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RESEARCH PAPER

Effect of foliar application of growth regulators and chemicals on growth, flowering and vase life of ornamental sunflower genotypes (*Helianthus annuus* L.)

A.S. PARMESHWAR*, D.P. KUMAR, Y.G. SHADAKSHARI[1] AND R. JAYANTHI
Department of Horticulture, University of Agricultural Sciences, G.K.V.K.,
BENGALURU (KARNATAKA) INDIA

Abstract : Foliar application of GA_3 @150ppm in HAM-196 and M-17R genotypes resulted in higher plant height and longer flower stalk length, respectively. Increase in number of flower per plant and flower diameter was observed in HAM-196 and M-17R genotypes sprayed with NaSio4 @ 300ppm. However spraying of GA_3 @150ppm increased the postharvest life in genotype M-17R.

Key Words : Growth regulators, Sunflower, Gibberlic acid, Benzyl adenine, Sodium silicate, Calcium, Sulphate

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INTRODUCTION

Ornamental sunflower (*Helianthus annuus* L.) is one of the most important and popular speciality cut flower of the world and is native to North America, where it was grown by indigenous people for food and medicinal purposes. It was first introduced in Europe as an ornamental crop but later years it become a very important oilseed crop around the world. In early 1990s, it regained popularity as a cut flower. Plant growth regulators play an important role and are being used for increasing growth and yield. In spite of its importance, very little information is available on effect of foliar application of growth regulators and chemicals on growth, flowering and vase life of ornamental sunflower. Hence, an experiment was laid out to study the various effects of growth regulators and chemicals on ornamental sunflower.

MATERIALS AND METHODS

The experiment was conducted during 2009-2010 in AICRP (sunflower), Zonal Agricultural Research Station, University of Agricultural Sciences, GKVK, Bengaluru on ornamental sunflower genotypes. Two to three seeds per hill were sown at 30x60cm spacing replicated thrice in split plot design with three genotypes *viz.,* P-70R, HAM-196 and M-17R. In total 13 treatments *viz.,* T_1-Gibberlic acid @ 50ppm, T_2-Gibberlic acid @ 100ppm, T_3-Gibberlic acid @ 150ppm, T_4-Benzyl adenine @ 200ppm, T_5-Benzyl adenine @ 300ppm, T_6-Benzyl adenine @ 400ppm, T_7-Sodium silicate @ 200ppm, T_8-Sodium silicate @ 300ppm, T_9-Sodium silicate @ 400ppm and T_{10}-Calcium sulphate @ 200ppm, T_{11}-Calcium sulphate @ 300ppm, T_{12}-Calcium sulphate @ 200ppm and T-$_{13}$ untreated control. The chemical and growth regulator treatments were given through foliar application at ten days intervals. The parameters *viz,* plant height, number of leaves, number of flowers per plant, flower stalk length, flower diameter and vase life were recorded.

RESULTS AND DISCUSSION

The effect of foliar application of growth and chemicals

* **Author for correspondence.**
[1]AICRP on Sunflower, University of Agricultural Sciences, G.K.V.K., BENGALURU (KARNATAKA) INDIA

on all three genotypes on plant height and number of leaves per plant recorded and tabulated in Table 1. The effect of genotypes on plant height was non-significant. Among different treatments T_3 recorded maximum (118.30cm) plant height which was at par with T_{10} (116.54cm) and minimum in T_{13} (94.38 cm). Maximum plant height (123.98cm) was registered in T_3 (GA_3@150ppm) in HAM-196 which followed by T_{10} (118.44cm) in HAM-196 genotype. Talukdar and Paswan (1997) reported that the application of GA_3 must have lead to increase in cell elongation which intern increased in intermodal length, thereby indirectly helping in increasing the plant height. More number of leaves per plant was noticed in genotype HAM-196 (21.84) followed by P-70R (20.05) whereas; minimum was recorded by M-17R (19.98). Among the treatments T_3 (GA_3@150ppm) had recorded maximum number of leaves per plant (23.49) which was at par with T_2 (GA_3@100ppm) and T_{10} (Calcium sulphate @ 200 ppm) (22.11 and 21.60, respectively) where as the interaction effect of genotypes and treatments was non-significant. Similar findings were reported in China aster and Marigold by Syamal *et al.* (1990).

