



Effect of polyamines and natural growth substances on the growth and flowering of rose (*Rosa hybrida*) cv. Samurai under protected conditions

Sumathi Tatte¹, Alka Singh^{1*} and T. R. Ahlawat²

¹Department of Floriculture and Landscape Architecture, ACHF, Navsari Agricultural University, Navsari-396450 (Gujrat), INDIA

²Department of Fruit Science, ACHF, Navsari Agricultural University, Navsari-396450 (Gujrat), INDIA

*Corresponding Author. E-mail : dralkasinghdhaka@gmail.com

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Abstract: Investigations were conducted to study the effect of different polyamines and natural growth substances as a pre harvest foliar spray on greenhouse rose cv. Samurai. The study involved preharvest foliar spraying with polyamines like spermine (10 ppm) and spermidine (10 ppm); natural growth substances like enriched banana pseudostem sap (1 per cent) and cow urine (2 per cent). All the treatments improved the vegetative and flowering characters over control. However, among different treatments, foliar spray of spermine 10 ppm, followed by spermidine 10 ppm were highly significant in influencing all vegetative parameters like plant height (79 cm), number of branches per plant (3.73), stem girth (10.69 mm), number of leaves per plant (91.33), leaf area (14.68 cm²) and leaf chlorophyll content (36.96 mg/g). Further, flowering parameters like flower stalk length (61.24cm), bud length (2.70mm), flower diameter (6.50 cm), number of petals per flower (55.90) and vase life (6.63 days) were significantly maximum in plants sprayed with spermine 10ppm. The treatment of foliar spray with spermine and spermidine almost doubled the flower production and improved the flower quality in terms of bud size and vase life as compared to control.

Keywords: Enriched banana pseudostem sap, Polyamines, Rose, Spermine, Spermidine

INTRODUCTION

Protected cultivation of flower crops is a leading industry in India and has the potential to change the scenario of Indian floriculture (Ramalingam, 2008 and Patel *et al.* 2014). Among the cut flowers grown in India primarily for export, rose tops the area grown under protected conditions (Sudhagar *et al.* 2013). Though roses occupy the top places in all international cut flower markets, competitions are very intensive where quality plays a priority role. A fierce competition exists in the international flower market with regard to flower quality wherein pre and post harvest handling techniques can play important role (Tatte *et al.*, 2015). The causes of this low quality can be primarily attributed to non-adoption of scientific management practices namely; low quality planting material, improper nutritional and plant protection practices and lack of technical knowledge regarding the various crop regulation and post harvest practices (Sharma *et al.*, 2001). Polyamines comprising of spermine, spermidine and putrescine form a new class of aliphatic amines that are ubiquitous in living organisms and they are involved in many plant developmental processes, including cell division, embryogenesis, reproductive organ development, root growth, tuberization, floral initiation and development (Galston *et al.*, 1997; Bais and Ravishankar, 2002). PAs and their biosynthetic

enzymes are associated with rapid cell division in many plant systems *viz.*, carrot embryogenesis (Montague *et al.*, 1978), tomato ovaries (Heimer and Mizrahi, 1982), tobacco ovaries (Slocum and Galston, 1985), fruit development (Kakkar and Rai, 1993) and other plant species (Bias and Ravishankar, 2002). High levels of endogenous PAs and their conjugates have also been found in apical shoots and meristems prior to flowering (Cabanne *et al.*, 1981). Significant effect of Putrescine on flower yield and chemical composition in *Chrysanthemum* has been reported (Mahros *et al.*, 2011). Further, increased flowering parameters like flower stalk length, flower bud diameter, bud height, fresh weight of flower stalk and vase life of rose flower with spermidine has been observed in rose (Farahi *et al.*, 2012). Banana pseudo stem sap has some special properties relating to various growth phenomena and is a potential source of cellulose, consisting of different phytochemicals. It is a novel organic liquid fertilizer and has a rich source of macro and micro nutrients comprising of N-280 mg/l, P-15 mg/l, K-3200mg/l, Ca- 90mg/l, Mg-400mg/l, S-210mg/l, Fe-8.2mg/l, Mn-6.5mg/l, Zn-1.43mg/l, Cu-0.52mg/l (Patil, 2008). Banana pseudo stem enriched sap contains growth regulators like GA₃ and cytokinin apart from essential plant nutrients. Influence of polyamines and natural growth substances on cut flower crops under protected conditions has not been extensively studied

in India. Hence, this experiment was planned to study the influence of polyamines (spermine, spermidine and putrescine) and natural growth substances (cow urine and enriched banana pseudostem sap) spray on vegetative and floral growth of rose (*Rosa hybrida*) plants with the basic objective to obtain improved flower quality of cut roses.

