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Effect of Foliar Spray of Polyamines and Biostimulants on Rose (*Rosa hybrida* L.) under Polyhouse Condition

Alka Singh [a*], H. P. Shah [a], G. D. Patel [a] and T. R. Ahlawat [b]

[a] Department of Floriculture and Landscape Architecture, ACHF, Navsari Agricultural University, Navsari, India.
[b] Department of Fruit Science, ACHF, Navsari Agricultural University, Navsari, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Investigation was done to find out the effect of different polyamines *viz*., spermine and spermidine (5, 10, 20 mg/l) and biostimulants *viz*., 2 % Novel (banana pseudostem sap) and 2% cow urine as foliar spray on growth parameters of rose var. Top Secret.

Plant height, number of branches and number of leaves were found to be significantly higher with foliar spray of polyamines and biostimulants. Maximum plant height was found in plants treated with 20 mg/l spermidine while number of branches were found maximum in plants treated with 20 mg/l spermine. Maximum number of leaves were observed with 20 mg /l spermine and were at par with 10 mg/l spermine and 20 mg/l spermidine.

Flower stem length and stem diameter were significantly maximum with treatment 20 mg/l spermine, at par with 10 mg/l spermine and 2% novel. Bud diameter was significantly higher with treatment of 10 mg/l spermine, 20 mg/l spermine, 20 mg/l spermidine and 2% novel while bud length and flower diameter were maximum in 20 mg/l spermidine. Chlorophyll and anthocyanins pigments were observed maximum in plants treated with 20 mg/l spermine followed by 2% Novel spray. Further, plants treated with 2% Novel showed maximum flower yield (16.98 flowers/plant) as well as vase life (8.53 days).

Keywords: Rose; polyamines; spermine; spermidine; banana pseudostem sap (Novel).

**Corresponding author: E-mail: alkaflori@nau.in;*

1. INTRODUCTION

Protected cultivation of flower crops is gaining significance for quality flower production both for National market as well as exports. Rose (*Rosa hybrida*L.) from Rosaceae family is one of the most commercial and popular cut flowers in the world and holds leading position in planting area, production rate, employment, and exports [1,2]. In fierce competitive international flower market, quality cut flower production plays important role wherein Indian roses suffer from lower prices owing to poor quality [3]. From this perspective, the application polyamines can be an effective way to improve the quantitative and qualitative traits in rose [4]. Polyamines viz., spermine, spermidine and putrescine are a new class of growth hormones that are ubiquitous in living organisms and involved in many plant developmental processes, including cell division, embryogenesis, reproductive organ development, root growth, as well as floral initiation and development [5,6]. Significant effect of polyamines on flower quality, vase life and yield has been reported in chrysanthemum [7], Gladiolus [8] and in rose [4,9]. Biostimulant *viz*., Novel is composed of banana pseudo stem sap, a patented product of Navsari Agricultural University, that has been known to have some special properties relating to various growth phenomena and is a potential source of cellulose, consisting of different phytochemicals. It is a rich source of macro and micro nutrients as well as contains growth regulators like GA_3 and cytokyanin [10,11]. Novel has been found to effectively influence good and qualitative production in different horticultural crops [11,12,13]. Cow urine has also been known to have presence of some growth promoting auxins [14] along with N, P, K, Ca, Mg, S and others [15] and influence plant growth in flower crops [16,17]. Influence of polyamines and biostimulants like banana pseudo stem sap and cow urine on cut flower crops under protected conditions has not been extensively studied. Hence, this experiment was planned with the basic objective to study the influence of poyamines (spermine and spermidine) and biostimulants (Novel and cow urine) as foliar spray on vegetative and flowering parameters in rose plants.

