International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2019; 7(4): 3090-3093

Received: 09-05-2019
Accepted: 13-06-2019

Pawan Kumar
Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India

Anjana Sisodia
Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India

Minakshi Padhi
Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India

Kalyan Barman
Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India

Anil K Singh
Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India

Correspondence
Minakshi Padhi
Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India

Plant growth and flowering in rose as influenced by application of calcium sulphate and salicylic acid

Pawan Kumar, Anjana Sisodia, Minakshi Padhi, Kalyan Barman and Anil K Singh

Abstract
The experiment was carried out at Horticulture Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi during 2018-19. The experiment was laid out in a Randomized Block Design (RBD) with four replications and seven treatments comprising of three levels each of $CaSO_4$ (5, 10 and 15 ppm) and SA (50, 100 and 150 ppm) along with control (Distilled water) in protected condition. Among all treatments, application of salicylic acid (SA) 150 ppm was most effective treatment for increasing growth parameters such as plant height, number of leaves per plant or per branch, number of branches per plant, flowering characters *viz*., early bud initiation, flower initiation, petals length, petal breadth and in all others parameters. From economic point of view, SA 150 ppm was found beneficial as compared to rest of the treatments.

Keywords: Rose, salicylic acid, $CaSO_4$, growth and flower initiation

Introduction
Rose (*Rosa hybrida*) belongs to the family Rosaceae. The rose is one of the oldest flowers in cultivation and most popular of all garden flowers throughout the world (Singh, 2006) [11]. The value of world exports of cut flowers showed an increasing by 10-15 percent per year. India has an age old tradition of growing flowers for various aspects. Introduction of greenhouse technology for cultivation of cut flowers in India in the recent past years has changed the scenario of Indian floriculture (Ramalingam, 2008) [9]. Huge capital investment has been made by the growers for the production of cut flowers meant to be 100 per cent export oriented. Among the cut flowers grown in India primarily for export, rose tops the area grown under protected conditions (Arun *et al.*, 1999) [2]. A fierce competition exists in the international flower market, where Indian roses suffer from poor prices due improper pre and postharvest handling techniques (Patel *et al*., 2007) [8].

Rose is regarded as queen of flower but vase life of rose is short due to limited water uptake, low available energy and susceptibility towards salicylic acid and calcium sulphate synthesis. Among various cultivars, rose cultivar Pleasure is a popular cut rose cultivar valued for its pink colour flower, long stalked flowers and leads the group of cultivars grown for cut flowers under closed and protected ecosystems. So for these aspects of chemical growth regulations on cut flower crops under protected conditions have not been extensively studied in India. Preharvest application of $CaSO_4$ could be effective in extending vase life of cut rose flowers. Increased Ca^{+2} concentrations in the petals should lead to lower membrane permeability and thus to better membrane functionality, which may delay disruption of Compartmentation and maintain the normal cellular functions for a longer period (Nabigol, 2012) [7]. Addition of SA and sucrose to vase solution of cut roses caused a significant reduction in respiration rate, alleviation of the moisture stress and improved the vase life (Senaratna *et al*., 2000) [10]. Even postharvest dipping of cut flowers in salicylic acid along sucrose solution effectively preserved the quality, delayed senescence and extended vase life of flowers during storage condition (Singh *et al*., 2018) [12]. The optimum quality for export of cut roses can be achieved by adopting proper pre and postharvest handling techniques (Chakradhar and Khiratkar, 2003 [4], and Hashemabadi and Zarchini, 2010) [6]. In order to study the effects of various growth regulating chemicals on the growth, flowering, yield and export quality of cut rose flowers, the present investigations were undertaken.

Materials and Methods

The experiment was conducted during 2018-2019 under protected polyhouse conditions at the Horticulture Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi. The present study was carried out in a rose cv. Pleasure. This cultivar is highly suitable for production of long stalked cut flowers and pink coloured flowers for international cut rose markets. The experiment was laid out with seven treatments with four replications in a Randomized Block design (RBD). Growth attributes and flowering parameters were observed with stipulated time interval. The study involved treatments with calcium sulphate ($CaSO_4$) (5, 10 and 15 ppm), salicylic acid (SA) (50, 100 and 150 ppm) and distilled water as control. The treatment solutions were made by dissolving chemicals in ethanol and volume made up by adding distilled water according to required concentration. The treatment chemicals were sprayed at 30 days after pruning. The observations were taken at a regular basis and were statistically analyzed at 0.05 probability.