MATERIALS AND METHODS

Location:The experiment was conducted under naturally ventilated polyhouse at greenhouse complex, Department of floriculture and landscape architecture, Navsari agricultural university, Navsari, Gujarat, India.

Crop and variety:The research work was carried out in a Hybrid Tea rose variety 'Samurai'. The variety is suitable to tropical conditions.

Preharvest spray of chemicals and natural growth substances: The experiment was laid out with five treatments in a randomized block design (RBD) with three replications. One year old uniform budded rose plants of cv. Samurai grown on raised beds in polyhouse were used to study. The study involved with preharvest spray treatments with Spermine (10 ppm), Spermidine (10 ppm), Enriched banana pseudostem sap (1%), cow urine (2%) and controls. Plots were sprayed with treatments 15 days after pruning and repeated after 15 days interval.

Measurement of traits: Traits were measured as following: plant height, length of flower stalk by ruler, leaf area by digital leaf area meter, bud length, bud diameter, flower diameter by vernier calipers. Bud diameter and bud length were measured at tight bud stage while flower diameter was measured at fully opened flower stage. Number of flowers per plant were counted based on flowering in one month obtained after regular pinching and bending practices. Number of branches per plant, number of leaves per stalk, petals per flower and vase life (days to wilting) were counted and recorded.

Chlorophyll content (mg/g):The total chlorophyll content was determined by following the method of Yoshida *et al.*, (1971) and expressed in mg/g of fresh weight.

Statistical analysis: The statistical analysis was done

by adopting the standard procedures of Panse and Sukhatme (1985) and the results were interpreted.

RESULTS AND DISCUSSION

In the present study, rose plants sprayed with polyamines and natural growth substances, showed good vegetative and floral growth compared to untreated plants. Among all the treatments studied, plants sprayed with 10 ppm spermine exhibited maximum plant height (79.00 cm), number of branches (3.73), number of leaves (91.33), leaf area (14.68 cm²), followed by plants sprayed with 10 ppm spermidine. Further, polyamines play roles such as a new class of plant growth regulators, Hormonal Second Messengers (HSM) and one of the reserves of carbon and nitrogen (Galston and kaur-Sawhney, 1997). Polyamines form a class of aliphatic amines that are ubiquitous in plants and have been implicated in wide range of biological processes, including cell division, protein synthesis, DNA replication, differentiation and rhizogenesis (Tabor and Tabor, 1984; Smith, 1985; Van Broeck *et al.*, 1994). Further, direct relationship of polyamines has been established with N (Zhang *et al.* 2013)), P (Hewitt, 1963, Aldesuquy *et al.*, 2014) and K (Amri *et al.* 2011)). Spermine and spermidine seem to mediate sensing signal mechanisms and gene players via N assimilation and carbon metabolism in different plant organs (Foyer *et al.*, 2002; Scheible *et al.*, 1997; Scheible *et al.*, 2000). The positive effect of polyamines on growth has also been earlier attributed to enhanced cell division and expansion (Cohen, 1988). Significantly maximum chlorophyll (3.96 mg/g) content was observed in plants sprayed with spermine 10 ppm, which was followed by spermidine 10 ppm (3.65 mg/g) as compared to control (1.95 mg/g). Exogenous application of polyamines in carnation has been also shown to retard chlorophyll loss and senescence in carnation (Lee *et al.*, 1997). Further, increase in the chlorophyll content in leaves was found due to foliar application of polyamines in gladiolus (Nahed *et al.*, 2009) and in chrysanthemum (Mahros *et al.*, 2011). Foliar application of polyamines have earlier shown to promote vegetative growth in matthiola (Youssef *et al.*, 2004), in periwinkle (Iman *et al.*, 2005), in *Di-*

Table 1. Effect of different polyamines and natural preservatives as pre harvest spray on vegetative growth of rose cv. Samurai.

