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RESEARCH PAPER

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Effect of plant growth regulators on flower yield, vase life and economics of dutch rose (*Rosa hybrida* Linn.) cv. 'PASSION' under polyhouse condition

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ABSTRACT : The experiment was carried out at Hi-Tech Horticulture Park, Department of Horticulture, College of Agriculture, Junagadh Agricultural University, Junagadh during 2008-09. The experiment was laid out in a Randomized Block Design (RBD) with three replications and nine treatments comprising of four levels each of GA_3 (50, 100, 150 and 200 ppm) and CCC (1000, 2000, 3000 and 4000 ppm) along with control (Water spray) in protected condition. Among all treatments, an application of GA_3 200 ppm is most effective treatment for increasing number of Flowers per plant, number of flowers per square meter, number of flower per hectare and vase life of rose flowers .From Economic point of view, GA_3 200 ppm was found beneficial as compared to rest of the treatments. The highest net returns and CBR were obtained with GA_3 200 ppm.

KEY WORDS : Rose, Plant growth regulators, Yield, Vase life, Economics

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Rose (*Rosa* spp.) or "Taruni pushpa" in Sanskrit belongs to the family *Rosaceae*. Rose has ever been the world's most favourite and unchallenged Queen of flowers making the number one in world's trade. Species of the genus *Rosa* have been identified almost everywhere in the Northern Hemisphere, as far as North Alaska and Norway. The Chinese were probably the first to cultivate roses for over 2000 years before. China roses were introduced to the European markets in the mid eighteenth century (Biswas, 1983).

In India, rose is cultivated on an area of 6500 ha in different parts (Anonymous, 2008). The major rose growing states are Rajasthan, Maharashtra, Karnataka, Uttar Pradesh and West Bengal. But, the greenhouse roses with long stems as modern flowers are produced predominantly in Maharashtra, Karnataka, West Bengal, Delhi, and Punjab (Chandigarh). In Gujarat, particularly Ahmedabad, Vadodara, Surat, Navsari and Valsad districts have vast scope for the cultivation of cut flowers. The areas under flower crops in India crossed 1.5 lakh hectares in the year 2007-08 with a production of 804 thousand metric tons of loose flowers and 3772 million lakhs of cut flowers (Anonymous, 2008). In Gujarat during 2007-08, the area under flower crops was about 8400 ha with production of 54588 MT loose and cut flowers (Anonymous, 2008). In Gujarat, the area under rose cultivation was about 2558 ha with production of 16479 MT flowers. There is great demand for cut flowers in other mega cities of India and other countries also; India's export of floriculture products has gradually increased from Rs. 115.4 crore in 2001 to Rs. 649.83 crore in year 2008. India is currently exporting cut roses to U.K., U.S.A., Germany, The Netherlands, Switzerland, France, Spain and Poland.

Under protected conditions, the rose is the leading cut flower commercially grown all over world. It ranks first in global cut flower trade. This flower has a worldwide consumption of more than $40 billion. However, its cultivation demands special care and attention, so that the flower blooms to their maximum potential. Tremendous progress has been made in raising new varieties by crossbreeding and selection. Previously commercial rose cultivation in India was mainly under open field conditions. However, with the advent of state-of the-art greenhouse cultivation in early 90's, large scale cultivation of export quality cut flowers in protected condition started, there by totally altering production dynamics. Cut flower trade is worldwide dominated by Hybrid Tea roses cv. GLADIATOR, Super Star, Happiness, First Red, Passion, etc.

Plant growth regulators play an important role in enhancing growth and development of plant. These chemicals in minute quantities have an influence on flower yield and quality. Growth regulators affect plant metabolism by bringing a change in nutritional and hormonal status of the plant. Growth regulators promote, inhibit or modify the physiological processes of the plant. They increase the flower yield and improve the quality by altering the behaviour of plant systems. They help in synthesis of metabolites and translocation of nutrients and assimilation of these into different plant parts, which ultimately result into higher yield and flower quality improvement.

RESEARCH METHODS

Experimental site :

The present experiment was carried out at Hi-tech Horticulture Park, (Greenhouse unit No. 6) Department of Horticulture, College of Agriculture, Junagadh Agricultural University, Junagadh during the year 2008-09. Experiment details are given in Table A.