2. MATERIALS AND METHODS

The experiment was conducted consecutively for three years during 2015-16 to 2017-18 under naturally ventilated polyhouse at greenhouse complex, Department of Floriculture and Landscape architecture, Navsari Agricultural University, Navsari, Gujarat, India. The research work was carried out on one year old plants of Hybrid Tea rose variety 'Top Secret' that was cultivated on raised bed. Foliar spray treatments consisted of spermine (5, 10 and 20 mg/l), spermidine (5, 10 and 20 mg/l), 2% Novel i.e. banana pseudostem sap, 2% cow urine and water as control. Plants were given foliar spray twice at fifteen days interval after pruning starting in the second week of November of each year. Different observations like plant height (cm), number of branches and number of leaves, length of flower stem(cm), flower stem diameter, bud diameter and flower diameter by *Vernier Calipers* and number of flowers per plant and vase life (days to wilting) were counted. Bud diameter was measured at tight bud stage while flower diameter was measured at fully opened flower stage. Number of flowers per plant was counted based on harvest flowers every month after regular pinching and bending practices. Besides, total chlorophyll content from leaves was determined by following the method of Yoshida et al., [18] and anthocyanins from flowers was estimated based on method of Lees and Francis [19] and expressed in mg/g of fresh weight.

The statistical analysis was done by adopting the standard procedures of Panse and Sukhatme [20], analysis was done following statistical NAU software for CRD design and the results were interpreted.

3. RESULTS AND DISCUSSION

The vegetative attributes *viz.* plant height, number of branches and number of leaves were found to be significantly increased in rose plants given foliar spray of polyamines and banana pseudo stem sap as observed during 1st year, 2nd year, 3rd year as well as pooled analysis as shown in Table 1. Comparing different treatments, significantly maximum plant height (116.33, 120.27, 118.20 and 118.27 cm) was found in plants treated with 20 mg/l spermidine, significantly maximum number of branches (6.73, 6.80, 7.20 and 6.91) and number of leaves (126.67, 131.77, 129.47 and 129.30) were observed with 20 mg /l spermine and were at par with 10 mg/l spermine and followed by 20 mg/l spermidine and 2% Novel as seen respectively during the three years as well as pooled analysis.

Polyamines, a new class of plant growth regulators plays role as Hormonal Second

Table 1. Effect of foliar spray of polyamines and biostimulants in Rose (*Rosa hybrida* L.) underpolyhouse condition on Plant height (cm), number of branches and number of leaves

		Height of plant (cm)				Number of branches				Number of leaves			
Sr. No.	**Treatments**	**1st year**	**2nd year**	**3rd year**	**pooled**	**1st year**	**2nd year**	**3rd year**	**pooled**	**1st year**	**2nd year**	**3rd year**	**Pooled**
1	T1: 5 mg/l Spermine	108.33	113.43	105.33	109.03	3.93	4.10	3.87	3.97	116.33	120.10	119.93	118.79
2	T2: 10 mg/l Spermine	116.00	119.37	109.73	115.03	6.03	6.17	6.73	6.31	125.33	128.23	128.93	127.50
3	T3: 20 mg/l Spermine	112.67	117.73	110.07	113.49	6.73	6.80	7.20	6.91	126.67	131.77	129.47	129.30
4	T4: 5 mg/l Spermidine	90.67	95.87	101.20	95.91	3.73	3.83	4.27	3.94	111.00	114.90	118.27	114.72
5	T5: 10 mg/l Spermidine	108.33	116.07	111.93	112.11	4.93	5.10	4.40	4.81	119.00	122.43	119.67	120.37
6	T6: 20 mg/l Spermidine	116.33	120.27	118.20	118.27	4.43	4.67	5.53	4.88	122.33	125.87	126.90	125.03
7	T7: 2% Novel	102.00	107.27	104.47	104.58	4.73	4.90	4.93	4.86	119.00	121.67	118.80	119.82
8	T8: 2%Cow urine	98.00	101.67	101.67	100.44	3.17	3.23	4.20	3.53	110.00	112.40	121.53	114.64
9	T9: control	98.33	102.63	104.80	101.92	2.60	2.67	3.13	2.80	106.33	109.13	117.80	111.09
T	**S.Em ±**	2.79	2.30	2.17	1.37	0.18	0.17	0.27	0.13	3.57	1.96	2.18	1.51
	C.D. 0.05	8.29	6.84	6.45	4.07	0.52	0.50	0.81	0.39	10.62	5.83	6.48	4.49
Y	**S.Em ±**	-	-	-	0.82	-	-	-	0.07	-	-	-	0.90
	C.D. 0.05	-	-	-	2.35	-	-	-	0.20	-	-	-	2.58
T X Y	**S.Em ±**	-	-	-	2.46	-	-	-	0.20	-	-	-	2.70
	C.D. 0.05	-	-	-	NS	-	-	-	0.57	-	-	-	NS
	CV%	4.57	3.61	3.50	3.82	6.81	6.38	9.58	8.43	5.27	2.82	3.09	3.76
					3.95				7.52				3.89