The effect of growth regulators and chemicals, genotypes and their interaction effects on number of flowers produced per plant, flower stalk length and flower diameter are presented in Table 2. The number of flowers produced per plant was highest in genotype HAM-196 (18.16) and lowest in M-17R (15.33). This can be attributed to the genetic potential of cultivars to produce more number of flowers per plant. Among the treatments, more number of flowers per plant were observed in T_8 (19.48) followed by T_7 (18.44) and T_3 (17.66). Whereas, least was recorded in T_{13} (14.20). It may be due to the fact that higher chlorophyll contents in Si sprayed plants, results photosynthetic activity improvement and higher productivity (Reezi *et al*., 2009). In the interaction effects of growth regulators and genotypes, highest number of flowers were observed in combination of T_8 in HAM-196 (21.60) and lowest with T_{13} in M-17R (13.00) which was at par with T_{13} in P-70R (13.53). this could be due to the synergetic effect of both genotypes and growth regulating chemicals.

The genotype M-17R (20.19cm) recorded the stalk length which is significantly superior over the others. Whereas, the genotype P-70R recorded lowest (15.62cm) flower stalk length. This variation might be due to genetic potential of the genotypes. Similar results were reported by Vidalie (1982) in carnation and Kishnaswaroop *et al*. (2004) in China aster. Among the treatments, T_3 (20.82cm) has recorded longer stalk length which was at par with T_2 (20.27cm). However, shorter stalk length was found in T_{13} (15.26cm). This increased length of stalk was due to effect of GA_3, which known for cell elongation and cell division. Similar results were reported in anthurium by Salvi (1997) and Chandrappa (2002). In the interaction effect of growth regulators and genotypes, highest was recorded with T_3 in M-17R (22.43cm) which was at par with T_2 in M-17R (21.79cm) and T_1 in M-17R (21.87cm) where as lowest was observed in T_{13} in P-70R (11.90cm). The increase

Table 1 : Effect of foliar application of growth regulators and chemicals on plant height and number of leaves of ornamental sunflower genotypes

Treatments (T)	Plant height (cm)				Number of leaves per plant			
	Genotypes				Genotypes			
	P70R	P70R	P70R	P70R	P70R	HAM196	M17R	Mean
T_1 -Gibberlic acid@50ppm	111.51	114.79	111.53	112.61	21.57	22.17	20.13	21.29
T_2 -Gibberlic acid@100ppm	115.39	115.55	110.33	113.76	21.77	23.17	21.40	22.11
T_3 -Gibberlic acid@150ppm	117.84	123.98	113.07	118.30	22.77	25.53	22.17	23.49
T_4-Benzyle adenine@200ppm	103.09	98.33	108.53	103.32	18.27	21.63	18.67	19.52
T_5-Benzyle adenine@300ppm	101.55	100.93	109.23	103.90	18.63	19.80	19.03	19.16
T_6-Benzyle adenine@400ppm	100.22	98.51	110.37	103.03	18.60	20.33	18.80	19.24
T_7-Sodium silicate@200ppm	110.51	108.55	104.87	107.98	20.40	22.27	20.47	21.04
T_8-Sodium silicate@300ppm	108.35	104.98	110.99	108.11	20.03	21.97	18.70	20.23
T_9-Sodium silicate@400ppm	103.45	102.66	107.97	104.69	18.63	21.73	20.33	20.23
T_{10}-Calcium sulphate@200ppm	113.67	118.44	117.50	116.54	20.93	22.47	21.40	21.60
T_{11}-Calcium sulphate@300ppm	110.14	114.39	114.98	113.17	20.93	22.27	20.47	21.22
T_{12}-Calcium sulphate400ppm	112.17	110.25	115.00	112.47	19.77	20.00	20.40	20.06
T_{13}-Control	100.08	90.55	92.51	94.38	18.33	20.63	17.73	18.90
Mean	108.30	107.83	109.76		20.05	21.84	19.98	
Source	F test	C.D. (P=0.05)	S.E.±		F test	C.D. (P=0.05)	S.E.±	
Treatment (T)	*	2.07	0.73		*	2.05	0.73	
Variety (V)	NS		0.65		*	1.45	0.37	
TXV	*	3.59	1.27		NS		1.26	

* indicates significance of value at P=0.05 NS= Non significant

in stalk length was due to increase in cell division and cell elongation.

