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EFFECT OF PLANT GROWTH REGULATORS ON THE POSTHARVEST LIFE OF TUBEROSE CV. DOUBLE

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ABSTRACT

The plant growth regulators (BA, GA, NAA and MH) were tried with 50 and 100 ppm concentrations to extend the vase life of cut tuberose spikes. Among the growth regulators BA and GA 100 ppm were found most effective in terms of improving the water uptake, maintenance of better water balance thereby increasing the fresh weight of flowers which finally contributed to the increased vase life (10.22 and 10.33 days, respectively) and increased number of florets opened (61.73 and 56.89%, respectively) per spike. By adding BA 100 ppm to the vase water petal senescence delayed to a considerable extent and maintained freshness for a longer time than GA 100 ppm.

Key words : Tuberose, BA, GA, NAA, MH, vase life

Tuberose is one of the most important bulbous ornamentals which is commercially grown for its cut flower, and occupies a prime position in commercial flower crops. Hence the effectiveness of plant growth regulators on the water relations, vase life and floret opening of cut tuberose spikes was worked out.

MATERIALS AND METHODS

Flowering spikes of tuberose cv. Double of 65 cm length were harvested when one or two lowermost florets were ready to open on the day of harvest. The spikes were harvested in the morning to avoid excessive heat and immediately the stems were placed in distilled water. Stems of the spikes were cut to uniform length of 55 cm and all the leaves except 2 to 3 below the lowermost floret were removed to avoid contact with the solution (Buys, 1969). After recording fresh weight, the spikes were placed in 500 ml conical flask containing 300 ml of aqueous solutions of plant growth regulators. Freshly prepared solutions were used in the experiment with distilled water as control.

The experiment was conducted in 1997 in the Department of Horticulture, A.N.G. Ranga Agricultural University, Hyderabad at normal room temperature of 26 ± 1°C having 70 ± 4% relative humidity in the laboratory, and the light intensity during the period of experimentation was recorded as 0.38 W m^{-2} illumination for 12h period.

The aqueous solutions of plant growth

regulators selected were BA, GA, NAA and MH with concentrations of 50 and 100 ppm and design of the experiment was CRD. Each treatment unit consisted of 3 replications with three spikes as a replication.

The weight of each container and solution with or without flower spike was recorded daily. While recording weights, everyday re-cutting of the floral stems (about 1 cm) was done uniformly. The water uptake, transpirational loss of water, water balance, and fresh weight were determined by the procedure described by Venkatarayappa *et al.* (1980). The vase life and number of florets opened were determined as described by Halevy and Mayak (1979).

RESULTS AND DISCUSSION

Water uptake (g/spike/day)

On day 1 and 2, the water uptake was not significantly affected by all the treatments. On day 3, the water uptake was maximum with BA treatments followed by GA treatments (Table 1). MH was at par with control. NAA 50 ppm significantly reduced water uptake. There were no differences in the water uptake between the two concentrations of any plant growth regulator. On day 4 and 5, the trend was similar as on day 3, but on day 4 BA at higher concentration significantly increased the water uptake over its lower concentration, whereas, on day 5 GA at higher concentration significantly increased water uptake. Increased water uptake was achieved by maintenance of cell integrity which was also confirmed by Mayak and Halevy (1974). Both the concentrations of NAA significantly reduced the water uptake as compared to control. On day 7 to 11, the water uptake was maximum with MH and control, followed by BA and GA. There were no significant differences in water uptake between the two concentrations. NAA recorded minimum rates of water uptake from day 4 onwards.

Transpirational loss of water (TLW) (g/spike/day)

The TLW by the cut tuberose spikes

Table 1. Effect of plant growth regulators on water uptake (g/spike/day) of cut tuberose spikes