Table 2. Effect of foliar spray of polyamines and biostimulants in Rose (*Rosa hybrida* L.) under polyhouse conditions on flower stem length (cm), flower stem diameter (mm) and bud length (cm)

		Flower stem length (cm)				Flower stem diameter (mm)				Bud length (cm)			
Sr. No.	**Treatments**	**1st year**	**2nd year**	**3rd year**	**pooled**	**1st year**	**2nd year**	**3rd year**	**pooled**	**1st year**	**2nd year**	**3rd year**	**pooled**
1	T1: 5 mg/l Spermine	68.00	69.67	77.07	71.58	5.60	6.00	7.10	6.23	4.77	4.80	5.07	4.88
2	T2: 10 mg/l Spermine	78.67	82.37	80.27	80.43	7.93	7.97	7.17	7.69	5.07	5.13	5.23	5.15
3	T3: 20 mg/l Spermine	81.00	84.27	86.07	83.78	8.17	8.27	7.43	7.96	5.50	5.67	5.50	5.56
4	T4: 5 mg/l Spermidine	68.00	70.83	76.07	71.63	5.57	6.33	6.83	6.24	4.60	4.70	5.20	4.83
5	T5: 10 mg/l Spermidine	73.00	74.57	73.80	73.79	6.90	7.07	7.13	7.03	5.30	5.33	5.73	5.46
6	T6: 20 mg/l Spermidine	75.67	77.87	78.07	77.20	7.37	7.43	7.23	7.34	5.83	5.90	5.87	5.87
7	T7: 2% Novel	77.67	80.70	81.07	79.81	7.47	7.67	7.20	7.44	5.37	5.40	5.23	5.33
8	T8: 2%Cow urine	59.00	64.27	72.20	65.16	5.53	5.67	6.87	6.02	5.47	5.43	5.53	5.48
9	T9: control	52.67	56.70	69.20	59.52	4.70	5.07	6.77	5.51	4.90	4.97	5.20	5.02
T	**S.Em ±**	2.38	1.78	1.93	1.66	0.21	0.20	0.30	0.14	0.11	0.12	0.26	0.09
	C.D. 0.05	7.08	5.28	5.72	4.93	0.62	0.60	NS	0.42	0.33	0.35	NS	0.27
Y	**S.Em ±**	-	-	-	0.49	-	-	-	0.08	-	-	-	0.06
	C.D. 0.05	-	-	-	1.41	-	-	-	0.23	-	-	-	NS
T X Y	**S.Em ±**	-	-	-	1.47	-	-	-	0.25	-	-	-	0.18
	C.D. 0.05	-	-	-	4.22	-	-	-	0.72	-	-	-	NS
	CV%	5.86	4.19	4.33	6.75	5.52	5.16	7.39	6.02	3.66	3.89	8.36	5.28
					3.44				6.22				6.04

Table 3. Effect of foliar spray of polyamines and biostimulants in Rose (*Rosa hybrida* L.) underpolyhouse conditions on bud diameter (cm), flower diameter (cm), number of flowers per plant and vase life (days)

