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Effect of pre harvest foliar spray of growth regulators on pre and post harvest parameters in ornamental sunflower genotype M-17R

Kirtimala B. Naik*, S. K. Nataraj, Y. G. Shadakshari, D. P. Kumar, G. K. Seetharamu and K. V.Jayaprasad
College of Horticulture, GKVK, Campus, University of Horticultural, Sciences, Bagalkot-587104.
*E-mail: kirtiflori@gmail.com

ABSTRACT

An experiment was conducted to study the effect of pre harvest foliar application of growth regulators on the pre and post harvest flower quality in ornamental sunflower during the year 2012-13, at College of Horticulture, GKVK campus, UHS, Bagalkot. At 60 DAS highest plant height was with GA_3 @ 150 ppm (154.73 cm) followed by GA_3 @ 200 ppm (146.20 cm) and GA_3 @ 250 ppm (145.53 cm). Sodium silicate @ 250 ppm (4508.77 cm^2) registered maximum plant spread at 60 DAS. Foliar application of GA_3 @ 150 ppm (25.00) produced highest number of leaves which was at par with Sodium silicate @ 250 ppm, GA_3 @ 200 ppm and GA_3 @ 250 ppm recording 24.87, 24.80 and 24.67 leaves respectively. Calcium sulphate @ 200 ppm registered highest leaf area of (4930.30 cm^2) which was at par with Sodium silicate @ 250 ppm, Calcium sulphate @ 300 ppm, Chlormequat chloride @ 500 ppm, Sodium silicate @ 350 ppm, and Chlormequat chloride @ 1000 ppm with 4792.64, 4735.04, 4721.75, 4503.05 and 4430.02 cm^2 respectively.

Key words : Ornamental sunflower, growth regulators, quality parameters, vase life

INTRODUCTION

Sunflower (*Helianthus annuus* L.) is native to North America and belongs to the family *Compositae*. The term *Helianthus* comes from the greek word '*Helios*' meaning sun and '*anthos*' meaning flower. Historically sunflower was first used as a garden plant, then as a flowering pot plant and more recently as a specialty cut flower. Specialty cut flowers can be defined as crops other than roses, carnations and chrysanthemums or other flowers that are present in the market only at a special time of the year. The type of flowers grown for the specialty cut flower market are usually field grown flowers with poor shipping characteristics. Several positive and precise results were obtained in the past by the growth regulating chemicals on various flowering annuals. Growth regulators have been found useful in overcoming the factors limiting the yield and quality of flowering annuals like marigold, china aster and daisy (Patil, 1998). The response exhibited by plants to growth regulators vary with the species, varieties and on the concentration of the chemical used. An attempt was made to study the effect of growth regulators on the pre and post harvest quality parameters of ornamental sunflonwer. The results pertaining to the effect of growth regulators on the pre and post harvest characters of ornamental sunflower genotype M-17R are discussed below.

MATERIAL AND METHODS

An experiment was conducted to study the effect of pre harvest foliar application of growth regulators on the pre and post harvest flower quality in ornamental sunflower. The entire experimental area was divided into plots measuring 6.72 sq.mts each, with 4 rows of 10 plants per row. Foliar application of different chemicals on leaves was taken up three times at 15 days, 30 days and 45 days after sowing. Design followed was RCBD adopting Fisher's method of analysis of variance technique as given by Panse and Sukhatamane (2002) by using SAS package V9-3 available at statistical cell, IIHR with three replications and sixteen treatments.