Result and Discussion

Table 1: Effect of plant growth regulators on growth attributes on rose cv. Pleasure.

Treatment	Plant height at 60 DAS	No. of leaves at 60 DAS	No. of leaves/branch at 45 DAS	No. of branch/plant
$CaSO_4$ 5 ppm	59.80	83.50	34.75	2.00
$CaSO_4$ 10 ppm	62.97	89.25	35.50	2.25
$CaSO_4$ 15 ppm	70.97	91.50	38.60	2.25
SA 50 ppm	71.70	94.50	39.38	2.25
SA 100 ppm	75.10	96.75	41.38	2.50
SA 150 ppm	75.70	103.25	43.38	2.75
Control	56.67	76.50	31.00	2.00
CD at 5%	10.38	7.41	4.76	NS

It is apparent from the Table 1 that all the three parameters were found significant except number of branches per plant. Maximum plant height at 60 DAS was recorded with the application of SA 150 ppm (75.70 cm) which was statistically at par with SA 100 ppm (75.10 cm), SA 50 ppm (71.70 cm) and$CaSO_4$ 15 ppm (70.97 cm), respectively. While, minimum plant height was recorded in plants treated with distilled water as control (56.67 cm). Maximum number of leaves at 60 DAS and number of leaves per branch at 45 DAS was registered with the application of SA 150 ppm (103.25 and 43.38) which found statistically at par with the application of SA 100 ppm (96.75 and 41.38) and found significant to other treatments. While minimum for both the parameters was recorded with plants treated with distilled water (Control) (76.50 and 31.00). It is due to the effect of salicylic acid that is having defensive feature induced a protective mechanism under unfavorable environmental conditions in plant physiology. This might help in accelerating related genes responsible for defensive control induces specific changes in leaf number. A similar result was found by Ehness and Roitsch (1997) [5]. In soybean, Yildirim *et al.* (2008) [14]. In cucumber and Singh (1993) [13]. In ornamental plants. However, the number of branches per plant was failed to exert any significant effect due to various effects of SA and $CaSO_4$ in rose cv. Pleasure. The maximum number of branches per plant was recorded in plants treated with SA 150 ppm (2.75) while, minimum numbers of leaves per plant were found with control (2.00).

Table 2: Effect of SA and $CaSO_4$ on flowering attributes in rose cv. Pleasure.

Treatments	Days to bud initiation	Days to flower initiation	No. of petals/flower	Bud length (cm)	Bud diameter (cm)	Petals length (cm)	Petals breadth (cm)
$CaSO_4$ 5 ppm	28.00	34.50	24.00	2.24	1.55	4.51	4.24
$CaSO_4$ 10 ppm	27.10	34.15	25.75	2.28	1.58	4.56	4.71
$CaSO_4$ 15 ppm	26.94	33.13	27.13	2.30	1.61	4.58	4.71
SA 50 ppm	26.17	32.88	27.38	2.32	1.69	4.60	4.78
SA 100 ppm	25.83	31.75	28.75	2.42	1.80	4.71	4.93
SA 150 ppm	25.00	31.25	29.63	2.63	1.86	4.82	5.18
Control	28.61	35.38	23.13	2.05	1.52	4.50	4.00
CD at 5%	NS	NS	2.04	0.28	0.22	0.21	0.26

It is evident from the Table 2 that all the given flowering attributes were found significant except for the parameters like days taken to bud and flower initiation. It was found that treatment with SA 150 ppm exerted for early initiation of bud and flower (25.00 days and 31.25 days) in rose cv. Pleasure; while delayed initiation was registered with control (28.61 days and 35.38 days) during the study.

