Research Article

EFFECT OF PLANT GROWTH REGULATORS ON GROWTH, YIELD AND QUALITY OF CHILLI (*Capsicum annuum* L.) AT RAMPUR, CHITWAN

B. R. Chaudhary, M. D. Sharma, S. M. Shakya and D. M. Gautam
Institute of Agriculture and Animal Sciences, Rampur, Chitwan, Nepal

ABSTRACT

The present investigation was carried out in the plain areas of Chitwan to determine the promising plant growth regulators (PGR) promoting growth and yield of chilli cultivars Jwala and Suryamukhi during winter-summer season of 2003/2004. Suryamukhi ranked superior to Jwala for most of the yield attributing characters, whereas Jwala was better in vegetative characters than Suryamukhi. Among PGRs, 2,4-D at 2 ppm was better for fruit set, number of fruits per plant, fruit length, number of seeds per fruit, seed weight per fruits, 1000 seed weight and fruit yield where as NAA at 40 ppm gave the highest leaf area index (LAI). PGRs were ineffective in promoting flowering and fruiting during winter season. GA_3 at 10 ppm exhibited maximum amount of ascorbic acid content. The treatments, 2 ppm 2,4-D, 5 ppm triacontanol, 40 ppm NAA and 10 ppm GA_3 produced 28.75%, 25.70%, 13.61% and 2.30% higher fruit yield over control, respectively. The highest net profit and B:C ratio were recorded in case of 2 ppm 2,4-D. The use of GA_3 as foliar spray was not economical.

Key words: 2,4-D, NAA, triacontanol, GA_3, leaf area index, net profit, B:C ratio

INTRODUCTION

Chilli (*Capsicum annuum* L.) is an important spice crop, grown extensively in most parts of Nepal. The fruits are available in the market throughout the year since chilies are produced in all the seasons in one or other part of the country. The production of chilli is governed not only by the inherent genetic yield potential of the cultivars but it is greatly influenced by several environmental factors and cultivation practices. 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 unfavorable environments, such as extremes of temperature i.e. too low or high temperatures (Rylski, 1973; Rylski and Halevy, 1975; Erickson and Markhart, 2001). Studies on the effect of plant growth regulators in solanaceous fruit and vegetable crops have revealed that the application of some of the plant growth regulators has been found effective in reducing the flower and fruit drops thereby enhancing production of chilli per unit area and per unit time. The varying responses of chilli to plant growth regulators have been reported by Chattopadhayay and Sen (1974), Minraj and Shanmugavelu (1987), Balraj *et al.*, (2002) and Joshi *et al.* (1999). However, information regarding the effectiveness of PGRs on growth and yield of chilli is meager in Nepal. 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, namely Jwala and Suryamukhi.

MATERIALS AND METHODS

The present investigation was conducted during winter-summer season (September to May) of 2003/04 at the Horticulture Farm of the Institute of Agriculture and Animal Science (IAAS), Rampur, Chitwan, Nepal with two popular chilli cultivars namely, Jwala and Suryamukhi as main plot treatments and four growth regulators, such as 2, 4-D at 2 ppm, NAA at 40 ppm, triacontanol at 5 ppm and GA_3 at 10 ppm and control (water spray) as sub-plot treatments. The experiment was laid out in split plot design with four replications. Each plot accommodated 24 plants planted at a spacing of 45 cm x 30 cm. A basal dose of 60 kg N, 60 kg P_2O_5 and 60 kg K_2O per hectare was applied at the time of foeld preparation. Remaining 60 kg N per hectare was applied at the time of side dressing in three equal split doses at 30, 60 and 127 days after transplanting. The nursery sowing was in the 3rd week of September and 36 days old seedling were transplanted in 3rd week of October, 2003 during evening hours and a light irrigation was given to the crop. The intercultural operations and plant protection measures were followed as per the recommendation of the crop.