Treatments:

T_1: Gibberellic acid (GA_3)@ 150 ppm
T_{10}: Calcium sulphate ($CaSo_4$) @ 200 ppm

T_2: Gibberellic acid (GA_3)@ 200 ppm
T_{11}: Calcium sulphate ($CaSo_4$) @ 300 ppm

T_3: Gibberellic acid (GA_3)@ 250 ppm
T_{12}: Calcium sulphate ($CaSo_4$) @ 400 ppm

T_4: Benzyl adenine (BA) @ 400 ppm
T_{13}: Chlormequat chloride (CCC) @ 500 ppm

T_5: Benzyl adenine (BA) @ 500 ppm
T_{14}: Chlormequat chloride (CCC) @ 1000 ppm

T_6: Benzyl adenine (BA) @ 600 ppm
T_{15}: Chlormequat chloride (CCC) @ 1500 ppm

T_7: Sodium silicate ($NaSiO_3$) @ 250 ppm
T_{16}: Control (No spray)

T_8: Sodium silicate ($NaSiO_3$) @ 350 ppm

T_9: Sodium silicate ($NaSiO_3$) @ 450 ppm

RESULTS AND DISCUSSION

Vegetative parameters

At 60 DAS highest plant height was with GA_3 @ 150 ppm (154.73 cm) followed by GA_3 @ 200 ppm (146.20 cm) and GA_3 @ 250 ppm (145.53 cm). While it was minimum with T_{15} Chlormequat chloride @ 1500 ppm (105 cm) and T_{10} Calcium sulphate @ 200 ppm (106.33 cm). It may be because though growth is under genetic control, environmental factors also influence it simultaneously. Hence, application of growth regulators play significant role in modifying growth of plants. Similar result with regard to GA_3 to promote maximum plant height was reported by Syamal *et al*. (1990) Leshem (1992); Herrera and Benedetto (1992), Dutta *et al.* (1993); Kamenidou (2005), Spitzer *et al*. (2011) and Dorajirao (2010).Sodium silicate @ 250 ppm (4508.77 cm^2) registered maximum plant spread at 60 DAS, followed by Chlormequat chloride @ 500 ppm (4209.49 cm^2).Silicon spray was earlier reported by Wroblewska and Debicz (2011) to increase plant spread in ornamental plants by stimulating synthates. Foliar application of GA_3 @ 150 ppm (25.00) produced highest number of leaves which was at par with Sodium silicate @ 250 ppm, GA_3 @ 200 ppm and GA_3 @ 250 ppm recording 24.87, 24.80 and 24.67 leaves respectively. Calcium sulphate @ 200 ppm registered highest leaf area of (4930.30 cm^2) which was at par with Sodium silicate @ 250 ppm, Calcium sulphate @ 300 ppm, Chlormequat chloride @ 500 ppm, Sodium silicate @ 350 ppm, and Chlormequat chloride @ 1000 ppm with 4792.64, 4735.04, 4721.75, 4503.05 and 4430.02 cm^2 respectively. The activity of sodium silicate may be attributed to its ability to reinforce cell wall and maintaining water status in plants and adequate supply of nutrients as reported by Wroblewska and Debicz (2011). Positive activity of calcium sulphate for growth was also reported by Parmeshwar (2010) in sunflower. Chlormequat chloride is reported to enhance availability of carbohydrates during growth and development of plant. Lokhande *et al*. (2008); Kamenidou *et al*. (2008) also reported that depending on the source and concentration of silicon supplied, several horticultural traits were improved in greenhouse produced sunflower **(Table 1)**.

Flower quality parameters

Foliar application of Gibberellic acid (GA_3)@ 150ppm favoured longest flower stalk length (35.93 cm) followed by GA_3@ 200 ppm (35.53 cm). Increase in stalk length may be due to increase in cell division and cell elongation. Similar results were reported by Kore *et al.* (2003) with GA_3 @ 200 ppm in china aster and Parmeshwar (2010) with GA_3 @ 150 ppm in sunflower. Increased flower stalk girth was observed with the foliar application of Chlormequat chloride @ 1500 ppm recording 0.46 cm which was at par with Sodium silicate @ 250 ppm and Calcium sulphate @ 200 ppm (0.44 and 0.43 cm respectively). It might be attributed to the increase in photosynthetic activity and accumulation of more carbohydrates in the flower stalk and enhanced varietal response to application of certain growth regulators. Similar results with relation to silicate application were earlier reported by Chikkur (2010) in rose and Kameniduo *et al*. (2010) by $NaSiO_3$ foliar spray in sunflower **(Table 2).**

