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Effect of foliar silicic acid on quality attributes of rose cut flowers (*Rosa hybrid* L.)

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ABSTRACT : A study was carried out in Division of Horticulture to evaluate the effect of foliar application Silicic acid on quality attributes of Rose cut flowers under naturally ventilated poly house with seven treatments, three replications and four varieties. Among the treatments application of foliar Silicic acid @ 4ml L^{-1} at 10 days interval recorded significantly highest flower bud length of 3.75 cm and neck length of 9.15cm. Foliar Silicic acid (SA) @ 6ml L^{-1} applied at 10 days interval recorded significantly highest flower stalk length of 32.62cm and girth of the flower stalk of 0.48cm. Foliar Silicic acid (SA) 6ml L^{-1} applied at 20 days intervals recorded significantly highest flower bud diameter of 2.10cm. Application of foliar Silicic acid proved to have beneficial effects on quality attributed of cut rose flowers under naturally ventilated poly house conditions.

KEY WORDS : Silicon, Rose flowers, Quality attributes, Silicic acid

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Rose (*Rosa hybrid* L.) is one of the best known commercial cut flower grown all over the world. Variety of shapes, sizes, colours and varsality has made it the queen of flowers. Quality of rose cut flowers depends on better nutrient management including macro, micro and beneficial elements. Among the nutrients silicon plays an important role in quality and productivity of flowers.

The role of Si in plant biology is subjected to multiple stresses including biotic and abiotic stresses. It is also known to increase drought tolerance in plants by maintaining plant water balance, photosynthetic activity, erectness of leaves and structure of xylem vessels under high transpiration rates (Melo *et al.,* 2003). Gong *et al.* (2003) observed improved water economy and dry matter yield with Si application and also enhanced leaf water potential under water stress conditions, reduced incidence of micronutrient and metal toxicity (Matoh *et al.,* 1991). The positive effect of silicon observed in agronomic crops has been generated interest for research with horticulture crops as well. The reported effects vary and depend strongly on plant species. Studies on effect of foliar silicon supply on grapes, cucumber, muskmelon, zucchini, squash and miniature rose (Bowen *et al.,* 1992 and Datnoff *et al.,* 2006) revealed benefits of the element related to resistance against disease, pests and drought. The majority of studies with horticultural crops generally emphasized on disease management of physiological difference between silicon treated plant and untreated control. There is a limited evidence that silicon supplementation affects the growth, yield and quality in flower crops. Although, few studies have confirmed the benefits of silicon as foliar applications. Hence, an attempt was made to evaluate the effect of foliar applied Silicic acid on quality attributes of rose cut flowers.

RESEARCH METHODS

The experiment was conducted at Department of Horticulture, University of Agricultural Sciences, G.K.V.K., Bangalore, which is situated at 12.68^0 North latitude, 77^0 35' East longitude at an altitude of about 930 m above the mean sea level. The average annual rainfall of the area is 953mm. the minimum and maximum temperature noticed during the study ranged from 12^{0}C to 27^{0}C, respectively and relative humidity ranged between 30 to 80 per cent. To impose treatments on uniformly grown plants, all the four cultivars were uniformly pruned on 15th August. Hard pruning was taken up at 20cm high from the ground. The cut ends were smeared with copper oxy chloride paste immediately after pruning to protect from disease.

The treatment were imposed fifteen days after pruning at regular intervals like treatment T_2, T_3 and T_4 ten sprays of foliar silicon sprayed at 10 days intervals. Whereas, for T_5, T_6 and T_7 5 sprays of foliar silicon sprayed at 20 days intervals were given. The varieties used for the study were Tropical Amazon, First red, Gold Strike, Tineke. The observations were taken under the Factorial Completely Randomized Design.

Treatment details :

T_1:Soil application of recommended NPK fertilizers as per package of practice.

T_2:Foliar spray of silicic acid @ 2 ml L^{-1} at 10 days interval

T_3:Foliar spray of silicic acid @ 4 ml L^{-1} at 10 days interval

T_4:Foliar spray of silicic acid @ 6 ml L^{-1} at 10 days interval

T_5:Foliar spray of silicic acid @ 2 ml L^{-1} at 20 days interval

T_6:Foliar spray of silicic acid @ 4 ml L^{-1} at 20 days interval

T_7:Foliar spray of silicic acid @ 6 ml L^{-1} at 20 days interval

Preparation of soluble silicic acid solution :

- Soluble Silicic acid was dissolved in fresh water in 1:5 dilution, kept it for 30 min for dissolution.
- Required quantity of diluted solution of Silicic acid was mixed with water and the required volume of water based was made as per need of per plot.
- Spray was given to treatment plots along with the wetting agent / sticker.
- The foliar silicon spray was applied to plants as per the treatment till the entire foliage got wet and dripped down.