RESULTS AND DISCUSSION

The data on various attributes presented in Table 1 and 2 showed that Jwala ranked better in plant height, leaf area index, fresh and dry weight of root and shoot and fruit length than Suryamukhi, while Suryamukhi topped in fruit set percent, number of fruits/plant, number of seeds/fruit, seed weight/fruit and total fruit yield. The higher plant height of Jwala might be due to its indeterminate growth habit. But in Suryamukhi, flower buds initiated in apical region of the plant thereby inhibiting the height. Similar results were reported by Elangovan *et al.* (1982). The highest fruit yield of Suryamukhi (191.2 q/ha) occurred mainly due to higher fruit set percent, greater number of fruits/plant, number of seeds/fruit and seed weight/fruit. With respect to the effect of plant growth regulators, 2, 4-D exhibited superior results to other growth regulators and control. However, in most of the yield attributing character, it was at par with triacontanol (Table 2). Fruit set in winter season was not significant due to lower temperature (<10^0C) (Rylski, 1973). Higher fruit yield with 2, 4-D and triacontanol might be due to higher fruit set percent, more number of fruits/plant, higher weight of seeds/fruit and longer fruits. Moreover, number of fruits per plant, number of seeds per fruit and seed weight per fruit had positive correlation with fruit yield. The beneficial effects of 2, 4-D and triacontanol on chilli have been reported by several research workers (Singh *et al.*, 1990; Joshi *et al.*, 1999; Balraj *et al.*, 2002; Muralidharan *et al.*, 2002; Joshi and Singh, 2001; 2003). Improvement in yield and its component characters due to application of 2, 4-D and triacontanol 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.

Table 1. Effect of plant growth regulators on growth attributes, leaf area index and fruit set of chilli cultivars

Treatments	Plant height (cm)	Leaf area index	Root weight/ plant (g)		Shoot weight/ plant (g)		Fruit set (%)	
			Fresh	Dry	Fresh	Dry	winter	Summer
A. Varieties								
Jwala	86.3	6.81	33.4	17.8	437.5	130.4	8.1	49
Suryamukhi	58.9	4.37	20.1	9.9	296.5	77.6	19	50.8
S Em	0.8	0.32	2.7	1.2	4.6	6.5	1.8	0.2
LSD (P=0.05)	2.5	1.01	8.6	3.8	14.6	20.8	5.72	0.63
B. PGRs								
control	71.5	4.65	22.9	13.1	346.2	82.3	8.3	44.8
2,4-D 2 ppm	69.7	6.03	31.9	15.5	368.8	116.3	26.6	57.9
NAA 40 ppm	73.4	6.79	27.9	13.9	365	110.6	10.3	45.4
Triacontanol 5 ppm	71.9	5.06	23.3	12.1	370	89.4	14.4	54.8
GA3 10 ppm	76.6	5.4	27.6	14.6	385	120.6	8	46.6
S Em	2.6	0.38	2.6	1.6	26.4	11.8	5.2	1.2
LSD (P=0.05)	ns	1.1	ns	ns	ns	ns	ns	3.53

Ascorbic acid content of the fruit was significantly increased (127.2 mg/100 g) with the application of GA_3 over other growth regulators. The augment of ascorbic acid with GA_3 treatment might be either due to encouragement of biosynthesis of ascorbic acid or protection of synthesized ascorbic acid from oxidation through the enzyme ascorbic acid oxidase. The results are in agreement with the findings of Chattopadhyay and Sen (1974) and Desai *et al.* (1993).

Interaction between varieties and plant growth regulators were found significant only for fresh shoot weight, short styled flowers and number of fruits/plant (Table 3). In general, all the PGRs produced higher fresh shoot weight per plant (g) than control in Jwala. However, all the PGRs except triacontanol were at par with control in Jwala. In Suryamukhi, GA_3 produced significantly higher fresh shoot weight per plant (g) than the triacontanol but it was at par with other growth regulators and with control.

In general, the number of fruits per plant increased with the application of growth regulators over control in both the varieties except GA_3 which was at par with control in Jwala. Application of 2, 4-D caused significant

Table 2. Effect of plant growth regulators on the yield and yield attributes of chilli

Treatment	Number of fruits/plant	Fruit length (cm)	Number of seeds/fruit	Seed weight/ fruits (g)	Fruit yield (q/ha)	Ascorbic acid (mg/100g)
A. Varieties						
Jwala	100	6.5	51	0.19	171.5	116
Suryamukhi	109	5.6	60	0.2	191.2	101.6
S Em	1.1	0.1	0.6	0.01	4	1
LSD (P=0.05)	3.5	0.32	1.9	0.03	12.73	3.2
B. PGRs						
Control	83	5.9	54	0.16	152.9	98.1
2,4-D 2 ppm	124	6.3	61	0.24	214.6	111.6
NAA 40 ppm	107	6	54	0.17	177	89.5
Triacontanol 5 ppm	113	6.2	55	0.23	205.8	117.8
GA3 10 ppm	94	5.9	55	0.18	156.5	127.2
S Em	2.5	0.1	1.5	0.01	6.4	2.3
LSD (P=0.05)	7.35	0.25	4.24	0.03	18.77	6.63

increase in number of fruits per plant and was higher than the other growth regulators and control in both the varieties but it was at par with the triacontanol in Jwala. Suryamukhi produced significantly more number of fruits per plant as compared to Jwala in control and GA_3.

