppm, CCC 100ppm and GA 10ppm + CCC 100ppm. The experiment was laid out in Randomized Block Design (RBD) with three replications. Results of the experiment showed a significant variation among the treatments. Plant height was observed highest, 24.83cm, 42.00cm and 58.77cm at 30, 60 and 90 DAT respectively with NAA 50ppm concentration. The highest RLWC% and RGR were recorded from plants treated with NAA 50ppm. Application of plant growth regulators extended the shelf-life of harvested chilli fruits to 10 days in NAA treated plants. Maximum number of fruits per plant (47) and yield (117 q/ha) were recorded with NAA treated plants followed by GA 10ppm. Based on the present results, it can be suggested that the use of plant growth regulators have a synergistic effect in increasing plant growth and yield of Chilli by increasing fruit set and dry matter accumulation.

Keywords: NAA, GA3, CCC, Relative Growth Rate, self life, Yield.

INTRODUCTION

Chilli is an important vegetable crop used throughout the world. Chilli has great commercial importance as spice and also consumed as green vegetables. In recent years, interest and demand for chilli has increased dramatically worldwide and have achieved major economic significance in the global market. It is one of the most valuable crops of India. India is also among the world top chilli producing countries. India is not only the largest producer but also the largest consumer of chilli in the world. Rising export demand coupled with higher price realization in the domestic market have motivated farmers to bring more area under chilli cultivation. It grows well in warm and humid climate and a temperature of 20-25°C. It can be grown in a large range of soil but cannot withstand heavy moisture. The production of chilli is reduced due to flower and fruit drop which is caused by physiological and hormonal imbalance in the plants particularly under unfavourable environments such as extremes of temperature (Erickson and Markhart 2001). Studies on the effect of plant growth regulators on solanaceous fruits and vegetable crops have revealed that the application of some of the plant growth regulators is effective in reducing the flower and fruit drop thereby enhancing production of chilli per unit area per time (Balraj *et al*., 2002; Chaudhary *et al*., 2006; Sultana *et al.,* 2006). A dramatic increase in number of flower was observed when plant growth regulators applied (Ghait *et al.,* 2018). Plant Growth Regulators are known to enhance the source sink relationship and stimulate the translocation of photo assimilates thereby helping better fruit set (Anolisa *et al.,* 2020; Kaur, 2017). Application of plant growth regulators increased dry matter in crops due to the increased carbohydrate accumulation resulting from a more efficient photosynthetic activity brought about by the anatomical modifications (Patel *et al.,* 2015; Singh and Singh 2019).

Hormones regulate physiological process and synthetic growth regulators may enhance growth and development of field crop thereby increased total dry mass of a field crop (Islam 2007; Cho *et al.,* 2008). The present study was, therefore, conducted with suggested concentration of imposed PGRs as foliar spray to determine the effective growth regulators promoting growth and yield in commercial chilli cultivars, pusa Jwala.

MATERIALS AND METHODS

The experiment was conducted in a Randomized Block Design with six treatment and three replications at USTM campus, during rabi season in the year 2021 on Chilli cv. Pusa Jwala. The seedlings was transplanted with a spacing of 60 × 45 cm. The treatments consisted of three growth regulators *viz.,* NAA (10ppm and 50 ppm), CCC (100ppm), GA (10ppm), GA (10ppm) + CCC (100ppm) and Control (water spray). The

treatments were applied two times, first at 15 days and second at 30 days after transplantation (DAT) respectively. The observations on growth and fruiting attributes were recorded from 10 random plants in each replication.

RESULT AND DISCUSSION

In this experiment different concentrations of PGRs showed significant effect on plant height of chilli at 30, 60 and 90 Days After Transplanting (Table 1). The highest plant height at 30 DAT, 60 DAT and 90 DAT was recorded with T_2 (50ppm NAA) followed by T_4 (10ppm GA). These findings are in agreement with. Natesh *et al.* (2005) in chilli. The promoting effect of NAA and GA on plant growth might be due to its effect on increasing the cell division and cell elongation. The reduction in plant height were recorded in CCC treated plant which may be due to restriction in cell division activity of CCC which leads to shortening of intermodal length (Pandey *et al*., 2001).