Table A : Experimental details

1.	Location	:	Hi-tech Horticultural Park (Polyhouse Unit no.6), Department of Horticulture, College of Agriculture, Junagadh Agricultural University, Junagadh, Gujarat (India).
2.	Design	:	Randomized Block Design (RBD)
3.	Year of experiment	:	2008-09
4.	Replications	:	Three (3)
5.	Treatments	:	Nine (9)
6.	Spacing	:	0.40m×0.30m×0.50m (pair row planting) Net plot size = 7.40m × 0.50m Gross plot size = 8.40m × 0.50m

Treatment details :

Nine treatments studied in the experiment are given in Table B:

Table B : Treatment details

Sr. No	Treatment No.	Treatments
1.	T_1	GA_3 50 ppm
2.	T_2	GA_3 100 ppm
3.	T_3	GA_3 150 ppm
4.	T_4	GA_3 200 ppm
5.	T_5	CCC 1000 ppm
6.	T_6	CCC 2000 ppm
7.	T_7	CCC 3000 ppm
8.	T_8	CCC 4000 ppm
9.	T_9	Control (Water Spray)

Experiment was conducted in Randomized Block Design having three replications. The treatments of foliar application of growth regulators *viz.*, Gibberellic acid 50, 100, 150 and 200 ppm and Cycocel 1000, 2000, 3000 and 4000 ppm along with control were given after bending operation. Results of this investigation are discussed by reviewing the available literature.

The grown rose flower plants under different treatments was observed for yield parameters *viz.*, number of Flowers per plant, number of flowers per square meter and number of flower per hectare, Vase life of flowers and the economics of different treatment was calculated on the basis of cost of the treatment.

Statistical analysis of data of various characters will be carried out as per Randomized Block Design (RBD). Analysis of variance will be worked out using standard statistical procedures as described by Panse and Sukhatme (1985).

RESEARCH FINDINGS AND DISCUSSION

The findings of the present study as well as relevant discussion have been presented under following heads :

Number of flowers per plant :

It was observed from Table 1 that, the number of flowers per plant was increased significantly with the increasing levels of gibberellic acid. GA_3 through alpha-amylase activity, auxin stimulating effect and cell wall loosing, increased cell elongation along with the cell enlargement. All these caused effect on increased leaf area, thereby causing increased photosynthetic area. Thus, this caused increase in carbohydrate food material. Similar trends were in consonance with Bankar and Mukhopadhyay (1982); Gowda (1985, 1988); Bhattacharjee (1993); Patil (2001) and Chaudhari (2003) in rose.

Number of flowers per square meter:

The flower yield per square meter observed in Table 2 was significantly increased with the increasing levels of gibberellic acid from 50 to 200 ppm. Higher yields of flowers per square meter are attributed to the production of large number of laterals at the early stage, which then had sufficient time to accumulate reserve carbohydrates for flower bud differentiation. Reports of Sable *et al.* (1992); Patil (2001) and Chaudhari (2003) on rose confirm the effect of GA_3. A similar effect of GA_3 on flower production was noted by Pappiah and Muthuswamy (1977) in *Jasminum auriculatum* and Bhattacharjee (1985) in *Jasminum arborescence* Roxb.

The flower yield per square meter (Table 2) increased with cycocel spray at concentration of 3000 and 4000 ppm. Increased flower yield in recent study are in agreement with the results obtained in rose by Bhattacharjee and Singh (1995) and Patil (2001).

Number of flowers per hectare (lakh) :

It was observed from Table 3 that the number of flowers per hectare was increased significantly with the application of GA_3 (50, 100, 150 and 200 ppm). The increase in yield due to GA_3 might be due to decrease in

Table 1 : Effect of plant growth regulators on no. of flowers per plant in rose (*Rosa hybrida* Linn.) cv. "PASSION" under polyhouse condition.

Treatment No.	Treatments details	No. of flowers per plant
T_1	GA_3 50	15.03
T_2	GA_3 100	19.00
T_3	GA_3 150	23.00
T_4	GA_3 200	28.07
T_5	CCC 1000	12.00
T_6	CCC 2000	14.00
T_7	CCC 3000	17.17
T_8	CCC 4000	23.37
T_9	Control	13.20
	S.E.±	0.863
	C.D. (P=0.05)	2.59
	C.V.%	8.16

Table 2 : Effect of plant growth regulators on no. of flowers per square meter in rose (*Rosa hybrida* Linn.) cv. "PASSION" under polyhouse condition.