		Bud diameter (cm)				Flower diameter (cm)				Number of flowers/ plant				Vase life (days)			
Sr. No.	**Treatments**	**1st year**	**2nd year**	**3rd year**	**pooled**	**1st year**	**2nd year**	**3rd year**	**pooled**	**1st year**	**2nd year**	**3rd year**	**pooled**	**1st year**	**2nd year**	**3rd year**	**pooled**
1	T1: 5 mg/l Spermine	5.03	5.13	5.53	5.23	7.13	7.23	8.13	7.50	11.37	11.87	14.20	12.47	6.10	6.20	7.80	6.70
2	T2: 10 mg/l Spermine	6.03	6.10	5.83	5.99	7.97	8.03	8.17	8.06	13.03	14.40	14.87	14.10	8.40	8.43	8.60	8.48
3	T3: 20 mg/l Spermine	5.80	5.83	5.90	5.84	8.67	8.73	8.80	8.73	14.67	16.37	16.80	15.94	8.50	8.47	8.33	8.43
4	T4: 5 mg/l Spermidine	4.80	4.87	5.30	4.99	7.77	7.80	7.90	7.82	11.03	11.30	14.33	12.22	5.67	5.73	6.80	6.07
5	T5: 10 mg/l Spermidine	5.10	5.17	5.63	5.30	8.10	8.23	8.30	8.21	12.37	12.87	14.73	13.32	8.23	8.30	8.07	8.20
6	T6: 20 mg/l Spermidine	5.87	5.90	5.97	5.91	9.80	9.87	9.03	9.57	13.70	15.13	15.60	14.81	8.60	8.63	8.27	8.50
7	T7: 2% Novel	5.37	5.50	5.73	5.53	9.00	9.10	8.77	8.96	15.17	18.30	17.47	16.98	8.50	8.57	8.53	8.53
8	T8: 2%Cow urine	4.97	5.00	5.43	5.13	8.60	8.63	8.30	8.51	12.77	13.50	14.73	13.67	6.43	6.67	7.80	6.97
9	T9: control	4.57	4.60	5.47	4.88	7.07	7.10	7.97	7.38	11.37	12.13	14.40	12.63	6.00	6.07	7.13	6.40
T	**S.Em ±**	0.22	0.23	0.30	0.16	0.28	0.26	0.26	0.17	0.39	0.34	0.44	0.26	0.24	0.22	0.23	0.21
	C.D. 0.05	0.64	0.67	NS	0.48	0.84	0.78	NS	0.51	1.16	1.01	1.29	0.77	0.72	0.66	0.69	0.62
Y	**S.Em ±**	-	-	-	0.08	-	-	-	0.08	-	-	-	0.12	-	-	-	0.05
	C.D. 0.05	-	-	-	0.23	-	-	-	NS	-	-	-	0.34	-	-	-	0.14
T X Y	**S.Em ±**	-	-	-	0.24	-	-	-	0.25	-	-	-	0.36	-	-	-	0.14
	C.D. 0.05	-	-	-	NS	-	-	-	NS	-	-	-	1.03	-	-	-	0.40
	CV%	7.06	7.34	9.04	8.59	5.97	5.46	5.39	6.27	5.27	4.23	4.94	5.58	5.69	5.17	5.09	8.08
					7.55				5.25				4.40				3.11

Table 4. Effect of foliar spray of polyamines and biostimulants in Rose (*Rosa hybrida* L.) underpolyhouse condition on Chlorophyll and Anthocyanin content

		Chlorophyll (mg/g)				Anthocyanin (mg/g)			
Sr. No.	**Treatments**	**1st year**	**2nd year**	**3rd year**	**pooled**	**1st year**	**2nd year**	**3rd year**	**pooled**
1	T1: 5 mg/l Spermine	2.86	2.97	2.73	2.85	1.7	1.68	1.82	1.73
2	T2: 10 mg/l Spermine	3.36	3.47	3.46	3.43	1.78	1.88	2.03	1.90
3	T3: 20 mg/l Spermine	3.70	4.02	4.18	3.96	2.17	2.33	2.42	2.30
4	T4: 5 mg/l Spermidine	3.11	3.04	3.15	3.10	1.68	1.79	1.78	1.75
5	T5: 10 mg/l Spermidine	3.15	3.26	3.34	3.25	1.83	1.89	1.94	1.89
6	T6: 20 mg/l Spermidine	3.36	3.50	3.58	3.48	1.98	2.10	2.19	2.09
7	T7: 2% Novel	3.49	3.67	3.86	3.67	2.12	2.21	2.31	2.21
8	T8: 2%Cow urine	3.06	3.30	3.33	3.23	1.81	1.87	1.90	1.86
9	T9: control	2.19	2.43	2.50	2.37	1.68	1.74	1.70	1.70
T	**S.Em ±**	0.14	0.12	0.10	0.099	0.059	0.093	0.10	0.071
	C.D. 0.05	0.43	0.37	0.30		0.17	0.27	0.30	
Y	**S.Em ±**	-	-	-	0.096	-	-	-	0.061
	C.D. 0.05	-	-	-		-	-	-	
T X Y	**S.Em ±**	-	-	-	0.032	-	-	-	
	C.D. 0.05	-	-	-		-	-	-	0.020
	CV%	7.99				5.50			