Sodium silicate @ 250 ppm significantly increased the flower head diameter (11.37 cm) and was at par with Chlormequat chloride @ 1500 ppm, Calcium sulphate @ 300ppm, Chlormequat chloride @ 1000 ppm and Sodium silicate @ 450 ppm recording 11.27, 11.18, 11.11 and 11.06 cm respectively. Smallest flower head diameter was observed with the foliar application of GA_3@ 200 ppm (6.96 cm) and GA_3@

Table 1. Vegetative parameters as influenced by application of different growth regulators in genotype M-17R

Sl.No.	Plant height (cm)			Plant spread (cm^2)			Number of leaves			Leaf area (cm^2)		
	DAS			DAS			DAS			DAS		
	30	45	60	30	45	60	30	45	60	30	45	60
Gibberellic acid (GA_3) @ 50 ppm (T_1)	33.09	105.00	154.73	187.17	1560.21	2087.40	12.40	21.33	25.00	370.60	1137.44	1572.00
Gibberellic acid (GA_3) @ 200 ppm (T_2)	29.60	104.13	146.20	270.51	1168.80	1977.86	11.93	21.13	24.80	331.07	1191.73	1659.20
Gibberellic acid (GA_3) @ 250 ppm (T_3)	28.47	97.40	145.53	392.52	2069.53	2816.67	11.33	19.73	24.67	385.00	1486.39	1806.15
Benzyl adenine (BA) @ 400 ppm (T_4)	17.33	55.83	108.67	443.07	1857.20	2909.19	6.87	15.00	19.07	319.00	1273.32	1644.37
Benzyl adenine (BA) @ 500 ppm (T_5)	16.47	60.53	110.73	407.87	2355.83	3365.39	7.60	14.47	21.67	339.33	1628.30	2319.70
Benzyl adenine (BA) @ 600 ppm (T_6)	16.27	55.00	116.33	452.51	2029.60	2526.37	10.40	17.47	21.07	351.60	2039.44	3362.19
Sodium silicate ($NaSiO_3$) @ 250 ppm (T_7)	18.93	73.66	112.27	493.68	2896.31	4508.77	12.27	21.27	24.87	480.60	3800.19	4792.64
Sodium silicate ($NaSiO_3$) @ 350 ppm (T_8)	22.47	60.53	110.00	426.80	1842.15	2772.72	12.17	20.67	24.73	482.47	3337.78	4503.05
Sodium silicate ($NaSiO_3$) @ 450 ppm (T_9)	22.33	56.40	115.33	491.16	1838.11	2439.68	8.40	17.60	21.73	456.93	2342.83	4377.91
Calcium sulphate @ 200 ppm (T_{10})	19.80	54.63	106.33	270.32	1734.52	2210.40	8.67	17.33	23.47	467.27	2313.30	4930.30
Calcium sulphate @ 300 ppm (T_{11})	22.51	63.47	113.07	485.24	1935.95	2659.11	9.07	19.00	23.93	459.00	2238.55	4735.04
Calcium sulphate @ 400 ppm (T_{12})	21.82	61.35	123.40	485.60	2059.32	2495.77	9.53	18.53	23.20	435.40	2307.84	4083.77
Chlormequatchloride (CCC) @ 500 ppm (T_{13})	22.40	62.49	125.87	402.6	2836.39	4209.49	8.47	19.13	23.67	480.80	3171.27	4721.75
Chlormequat chloride (CCC) @ 1000 ppm (T_{14})	20.53	60.32	130.53	431.9	1639.19	2455.93	9.07	17.27	22.67	378.13	2754.27	4430.02
Chlormequat chloride (CCC) @ 1500 ppm (T_{15})	22.40	54.51	105.00	345.6	2636.48	3974.03	8.93	17.93	20.00	432.40	2063.81	4072.61
Control (No spray) (T_{16})	15.07	61.00	120.13	411.6	2449.09	3085.13	9.60	18.53	22.53	428.20	1635.15	3807.55
Mean	21.84	67.89	121.51	399.9	2056.79	2905.87	9.79	18.53	22.94	412.36	2170.10	3551.14
SEm	0.39	0.64	0.54	18.04	73.13	69.75	0.17	0.30	0.23	5.54	64.67	179.86
CD($P=0.05$)	1.14	1.84	1.56	52.10	211.21	201.45	0.50	0.86	0.67	16.00	186.77	519.48
CV %	3.13	1.62	0.77	7.81	6.16	4.16	3.06	2.77	1.76	2.33	5.16	8.77
F-Test	*	*	*	*	*	*	*	*	*	*	*	*