Treatment no.	Treatments details	No. of flower per square meter
T_1	GA_3 50	75.03
T_2	GA_3 100	95.00
T_3	GA_3 150	115.00
T_4	GA_3 200	140.33
T_5	CCC 1000	60.00
T_6	CCC 2000	70.00
T_7	CCC 3000	85.83
T_8	CCC 4000	116.83
T_9	Control	66.00
	S.E.±	4.327
	C.D. (P=0.05)	12.97
	C.V.%	8.19

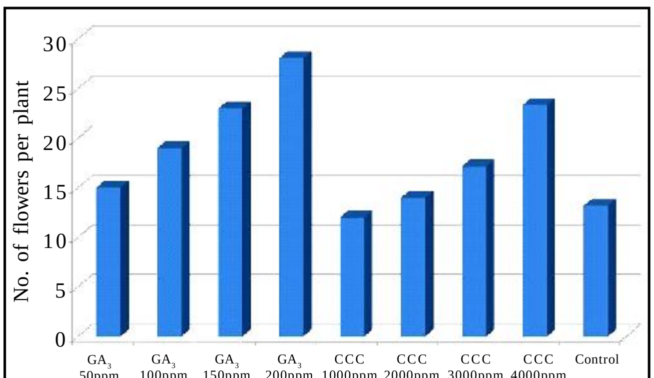

Fig. 1 : Effect of plant growth regulators on no. of flowers per plant in rose (*Rosa hybrid* Linn.) cv. "PASSION" under polyhouse condition

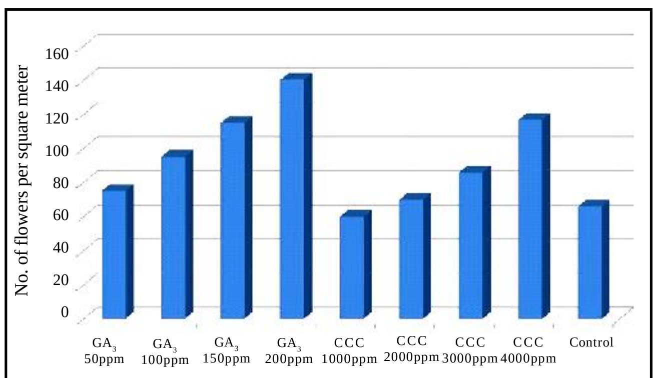

Fig. 2 : Effect of plant growth regulators on no. of flowers per square meter in rose (*Rosa hybrid* Linn.) cv. "PASSION" under polyhouse condition

blind shoots as a result of chemical sprays. In treated plants with GA, reduced the atrophy of flower buds, the main factor responsible for blindness (Dhekney *et al.*, 2000). GA_3 through alpha-amylase activity, auxin stimulating effect and cell wall loosing, increased cell elongation along with cell enlargement. All this causes

Table 3 : Effect of plant growth regulators on no. of flowers per hectare (lakh) in rose (*Rosa hybrida* Linn.) cv. "PASSION" under polyhouse conditions

Treatment no.	Treatments details	No. of flower per hectare (lakh)
T_1	GA_3 50	7.50
T_2	GA_3 100	9.50
T_3	GA_3 150	11.50
T_4	GA_3 200	14.03
T_5	CCC 1000	6.00
T_6	CCC 2000	7.00
T_7	CCC 3000	8.58
T_8	CCC 4000	11.67
T_9	Control	6.60
	S.E.±	0.431
	C.D. (P=0.05)	1.29
	C.V.%	8.16

Table 4 : Effect of plant growth regulators on vase life of flowers in rose (*Rosa hybrida* Linn.) cv. "PASSION" under polyhouse condition

Treatment no.	Treatment details	Vase life of flowers (days)
T_1	GA_3 50	9.00
T_2	GA_3 100	10.17
T_3	GA_3 150	11.27
T_4	GA_3 200	12.23
T_5	CCC 1000	7.23
T_6	CCC 2000	7.43
T_7	CCC 3000	8.00
T_8	CCC 4000	8.23
T_9	Control	5.77
	S.E.±	0.339
	C.D. (P=0.05)	1.02
	C.V.%	6.66

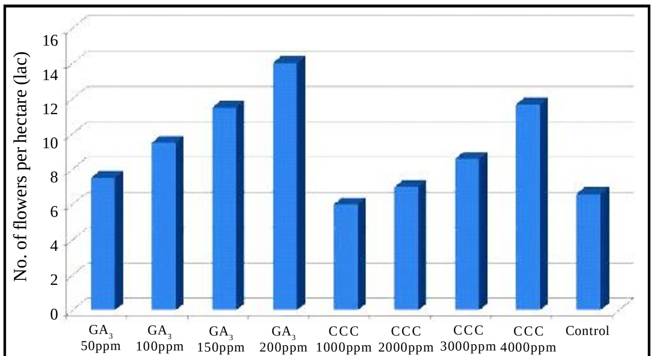

Fig. 3 : Effect of plant growth regulators on no. of flowers per hectare (lakh) in rose (*Rosa hybrid* Linn.) cv. "PASSION" under polyhouse condition