The observations on quality parameters like flower bud length (cm), bud diameter (cm), stalk length (cm), neck length (cm), flower stalk girth (cm), and vase life (days) were recorded. Five labeled plants which were selected per treatment per replication were used for recording the observation.

RESEARCH FINDINGS AND DISCUSSION

The length of the flower bud was highest in variety First Red (4.22cm), which was significantly superior over other varieties, whereas length of the flower bud was lowest in variety Tineke (3.08cm), This difference may be due to the varietal character, These results are in accordance with the finding of Nagaraju *et al*. (2003) in rose. Significant influence of foliar SA treatment was noticed with regard to the length of the flower bud. Among the treatments (T_3) Foliar SA @ 4ml L^{-1} at 10 days intervals was recorded maximum flower bud length of 3.74 cm, whereas minimum flower bud length of 3.56 cm was recorded in untreated control (T_1). Foliar application of silicon may have influence on the rose flowers in increasing bud length (Table 1).

Diameter of flower bud is one of the important characters that is considered as essential for grading export quality rose cut flowers. A medium bud at tight bud stage has more demand in domestic as well as in international market. The diameter of the flower bud was highest (2.30 cm) in variety Tineke (V_4),which was on par with variety First red(V_2) (2.27).The minimum diameter of the flower bud 1.77 cm was recorded in variety Tropical amazon (V_1). This variation might be due to varietal characteristics. Similar variations in flower diameter were obtained by Verma *et al.* (2008).

Significant influence of foliar SA treatments was noticed with respect to the diameter of the flower bud. Among the treatments (T_4) Foliar SA @ 6ml L^{-1} at 10 days intervals recorded maximum flower bud diameter of 2.10 cm, whereas minimum flower bud diameter of 1.96 cm was recorded in untreated control (T_1). Si application was found to reduce evapotranspiration which could have contributed to increased turger pressure within the flower, resulting in cell swelling and thus, larger flower diameter. These results are in accordance with the findings of Kamenidou *et al.* (2010) in gerbera and

Kamenidou and Todd (2008) in ornamental sunflower and Saeed *et al.* (2009) in rose.

Significant differences in stalk length were observed between varieties. The rose variety First red (V_2) recorded maximum stalk length of 42.89 cm, which is followed by var. Tropical amazon(V_1) *i.e.,* 31.51 cm, whereas minimum length of the flower stalk of 25.26 cm was recorded in var. Tineke (V_4) (Table 1). This difference in stalk length among varieties might be due to varietal character and genetic makeup. Similarly, several workers reported differences in length of cut flower stalk (Polara *et al.,* 2004).

Foliar application of silicon treatments had significant influence on Length of the cut flower stalk. Among the treatments (T_4) Foliar SA @ 6 ml L^{-1} applied at 10 days intervals recorded maximum stalk length of 32.62 cm, which is at par with the treatments (T_7) receiving foliar SA @ 6ml L^{-1} at 20 days interval and (T_3) Foliar SA @ 4ml L^{-1} applied at 10 days intervals *i.e.,* 32.31 and 32.26 cm, respectively, whereas, minimum stalk length of 29.86 cm was recorded in untreated control(T_1).Similar results were obtained by Kamenidou *et al.* (2010) in gerbera. Saeed *et al.* (2009) reported that Si could increase total gibberllic acid content and increases the shoot height in rose.

The interaction between varieties and foliar SA applied treatments had significant influence on stalk length of the flower, Among the interactions between varieties and treatments, (V_2T_7) var. First red with Foliar SA @ 6ml L^{-1} applied at 20 days intervals noticed the highest stalk length of 44.15 cm, which was followed by the treatment (V_2T_5) var. First red with Foliar SA @ 2ml L^{-1} applied at 20 days intervals *i.e.,* 43.20 cm, whereas lowest stalk length of 24.13 cm was noticed in the treatment (V_4T_1) var. Tineke with control .It might be due to synergetic interactions between varieties and treatments (Table 2).