* - Significant at $P = 0.05$ NS - Non significant at $P = 0.05$

150 ppm (7.19 cm). Flower disc diameter increased with the foliar application of Chlormequat chloride @ 1500ppm (4.47) which was at par with Chlormequat chloride @ 1000 ppm, Sodium silicate @ 250 ppm and Calcium sulphate @ 200 ppm recording 4.32, 4.11 and 4.00 cm respectively. Smallest flower disc diameter was produced with the foliar application of GA_3 @ 250 ppm and GA_3 @ 150 ppm (1.80 and 1.89 cm respectively). Flower head diameter in sunflower ranging from 8-15 cm is considered ideal for florist according to Sloan and Harkness (2006). With the application of growth regulators there is a decrease in apical dominance leading to the development of side buds by diverting carbohydrates for flower development. Similar results were reported by Lokhande *et al*. (2008), Muhammad *et al*. (1997), Katkar *et al*. (2003) and Kamenidou (2005) by application of various growth regulators **(Table 2).**

Total number of flower heads per plant was highest with the foliar application of Sodium silicate @ 250 ppm (24.93) followed by Sodium silicate @ 350 ppm, Chlormequat chloride @ 1500 ppm and Chlormequat chloride @ 1000 ppm (22.53, 22.40 and 22.13).

Foliar spray of Sodium silicate @ 250 ppm (20.80) followed by Sodium silicate @ 350 ppm (19.67) produced more number of marketable flower heads per plant. Total number of marketable flowers per hectare increased with the foliar application of Sodium silicate @ 250 ppm (11.55) lakh flowers ha^{-1} followed by Sodium silicate @ 350 ppm (10.93) lakh flowers ha^{-1}. It may be because sodium silicate application increased the parameters such as stalk girth, flower diameter and number of petals per flower. Similar results with application of silicon were reported by Chikkur, 2010 in rose **(Table 2).**

While, post harvest cumulative water uptake was highest in the flowers harvested from plants with foliar application of Sodium silicate @ 250 ppm, BA @ 600 ppm and GA_3 @ 150 ppm recording 40.80, 39.20 and 38.23 g respectively. Cumulative water loss was induced in the flowers harvested from plants with foliar application of GA_3@ 250 ppm (42.63 g) followed by Sodium silicate @ 450ppm, GA_3 150ppm and Calcium sulphate @ 200 ppm recording 41.40, 41.23 and 40.27 g respectively. While lowest cumulative water loss was observed with foliar application of BA @ 400 ppm and Chlormequat chloride @ 1000 ppm recording 34.03 and 34.43 g respectively. Similar results with application of GA_3 were reported by Michalczuk *et al*. (1989) and Torre *et al*. (1999) in rose and Parmeshwar (2010) in sunflower **(Table 2).**

Sodium silicate @ 250 ppm increased the post harvest vase life of cut flowers (5.90) and was at par with Sodium silicate @350 ppm, Chlormequat chloride @ 1500ppm and Chlormequat chloride @ 1000 ppm recording 5.70, 5.67 and 5.53 days respectively. Vase life was enhanced by 2.10 days in comparison to control. This may be because of the contribution of Sodium silicate and with respect to pre harvest floral parameters which in turn contributed to maximize post harvest vase life of the cut flowers. Similar results were also reported by Srikanth (2011) in china aster and Parmeshwar (2010) in sunflower **(Table 2).**

Table 2. Flower quality, yield and post harvest parameters as influenced by the application of different growth regulators in genotype M-17R