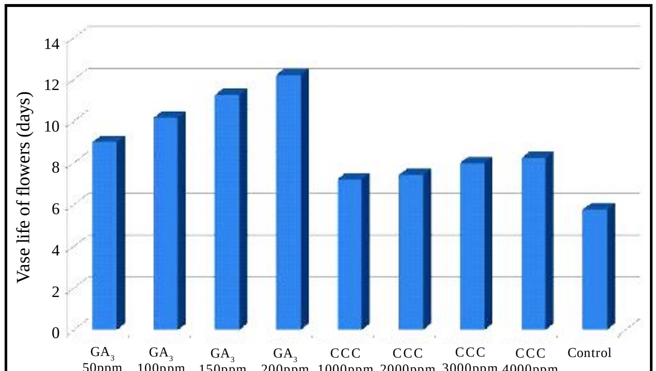

Fig. 4 : Effect of plant growth regulators on vase life of flowers in rose (*Rosa hybrid* Linn.) cv. "PASSION" under polyhouse condition

Table 5 : Economics and cost benefit ratio of rose as influenced by different growth regulators.

Treatment details		Yield (Number of flowers) (Rs. Lakh/ha)	Gross realization (Rs. Lakh/ha)	Total cost of cultivation (Rs. Lakh/ha)	Net return (Rs. Lakh/ha)	CBR
T_1	GA_3 50 ppm	7.50	15.00	9.39	5.61	1:1.59
T_2	GA_3 100 ppm	9.50	19.00	9.46	9.54	1:2.00
T_3	GA_3 150 ppm	11.50	23.00	9.53	13.47	1:2.41
T_4	GA_3 200 ppm	14.03	28.06	9.60	18.46	1:2.92
T_5	CCC 1000 ppm	6.00	12.00	9.34	2.66	1:1.28
T_6	CCC 2000 ppm	7.00	14.00	9.37	4.63	1:1.49
T_7	CCC 3000 ppm	8.58	17.16	9.40	7.76	1:1.82
T_8	CCC 4000 ppm	11.67	23.34	9.43	13.91	1:2.47
T_9	Control	6.60	13.2	9.31	3.89	1:1.41

Average price of flower sale: Rs.2/flower

Cost of inputs: GA_3 = 131 Rs./ 1g, CCC = 950 Rs. / 500ml had effect on increased leaf area, thereby causing increased photosynthetic area. Thus, caused increase in carbohydrate food material. Similar trends were in consonance with Nanjan and Muthuswamy (1975) and Patil (2001) in rose.

The flower yield per hectare (Table 3) increased with cycocel spray at concentration of 3000 and 4000 ppm. Increased flower yield in recent study are in agreement with the results obtained in rose by Bhattacharjee and Singh (1995) and Patil (2001).

Vase life of flowers:

The data presented in Table 4 revealed that cut flowers obtained from plants that were treated with GA_3 200 ppm showed the maximum vase life as compared to other treatments as well as control. This might be due to higher stalk length as well as more number of petals. GA_3 reduced the water loss and has anti-senescence property leading to enhanced vase-life of flowers, which was also reported by Dehale *et al.* (1993). GA_3 increased flower size, which increased stored food material in the tissue, which caused increase in vase life of flowers indirectly. The positive effect of GA_3 in extending the vase life observed in the present study is in consonance with the findings of Dhekney *et al.* (2000) in rose and Dutta *et al.* (1993) and Dehale *et al.* (1993) in chrysanthemum.

It is obvious from Table 4 that each concentration of CCC (at 1000, 2000, 3000 and 4000 ppm) increased the shelf life of rose as compared to control. The vase life of rose was increased with increase in the level of CCC concentration. The maximum vase life (8.23 days) was recorded with 4000 ppm. These results are in conformity with the observations of Makwana (1999) in gaillardia and Pandya (2000) in marigold.

Economics :

Economics is the need of the hour for the farmers while taking a decision regarding the adoption of a new technique in greenhouses. Hence, the gross realization, net realization and cost benefit ratio was computed for different growth regulator treatments (Table 5).

In the present experiment, the highest economical gain of Rs.18.46 lakh/ha was recorded with GA_3 200 ppm followed by GA_3 150 ppm (Rs. 13.47 lakh/ha.), CCC 4000 ppm (Rs.13.91 lakh/ha.). The highest CBR (1:2.92) was obtained under the GA_3 200 ppm followed by GA_3 150 ppm (1:2.41) and CCC 4000 ppm (1:2.47). These findings could be supported by reports of Chaudhari (2003) and Patil (2001).

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