The genotype M-17R recorded maximum flower diameter of 9.60cm, where as HAM-196 recorded the minimum (8.02cm). The variation in flower diameter may be attributed to the genetic response of the genotype. These results are in accordance with the findings of Kishnaswaroop *et al*. (2004) in china aster. Among the treatment, highest (10.05cm) was recorded in T_8 and lowest (6.90cm) in T_{13}. Kamenidou *et al.* (2008) reported that, Si application was found to reduce evapotranspiration, this could have contributed to increased turgor pressure within the flower, resulting in cell swelling and thus larger flower diameters. With regard to interaction effect, larger flowers were observed in combination of M-17R with T_8 (10.59cm) which was at par with T_8 in P-70R (10.53cm) and smaller (5.70cm) flowers were observed with T_{13} in P-70R. This might be due to effect of silicon and genetical characteristics of the individual genotypes Kamenidou *et al.* (2008).

The data pertaining to vase life of cut sunflower as influenced by genotypes, growth regulators and their interactions are presented in Table 3. Observations on the vase life of cut sunflower revealed that there were significant differences among the genotypes, growth regulators and their interaction effect. The genotype M-17R recorded longer vase life of 4.30 days fallowed by HAM-196 (3.20 days) and genotypes P-70R (2.58 days) records shorter vase life. 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 (Halevy, 1976). This variation between genotypes with regard to vase life could also be due to difference in their genetic makeup of the genotype. Similar variations with regard to vase life were obtained by Bhattacharjee *et al.* (1993), Kazuo *et al*. (2002).

Among the treatments, T_3 (5.22 days) was found superior for vase life, which was at par with T_2 (5.00 days). However, poor vase life was observed in T_{13} (1.66 days) which was at par with T_6 (2.00 days). This might be due to the effect of GA_3 which may inhibit ethylene production in all flower parts. This was most pronounced in the bases of the petals which suggest that these structures may play an important regulatory role in the senescence of the petals. With regard to the