These results showed that both at 30 DAT and 60 DAT the treatment T_2 (50ppm NAA) showed maximum number of branch per plant followed by T_4 (10ppm GA) but after 90 DAT, T_3 (100ppm CCC) showed the maximum number of branch per plant. These findings are in agreement with Yoganand (2001) in bell pepper and Ashwin *et al.* (2021) in finger millet. The increased in no. of branches in CCC treated plant may result from blocking of GA biosynthesis or reduction in endogenous auxin level. A decreased in shoot elongation possibly increased the meristematic activity in the leaf primordial, producing more cells resulting in increased no of leaves and branches (Das *et al.*, 2009). The stimulating action of plant growth regulators increase the cell wall plasticity of the stem cell.

It is apparent from Table 1, that Relative Growth Rate (RGR) differed significantly among the applied treatments in comparison to control. The highest RGR (0.0291 gg^{-1}/day) was observed from T2 (NAA 50ppm) followed by T_4 (GA 10ppm) (0.0287 gg^{-1}/day) over T_6 control (0.0227 gg^{-1}/day). However, moderate effect on RGR was observed from combined treatment T_5 (GA 10ppm and CCC 100ppm) (0.0270 gg^{-1}/day) and T_3 CCC 100ppm (0.0261 gg^{-1}/day) which differed significantly over control. These findings are in agreement with those of Ashwini *et al.* (2021). The significant effect on RGR might be due to higher photosynthetic efficiency and enhanced source to sink relationship of the plant, increased uptake of nutrients and water, reduced transpiration and respiration, enhanced translocation and accumulation of sugar and other metabolites. Hormones regulate physiological process and synthetic growth regulators may enhance growth and development of field crop thereby increased total dry mass of a field crop (Islam, 2007; Cho *et al.* 2008).

Data presented in Table 2, indicate that there was significant difference in RLWC%, among the applied treatments in comparison to control. The highest (86.4%) RLWC % was recorded with T_2 (NAA 50ppm) followed by T_4 (GA 10ppm), T_1 (NAA 10ppm) and T_5 (GA 10ppm and CCC 100ppm). The RLWC in leaves appeared to be better indicator of water status of plant as because, it reflects the balance between water supply to the leaves and transpiration rate (Sinelair and Ludlow 1985). From the present investigation, it is clear, that due to foliar spray of PGRs the water status of plants is improved, which is important for maintenance of turgidity and essential for plant growth or survival. Kumar *et al.* (2001) reported that foliar spray of GA_3 partially counteracted the effect of water deficit on net photosynthetic rate, transpiration rate, stomatal conductance, carboxylation efficiency.

Data presented in Table 2, revealed that, all the applied treatments increased no. of fruits per plant over control. The maximum number of fruits per plant was obtained with T_2 NAA 50ppm treated plant (47.1) followed by T_4 GA 10ppm (45.2) and T_1 NAA 10ppm (39.9) respectively. These results are in agreement with the findings of Patel *et al.* (2015) in Paprika chilli and Sowjanya *et al.* (2022) in groundnut. The increased no. of fruits per plant due to different concentration of PGRs might be ascribed to more efficient utilization of food for reproductive growth (flowering and fruit set), higher photosynthetic efficiency and enhanced source to sink relationship of the plant, increased uptake of nutrients and water, reduced transpiration and respiration, enhanced translocation and accumulation of sugar and other metabolites.

In this experiment application of plant growth regulators showed significant effect on the shelf life of chilli fruit as shown in Table 2. The extended shelf-life of harvested chilli fruits due to foliar spray of PGRs might be due to delaying senescence, preserving cellular organization, retarding respiration rate and its effect on cell wall metabolism. The present results are in agreement with that of Selvan and Bal (2005) in guava and Martinsson *et al.* (2005) in strawberry. Application of NAA improved the fruit quality was also reported by Gautam *et al*. (2021) in litchi.