Sl. No.	Flower stalk length (cm)	Flower stalk girth (cm)	Flower head diameter (cm)	Flower disc diameter (cm)	Number of ray florets per flower	Number of flower heads per plant	Number of marketable flower heads per plant	Number of marketable flower heads (lakhs ha^{-1})	CWU (g)	CWL (g)	Vase life (days)
T_1	35.93	0.35	7.19	1.89	21.40	15.00	7.40	4.11	38.23	41.23	5.20
T_2	35.53	0.31	6.96	1.97	19.67	11.67	7.67	4.25	35.05	39.10	5.13
T_3	20.33	0.31	8.63	1.80	24.33	14.40	10.07	5.59	35.33	42.63	5.13
T_4	31.33	0.41	9.43	3.79	33.13	21.00	14.90	8.27	32.37	34.03	4.53
T_5	22.20	0.39	10.35	3.51	33.40	20.00	15.33	8.51	35.60	35.93	3.80
T_6	27.33	0.35	9.29	3.86	33.33	18.47	13.33	7.40	39.20	38.87	4.33
T_7	26.27	0.44	11.37	4.11	34.93	24.93	20.80	11.55	40.80	35.53	5.90
T_8	23.20	0.39	10.62	3.61	34.67	22.53	19.67	10.92	36.80	39.37	5.13
T_9	23.80	0.37	11.06	3.75	33.27	15.40	13.87	7.70	37.33	42.40	4.87
T_{10}	25.73	0.43	10.41	4.00	34.33	20.93	16.73	9.29	37.40	40.27	4.80
T_{11}	21.73	0.34	11.18	3.49	33.53	20.00	16.67	9.26	37.07	35.87	4.40
T_{12}	18.87	0.33	10.05	3.36	33.27	18.27	16.33	9.07	34.10	36.67	4.60
T_{13}	24.00	0.37	11.02	3.44	33.23	20.60	17.00	9.44	33.07	37.10	5.07
T_{14}	27.50	0.41	11.11	4.32	33.93	22.13	17.53	9.74	31.07	34.43	5.53
T_{15}	27.81	0.46	11.27	4.47	34.13	22.40	17.67	9.81	32.27	35.10	5.67
T_{16}	30.04	0.34	10.46	3.86	33.40	21.98	14.77	8.20	31.67	35.13	3.60
Mean	26.35	0.37	10.02	3.45	31.50	19.36	14.98	8.27	35.46	37.73	4.86
SEm	0.25	0.01	0.11	0.05	0.65	0.64	0.56	0.28	1.09	0.29	0.18
CD(*P=0.05*)	0.72	0.03	0.31	0.16	1.88	1.85	1.62	0.83	3.15	0.83	0.53
CV%	1.65	4.07	1.87	2.73	3.59	5.73	6.47	5.99	5.32	1.32	6.55
F-Test	*	*	*	*	*	*	*	*	*	*	*

* - Significant at $P = 0.05$ NS - Non significant at $P = 0.05$

Where:

T_1: Gibberellic acid (GA_3) @ 50 ppm
T_2: Gibberellic acid (GA_3) @ 200 ppm
T_3: Gibberellic acid (GA_3) @ 250 ppm
T_4: Benzyl adenine (BA) @ 400 ppm
T_5: Benzyl adenine (BA) @ 500 ppm
T_6: Benzyl adenine (BA) @ 600 ppm
T_7: Sodium silicate ($NaSiO_3$) @ 250 ppm
T_8: Sodium silicate ($NaSiO_3$) @ 350 ppm
T_9: Sodium silicate ($NaSiO_3$) @ 450 ppm
T_{10}: Calcium sulphate @ 200 ppm
T_{11}: Calcium sulphate @ 300 ppm
T_{12}: Calcium sulphate @ 400 ppm
T_{13}: Chlormequatchloride (CCC) @ 500 ppm
T_{14}: Chlormequat chloride (CCC) @ 1000 ppm
T_{15}: Chlormequat chloride (CCC) @ 1500 ppm
T_{16}: Control (No spray)
CWU: Cumulative water uptake
CWL : Cumulative water loss

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