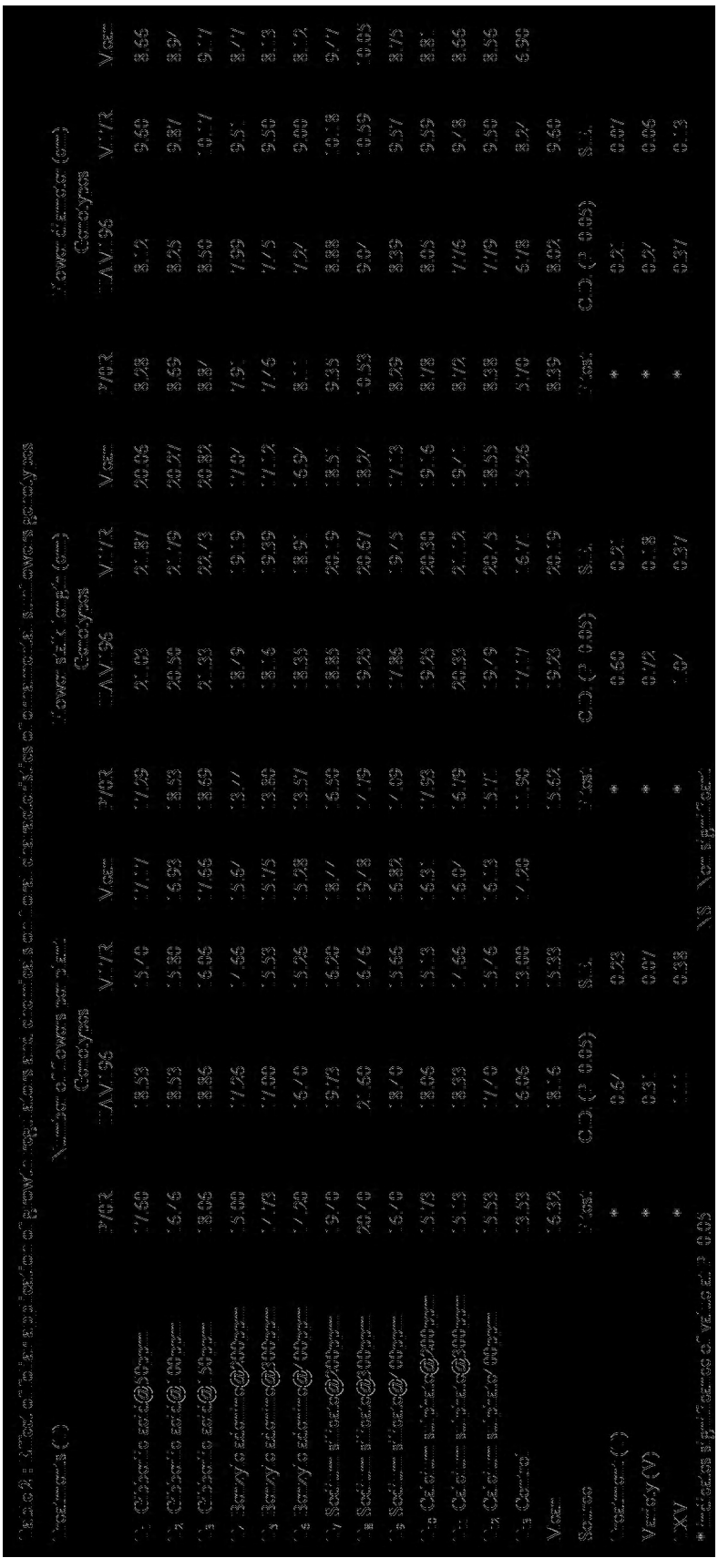

Table 3 : Effect of foliar application of growth regulators on vase life studies of ornamental sunflower genotype

Treatments (T)	Genotypes			Mean
	P70R	HAM196	M17R	
T_1 -Gibberlic acid@50ppm	2.66	4.66	5.00	4.11
T_2 -Gibberlic acid@100ppm	4.00	5.00	6.00	5.00
T_3 -Gibberlic acid@150ppm	4.33	5.33	6.00	5.22
T_4-Benzyle adenine@200ppm	1.66	2.00	4.00	2.55
T_5-Benzyle adenine@300ppm	2.33	2.33	3.33	2.66
T_6-Benzyle adenine@400ppm	1.66	1.33	3.00	2.00
T_7-Sodium silicate@200ppm	1.66	3.00	5.66	3.44
T_8-Sodium silicate@300ppm	2.00	2.33	4.33	2.88
T_9-Sodium silicate@400ppm	2.00	2.66	2.66	2.44
T_{10}-Calcium sulphate@200ppm	3.66	4.33	5.33	4.44
T_{11}-Calcium sulphate@300ppm	3.33	4.00	4.00	3.77
T_{12}-Calcium sulphate400ppm	3.00	3.33	4.33	3.55
T_{13}-Control	1.33	1.33	2.33	1.66
Mean	2.58	3.20	4.30	
Source	Treatment(T)	Variety (V)	VXT	
F test	*	*	*	
C.D. (P=0.05)	0.50	0.24	0.87	
S.E.±	0.17	0.08	0.31	

* indicates significance of values at P=0.05 NS= Non significant

interaction effect, M-17R with T_3 (6.00 days) recorded maximum vase life, which was at par with T_2, T_7, T_{10} in M-17R, and T_3 in HAM-196 (6.00, 5.66, 5.33 and 5.33 days, respectively). Whereas minimum vase life was recorded in combination of P-70R with T_{13} (1.33 days) which was at par with T_{13} in HAM-196, T_6 in HAM-196, T_4, T_6, T_7, T_8, T_9 in P-70R and HAM-196 T_4 (1.33, 1.33, 1.66, 1.66,1.66, 2.00, 2.00 and 2.00 days, respectively). This might be due to combination of long stalked genotypes and antiethylene effect of GA_3. Similar results were obtained by Prince *et al*. (1980).

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