The significant differences were observed between varieties with respect to neck length. The variety First red recorded maximum neck length of 9.85 cm, which was followed by var. Tropical Amazon *i.e.,* 8.93 cm, whereas minimum neck length of 8.69 cm was recorded in var. Tineke. This could be due to varietal differences. These results are in accordance with Geetha (2004) in rose. Significant influence of foliar SA treatments noticed with regard to the neck length of the flower, Among the treatments highest neck length of 9.15 cm was noticed in (T_7) Foliar SA @ 6ml L^{-1} applied at 20 days intervals, whereas, the lowest neck length of 8.48 cm was noticed in control. The increase in stalk length of the flower may indirectly have influence on increase in neck length of the flower.

Table 1 : Effect of foliar spray of silicic acid (SA) on flower quality attributes of different varieties of rose (*Rosa hybrid*)

Direct effect	Flower Bud (cm)		Stalk length (cm)	Neck length (cm)	Girth of flower stalk (cm)	Vase life (days)
	Length	Diameter				
Varieties						
V_1: Tropical amazon	4.01	1.77	31.51	8.93	0.46	8.55
V_2: First red	4.22	2.27	41.89	9.85	0.48	10.74
V_3: Gold strike	3.32	1.80	27.51	8.75	0.43	8.10
V_4: Tineke	3.08	2.30	25.26	8.69	0.41	7.24
F – Test	*	*	*	*	*	*
S.E. ±	0.02	0.02	0.63	0.12	0.01	0.21
C.D. (P=0.05)	0.05	0.06	1.26	0.24	0.02	0.43
Treatments						
T_1: Control	3.56	1.96	29.86	8.48	0.41	8.67
T_2: SA @ 2 ml L^{-1} once in 10 days	3.61	2.00	30.92	8.57	0.42	8.75
T_3: SA @ 4 ml L^{-1} once in10 days	3.74	2.06	32.26	8.77	0.45	8.46
T_4: SA @ 6 ml L^{-1} once in10 days	3.67	2.08	32.62	8.67	0.48	8.67
T_5: SA @ 2 ml L^{-1} once in 20 days	3.67	2.00	31.19	8.71	0.44	8.46
T_6: SA @ 4 ml L^{-1} once in 20 days	3.63	2.04	31.23	8.75	0.47	8.75
T_7: SA @ 6 ml L^{-1} once in 20 days	3.69	2.10	32.31	9.15	0.45	8.83
F – Test	*	*	*	*	*	NS
S.E. ±	0.02	0.02	0.52	0.09	0.01	0.20
C.D. (P=0.05)	0.06	0.06	1.46	0.26	0.03	-

* indicate significance of value at P=0.01 NS=Non-significant

Girth of flower stalk influenced on quality. The significant differences in girth were obtained among the varieties. The variety First red recorded highest flower stalk girth of 0.48 cm, which is at par with the var. Tropical amazon (0.46 cm), the lowest flower stalk girth was recorded in var. Tineke (0.41cm) (Table 2). The differences in the thickness of flower stalks may be attributed to varietal characteristics. Similar variations in stalk girth was reported by Biradar (1996) in gerbera.

Foliar application of silicon treatments had significant influence on girth of the cut flower stalk. The treatment T_4 recorded maximum stalk girth of 0.48 cm followed by T_6 (0.47 cm) and least stalk girth was recorded in T_1 (0.41cm). It might be due to increase in photosynthetic activity and accumulation of more carbohydrates in the flower stalk. Similar results were reported by Saeed *et al.* (2009), Seung *et al.* (2005) in rose, Kamenidou *et al.* (2010) in gerbera.

The interaction between varieties and foliar SA applied treatments had significant influence on stalk length of the flower, Among the interaction effects, treatment V_2T_7 recorded highest girth of flower stalk (0.51 cm) which is on par with the treatments V_2T_6 (0.50 cm), V_2T_4(0.50cm), V_2T_5(0.48 cm), V_2T_3(0.48 cm) and minimum girth of flower stalk was recorded in V_4T_1 (0.33 cm). It might be due to enhanced varietal response of

Table 2 : Effect of foliar spray of Silicic acid (SA), different varieties and their interaction on flower quality attributer of rose (*Rosa hybrid*)