Table 3. Interaction between varieties and plant growth regulators on fresh shoot weight, short styled flowers and fruits per plant

Treatments	Fresh shoot weight/plant (g)*		Number of fruits/plants•	
	Jwala	Suryamukhi	Jwala	Suryamukhi
Control	365	327.5	77.5	89.2
2,4-D (2 ppm)	477.5	260	122.3	126.7
NAA (40 ppm)	437.5	292.5	102.9	110.2
Triacon (5 ppm)	500	240	112.6	113.4
GA3 (10 ppm)	4.7.5	362.5	82.6	105.6

* LSD(P=0.05),for PGRs at variety = 54.518
LSD (P=0.05) for variety at PGRs = 99.383

• LSD(P=0.05),for PGRs at variety = 5.199
LSD (P=0.05) for variety at PGRs = 7.702

Based on overall performance of varieties and growth regulators, the foliar application of either 2, 4-D @ 2 ppm or triacontanol @ 5 ppm in three sprays (46, 82 and 157 DAT) can be suggested to the farmers to maximize their yield per unit area in summer season (not in winter season) in terai and inner terrain regions of Nepal.

CONCLUSIONS

The plant growth regulators were applied thrice as foliar sprays and the first spray at first flower bud initiation stage i.e. 46 days after transplanting; the second spray 82 days after transplanting and the third spray 157 days after transplanting during flowering-fruiting stage, respectively.

REFERENCES CITED

Balraj, R., M. B. Kurdikeri and Revanappa. 2002. Effect of growth regulators on growth and yield of chilli (*Capsicum annuum* L.) at different pickings. Indian J. Hort. 59 (1): 84-88.

Chattopadhyay, T. K. and S. K. Sen. 1974. Studies on the effect of different growth regulators on reproductive physiology and morphology of chilli (*Capsicum annuum* L.). Veg. Sci. 1: 42-45.

Desai, B. B., V. B. Patil and U. D. Chayan. 1993. Effects of synthetic plant growth regulators on the chemical composition of some promising chilli cultivars. J. Maharastra Agri. Univ. 18 (2): 292-293.

Elangovan, M. S., S. Pandian and P. Rangoswamy. 1982. Evaluation of chilli (*Capsicum annuum* L.) under Kovilpatti conditions. S. Indian Hort. 30 (1): 37-38.

Erickson, A. N. and A. H. Markhart. 2001. Flower production, fruit set and physiology of bell pepper during elevated temperature and vapor pressure deficit. J. American Soc. Hort. Sci. 126 (6): 697-702.

Joshi, N. C. and D. K. Singh. 2001. Effect of plant bioregulators on chilli. Veg. Sci. 28 (1): 74-75.

Joshi, N. C. and D. K. Singh. 2003. Effect of pant bioregulators on growth and yield of chilli (*Capsicum annuum* L.). Prog. Hort. 35 (2): 212-215.

Joshi, N. C., D. K. Singh and S. K. Jain. 1999. Response of plant bioregulators on growth and yield of chilli during summer season. Adv. Hort. & Fores. 7: 95-99.

Minraj, N and K. G. Shanmugavelu. 1987. Studies on the effect of triacontanol on growth, flowering, yield, quality and nutrient uptake in chillies (*Capsicum annuum* L.). S. Indian Hort. 35 (4): 362-366.

Murlidharan, R., A. Saravanan and P. Muthuvel. 2002. Effect of plant growth regulators on yield and qualityof chilli (*Capsicum annuum* L.). S. Indian Hort. 50 (1-3): 254-257.

Rylski, I. 1973. Effect of night temperature on shape and size of sweet pepper (*Capsicum annuum* L.). J. American Soc. Hort. Sci. 98 (2): 149-152.

Rylski, I. and A. H. Halevy. 1975. Optimal environment for set and development of sweet pepper fruit. Acta Hort. 42: 55-62.

Singh, D. K., G. Lal and R. P. Singh. 1990. Effect of synthetic auxins on the performance of cilli (*Capsicum annuum* L.) cultivars under tarai conditions of U. P. during winter season. Prog. Hort. 22 (1-4): 191-197.