Data presented in Table 2, revealed that, all the applied treatments showed increased in fruit yield per hectare over control. The highest yield of fruit was recorded from T_2 NAA 50ppm treated plant (117.4 q/ha) followed by T_4 GA 10ppm (105.5 q/ha) and T_1 NAA 10ppm (103.2 q/ha) respectively. These results showed that NAA 50ppm is the most significant concentration for better yield of fruit as compared other treatments. These results are in agreement with those. Gautam *et al.* (2021) also reported higher yield in litchi after the spray of NAA and inferred that the higher yield was due to appropriate growth of plants, control of abscission layer in full bloom stage and acceleration in full development by the positive hormonal actions. An increased in the growth parameters could be attributed to the increase in meristematical activity of apical tissue due to exogenous application of growth regulators such as GA3, NAA which are involved in increasing photosynthetic activity, efficient translocation and utilization of photosynthates causing rapid cell elongation and cell division which stimulate growth, besides increasing the uptake of nutrients (Prabhavathi *et al.,* 2008).

Table 1: Effect of foliar application of Plant Growth Regulators on plant height, branch number per plant at 30.60 and 90 days after transplantation (DAT) and Relative Growth Rate (RGR) of chilli.

Treatments	Plant height (cm)			No. of branch per plant			RGR (gg^{-1}/day)
	30DAT	60DAT	90DAT	30DAT	60DAT	90DAT	
T_1 NAA10ppm	22.32	40.66	55.83	4.53	8.00	11.00	0.0285
T_2 NAA50ppm	24.83	42.00	58.77	5.83	8.67	12.52	0.0291
T_3 CCC100ppm	19.43	33.21	48.76	5.33	8.56	13.02	0.0261
T_4 GA10ppm	24.22	41.66	57.02	4.36	7.33	11.33	0.0287
T_5 GA10ppm+ CCC100ppm)	20.66	37.00	53.01	3.47	7.53	10.42	0.0270
T_6 control	19.01	32.66	48.00	3.23	5.66	7.01	0.0227
C.D at 5%	0.219	0.127	0.108	0.134	0.098	0.294	0.00019
S.Ed	0.121	0.070	0.060	0.074	0.054	0.162	0.00034

Table 2: Effect of foliar application of Plant Growth Regulators on percent Relative Leaf Water Content (RLWC %), self life of fruit, number of fruits per plant and yield per hectare.

Treatments	RLWC%	Shelf life (days)	No. of fruits/plant	Yield/ ha (q/ha)
T_1 NAA10 ppm	83.19	8.96	39.9	113.2
T_2 NAA50 ppm	86.40	10.06	47.1	117.4
T_3 CCC100 ppm	79.37	8.83	38.1	95.1
T_4 GA10 ppm	83.20	9.66	45.2	105.5
T_5 GA10 ppm + CCC100 ppm	82.70	8.9	37.5	99.4
T_6 Control	77.78	7.16	31.2	76.2
S.Ed	0.156	0.115	0.667	2.356
C.D. at 5%	0.283	0.209	1.207	4.270

CONCLUSIONS

From the present investigation it is concluded that among the foliar treatments applied, NAA 50ppm concentration was found to be most effective and promising in improving the physiological efficiency and productivity potential of chilli Pusa Jwala in the climatic condition of Ri-Bhoi, District, Meghalaya. The treatments with plant growth regulators can be considered as a suitable cost effective technique to improve yield and quality of chilli.

FUTURE SCOPE

Under the changing climatic condition plant faced many biotic and abiotic stress which hamper the plant growth. Plant growth regulators have the potentiality to minimize the stress affect. The requirement of plant growth regulators are very less with more effect on plant growth which can minimize the requirement of conventional fertilizers.

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Conflict of Interest. None.

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