Interaction effect		Flower bud (cm)		Stalk length (cm)	Neck length (cm)	Girth of flower stalk (cm)	Vase life (days)
		Length	Diameter				
Varieties × Treatments							
Tropical amazon	Control	3.83	1.70	30.71	8.61	0.43	8.50
	SA @ 2 ml L^{-1} once in 10 days	4.02	1.75	31.82	8.81	0.46	9.00
	SA @ 4 ml L^{-1} once in 10 days	4.17	1.80	32.28	8.43	0.47	8.50
	SA @ 6 ml L^{-1} once in 10 days	4.04	1.76	32.86	8.56	0.48	8.17
	SA @ 2 ml L^{-1} once in 20 days	4.06	1.77	30.67	8.60	0.46	8.17
	SA @ 4 ml L^{-1} once in 20 days	3.89	1.78	31.03	8.61	0.47	8.67
	SA @ 6 ml L^{-1} once in 20 days	4.06	1.81	31.24	8.80	0.44	8.83
First red	Control	4.08	2.12	37.71	8.03	0.45	10.67
	SA @ 2 ml L^{-1} once in 10 days	4.18	2.18	40.26	8.34	0.42	10.67
	SA @ 4 ml L^{-1} once in 10 days	4.29	2.28	42.50	9.11	0.48	10.50
	SA @ 6 ml L^{-1} once in 10 days	4.26	2.39	42.53	9.17	0.50	10.50
	SA @ 2 ml L^{-1} once in 20 days	4.26	2.25	43.20	8.78	0.48	10.83
	SA @ 4 ml L^{-1} once in 20 days	4.28	2.29	42.85	9.01	0.50	11.17
	SA @ 6 ml L^{-1} once in 20 days	4.17	2.36	44.15	9.51	0.51	10.83
Gold strike	Control	3.32	1.73	26.90	8.85	0.42	8.00
	SA @ 2 ml L^{-1} once in 10 days	3.16	1.77	27.45	8.96	0.46	8.17
	SA @ 4 ml L^{-1} once in 10 days	3.41	1.82	28.08	8.79	0.41	7.83
	SA @ 6 ml L^{-1} once in 10 days	3.22	1.81	28.71	8.69	0.46	8.50
	SA @ 2 ml L^{-1} once in 20 days	3.31	1.77	27.13	8.27	0.40	8.00
	SA @ 4 ml L^{-1} once in 20 days	3.35	1.80	27.30	8.81	0.44	8.00
	SA @ 6 ml L^{-1} once in 20 days	3.45	1.88	27.01	8.90	0.42	8.17
Tineke	Control	3.03	2.29	24.13	8.52	0.33	7.50
	SA @ 2 ml L^{-1} once in 10 days	3.08	2.32	24.17	8.15	0.36	7.17
	SA @ 4 ml L^{-1} once in 10 days	3.09	2.35	26.18	8.74	0.42	7.00
	SA @ 6 ml L^{-1} once in 10 days	3.17	2.35	26.39	8.27	0.45	7.50
	SA @ 2 ml L^{-1} once in 20 days	3.07	2.20	24.17	9.18	0.41	6.83
	SA @ 4 ml L^{-1} once in 20 days	3.01	2.28	24.92	8.56	0.45	7.17
	SA @ 6 ml L^{-1} once in 20 days	3.09	2.34	26.83	9.38	0.44	7.50
F – Test		NS	NS	*	NS	*	NS
S.E. ±		0.05	0.06	0.23	0.24	0.02	0.40
C.D. (P=0.05)		-	-	0.64	-	0.05	-

* indicate significance of value at P=0.01 NS=Non-significant

the plants to the silicon application.

Post harvest behaviour of cut flowers not only depends on post harvest factors but also on pre-harvest factors. Vase life is one such post harvest trait. The vase life of cut flowers is significantly influenced by the varieties; the variety First red recorded higher vase life of 10.74 days, followed by the var. Tropical Amazon recorded the vase life of 8.55 days. While the lowest vase life of 7.24 days has recorded in variety Tineke (V_4). This could be due to longer stalk length, excessive accumulation of sugars in the stem, which are translocated to corolla, thus, increasing the water uptake and maintaining turgidity in stem, resulting in prolonged vase life of the flower. This variation between varieties with regard to vase life could also be due to difference in their genetic makeup of the varieties. Similar variations with regard to vase life were obtained by Bhattacharjee *et al.* (1993).

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