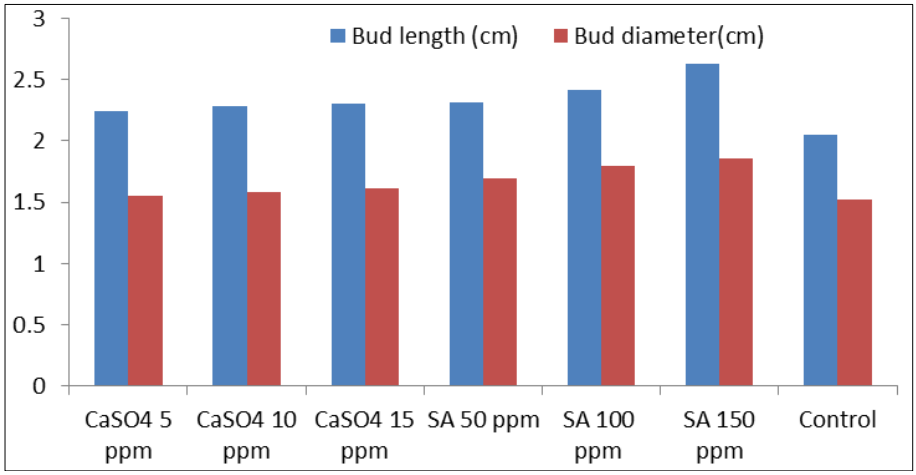

Fig 1: Effect of $CaSO_4$ and SA on bud length and bud diameter.

Maximum bud length was obtained in the plants treated with SA 150 ppm (2.63 cm) which was statistically at par with SA 100 ppm (2.42 cm). Whereas, minimum bud length was recorded with control (2.05 cm). Maximum diameter of bud, petal length, petal breadth and more number of petals were registered by plants treated with SA 150 ppm (1.86 cm, 4.82 cm, 5.18 cm and 29.63, respectively) which was statistically at par with SA 100 ppm (1.80 cm, 4.71 cm, 4.93 cm and 28.75, respectively) While, minimum bud diameter, petal length, petal breadth and less number of petals per flower were obtained with control (1.52 cm, 4.50 cm, 4.00 cm and 23.13, respectively). The increase in bud and petal geometry might be due to a significantly higher water uptake and maintain the water in cut flowers which increases the number of petals and length and breadth of buds and petals, subsequently. The increase in water uptake is apparently due to the acidifying and stress alleviating properties of SA (Bayat and Aminifard, 2017) [3].

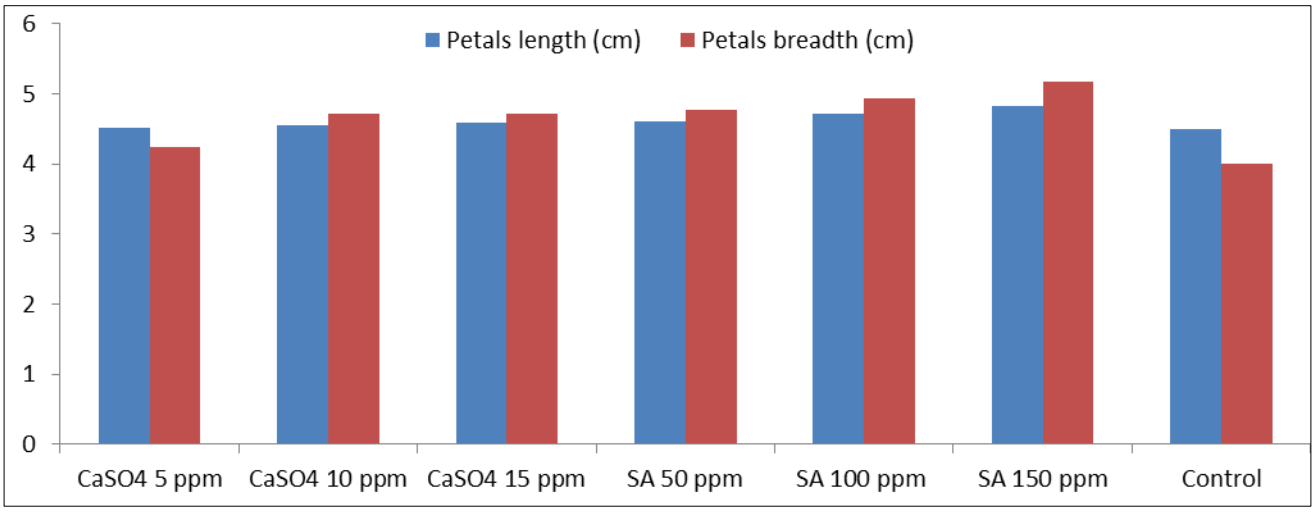

Fig 2: Effect of $CaSO_4$ and SA on petal length and petal breadth.

Conclusion

It is clearly indicated by findings of present study that foliar application of salicylic acid on cut rose flowers effectively influenced vegetative growth and flowering characters. These characteristics suggest that SA150 ppm can be considered as a novel substance for influencing vegetative growth and flowering characters. However, further research is needed to optimize SA treatments for this purpose.

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