Messengers (HSM) [5] and thereby known to implicate biological processes like protein synthesis [6, 21]. Besides, spermine and spermidine seem to mediate sensing signal mechanisms and nitrogen assimilation and carbon metabolism in different plant organs and thereby promote plant growth. Foliar application of polyamines significantly promoted vegetative growth in chrysanthemum [7] and gladiolus [22]. Besides, Novel i.e. banana pseudostem sap has also been reported to enhance vegetative growth in different horticulture crops [11].

Flowering parameters also were found to be improved by spraying of polyamines and banana psuedostem sap (Novel) during individual year as well as in pooled, Tables 2 and 3. Flower stem length (81.00, 84.27, 86.07 and 83.78 cm) and flower stem diameter (8.17, 8.27, 7.43 and 7.96 mm) were significantly maximum with treatment of 20 mg/l spermine, at par with 10 mg/l spermine and followed by 2% Novel in the pooled data analysis (Table 2). Improvement in flowering parameters by application of polyamines and banana pseudostem sap was indirect effect of more carbon assimilation with better vegetative growth as polyamines are involved in plant development processes as well as floral initiation development (5, 6, 9) and the macro and micro nutrients along with growth regulators like GA_3 and cytokyanin [10,11] content in banana pesudostem is been known to promote overall plant growth [12].

Further, pigments *viz*., chlorophyll (3.70, 4.02, 4.18 and 3.96 mg/g) and anthocyanins (2.17, 2.33, 2.42 and 2.30 mg/g) were observed maximum in plants treated with 20 mg/l spermine which was followed by 2% Novel and 20 mg/l spermidine, Table 4. Exogenous application of polyamines in carnation has been also shown to retard chlorophyll loss and senescence in carnation [23]. Further, increase in the chlorophyll content in leaves was also observed with foliar application of polyamines in gladiolus [22] and in chrysanthemum [7]. Polyamines being involved in plant biological process may have promoted better plant growth in form of flower stalk length as also envisaged by other researchers in cut flowers [4, 22].

Flower size, yield and vase life were highly influenced by foliar application of spermine and Novel. Bud diameter was maximum (6.03, 6.10, 5.83 and 5.99 cm) with treatment of 10 mg/l spermine, which was at par with 20 mg/l spermine and 20 mg/l spermidine while maximum flower diameter (9.80, 9.87, 9.03 and 9.57 cm) was found with 20 mg/l spermidine, followed by 2 % Novel and 20 mg/l spermine, Table 3. Plants treated with 2% Novel showed maximum flower yield (15.17, 18.30, 17.47 and 16.98) as well as showed maximum vase life (8.50, 8.57, 8.53 and 8.53 days) followed by 20 mg/l spermine treatment. Novel i.e. banana pseudo stem sap has been known to possess nutrients like N and K along with gibberellins and cytokyanins which may have influenced flower quality and yield. Foliar application of Novel i.e. banana pseudostem sap has been found to increase yield in spinach [24], onion [12] marigold [25] and mango [13]. Polyamines are known to be associated with the physiology of flowering metabolite synthesis [26, 27] and correlation between polyamines and flowering processes has been observed earlier in *Arabidopsis* [28] and in chrysanthemum [7]. Beneficial effects on flower parameters have also been reported with polyamines in gladiolus [22], carnation [29] and with banana psedostem sap in marigold [24].

4. CONCLUSION

Based on the findings of the present study, it may be concluded that the foliar application of 20 mg/l spermine among polyamines or biostimulant comprising of banana pseudostem sap (2% Novel) twice at fifteen days interval after pruning has been found to be highly beneficial in improving flower quality and yield in cut flowers of rose under protected cultivation. Any of these foliar spray can be recommended for the beneficial role in roses.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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