Treatments	Plant height (cm)	Number of branches	Stem girth (mm)	Number of leaves	Leaf area (cm ²)	Chlorophyll content (mg/g)
T ₁ Spermine @ 10 ppm	79.00	3.73	10.69	91.33	14.68	3.96
T ₂ Spermidine @ 10 ppm	70.36	3.03	9.60	61.67	10.07	3.65
T ₃ Enriched banana pseudostem sap @ 1%	63.93	2.77	9.40	42.00	11.29	3.03
T ₄ Cow urine @ 2 %	69.64	2.00	9.58	31.33	8.03	2.89
T ₅ Control	65.00	1.80	9.15	32.33	8.55	1.95
S.Em _±	2.09	0.10	0.30	1.80	0.34	0.09
CD 5%	6.82	0.34	0.97	5.88	1.12	0.30
CV %	5.20	6.69	5.32	6.04	5.63	5.11

Table 2. Effect of different polyamines and natural preservatives as pre harvest spray on flowering of rose cv. Samurai.

Treatments	Length of flower stalk (cm)	Number of flowers	Bud length (cm)	Bud diameter (cm)	Flower diameter (cm)	Number of petals per flower	Vase life (Days)
T ₁ spermine @10 ppm	61.24	6.19	2.70	2.60	6.50	55.90	6.63
T ₂ spermidine @10 ppm	57.20	6.00	2.50	2.14	6.36	53.18	6.53
T ₃ Enriched banana pseudostem sap @1%	53.18	5.53	2.34	2.02	6.30	48.82	6.47
T ₄ cow urine @ 2 %	48.13	4.53	2.26	1.91	6.13	41.65	6.40
T ₅ control	39.83	3.36	2.10	1.60	5.89	40.43	5.98
S.Em±	1.13	0.15	0.06	0.07	0.09	0.84	0.09
CD 5%	3.67	0.49	0.20	0.22	0.28	2.74	0.28
CV %	3.76	5.07	4.54	5.65	3.13	3.03	3.13

anthus caryophyllus and *Dahlia pinnata* (Mahgoub *et al.*, 2006, 2011) and in gladiolus (Nahed *et al.*, 2009).

Foliar application of spermine and spermidine both, showed significant effect on floral attributes in rose in the present study. Different flowering characters like length of flower stalk (61.24 cm), length of bud (6.19 cm), flower diameter (6.50 cm), number of petals per flower (55.90), number of flowers per plant (6.19) and vase life (6.63) were found to be significantly maximum with the application of 10 ppm spermine, followed by 10 ppm spermidine as compared to control with 39.83 cm flower stalk, 3.36 number of flowers, 2.1 cm bud length, 1.6 cm bud diameter, 5.89 cm flower diameter, number of petals (40.43) and 5.98 days of vase life. Conjugated polyamines are known to be associated with the physiology of flowering metabolite synthesis (Slocum and Galston, 1985). Correlation between polyamines and flowering processes has been observed earlier in cherries (Wang *et al.*, 1985) and in *Arabidopsis* (Applewhite *et al.*, 2000). High levels of endogenous polyamines and their conjugates have been known to be found in apical shoots and meristems prior to flowering in tobacco (Cabanne *et al.*, 1981) and flower parts of many plants (Martin-Tanguy, 1985). Further, Farahi *et al.*, (2012) reported improved stalk length, length of bud and bud diameter with foliar application of spermidine in rose plants. Beneficial effects of polyamines on flower parameters have also been reported in chamomile plant (Wahed *et al.*, 2004), datura (Youssef *et al.*, 2004), carnation (Mahagoub *et al.*, 2006), gladiolus (Nahed *et al.*, 2009) and chrysanthemum (Mahros, *et al.*, 2011).

Conclusion

In the present investigation, significant role of a new class of growth hormone, polyamines *viz.*, spermine and spermidine in overall plant growth and development in rose plants has been found. The treatment comprising of foliar application of 10 ppm of spermine and 10 ppm of spermidine were highly effective in influencing plant growth and improving flower parameters in rose plants. Number of branches, number of leaves, leaf area, chlorophyll content and number of flowers were almost doubled in plants and flower qual-

ity was significantly improved with 10 ppm spermine and spermidine foliar spary as compared to control..

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