	Days										
Treatment	1	2	3	4	5	6	7	8	9	10	11
Benzyl adenine 50 ppm	8.77	9.55	9.11	6.00	4.00	2.89	2.11	1.67	1.67	1.44	1.44
Benzyl adenine 100 ppm	8.89	10.00	9.44	7.33	4.22	2.55	1.89	1.44	1.56	1.44	1.22
GA 50 ppm	9.33	10.34	7.78	6.44	3.11	2.67	2.44	1.67	1.77	1.56	1.55
GA 100 ppm	9.22	9.78	7.89	6.78	4.22	3.11	2.33	1.89	1.56	1.56	1.44
NAA 50 ppm	9.67	9.22	4.89	3.89	1.22	1.56	1.22	1.00	1.00	1.00	0.78
NAA 100 ppm	9.33	8.99	5.33	2.56	1.00	1.22	1.00	0.78	0.89	0.89	0.67
MH 50 ppm	8.67	9.44	6.22	5.67	3.67	3.11	2.55	2.11	1.78	1.45	1.67
MH 100 ppm	9.33	9.89	6.89	5.89	3.88	3.22	2.45	1.78	1.78	1.67	1.55
Control	8.00	8.11	6.33	5.11	3.88	5.67	2.44	1.78	1.67	1.56	1.44
Mean	9.02	9.48	7.09	5.52	3.24	2.89	2.09	1.57	1.52	1.39	1.31
S.Em±	0.49	0.56	0.46	0.28	0.36	0.81	0.23	0.13	0.13	0.13	0.15
CD at 5%	NS	NS	1.36	0.79	1.07	NS	0.67	0.38	0.38	0.40	0.45

was not significantly influenced (Table 2) by plant growth regulators for most of the days during vase life period. On day 3, TLW was significantly higher with MH but was at par with NAA 100 ppm, GA 50 ppm and control. There were significant differences among the plant growth regulators without any influence to the concentration. On day 10, NAA 100 ppm significantly reduced the TLW. There was no difference between the concentrations. Among all the plant growth regulators tested, BA recorded minimum rates of TLW.

Water balance (g/spike/day)

On day 1, the water balance was maximum (Table 3) compared to any other day of vase life period in all the treatments. There were no significant differences between the concentrations of BA, GA and NAA in increasing the water balance. MH 50 ppm significantly reduced the water balance as compared to BA and GA 100 ppm and NAA 50 ppm. Control was at par with them. On day 2, BA at higher (100 ppm) concentration significantly improved water balance over its lower concentration. There were no differences between the concentrations of other plant growth regulators. Both GA concentrations and MH 100 ppm significantly increased the water balance. On day 3, there were no differences between the concentrations of any growth regulator but BA and GA significantly increased the water balance. On day 4, a similar trend continued with BA and GA increasing the water balance compared to NAA 50 ppm and control. On day 7, GA at lower concentration significantly improved the water balance over its higher concentration, however, there were no differences in water balance between the concentrations of the remaining growth regulators. By adding BA and GA to the vase water improved the positive water balance (Mayak and Halevy, 1974) for longer period thereby increased the vase life of cut tuberoses. The water balance during the later part of vase life was non-significant.

Table 2. Effect of plant growth regulators on transpirational loss of water (g/spike/day) of cut tuberose spikes

Treatment	Days										
	1	2	3	4	5	6	7	8	9	10	11
Benzyl adenine 50 ppm	3.56	5.11	5.78	6.00	5.33	4.56	2.78	2.34	2.22	1.78	1.78
Benzyl adenine 100 ppm	3.22	4.78	5.56	5.55	4.89	5.00	2.89	2.00	2.33	1.44	1.56
GA 50 ppm	3.78	5.33	6.00	5.56	4.78	2.00	1.45	2.55	1.67	1.55	1.56
GA 100 ppm	3.56	5.11	5.44	5.33	4.77	3.67	2.78	1.89	2.00	1.45	2.56
NAA 50 ppm	4.00	5.44	5.78	5.45	6.11	3.00	1.22	1.44	0.78	1.00	0.56
NAA 100 ppm	3.89	5.44	6.56	6.22	4.89	3.34	1.67	0.78	1.11	0.78	0.56
MH 50 ppm	4.00	6.11	6.77	6.89	5.89	2.77	1.55	1.89	1.67	1.78	1.78
MH 100 ppm	4.44	6.00	6.89	7.56	6.33	3.34	1.78	1.67	2.00	1.44	1.22
Control	3.89	5.11	6.00	5.78	4.44	4.33	1.78	1.56	1.22	1.44	1.33
Mean	3.82	5.38	6.09	6.04	5.27	3.56	1.99	1.79	1.67	1.41	1.43
S.Em±	0.25	0.40	0.33	0.60	0.91	0.72	0.42	0.41	0.39	0.18	0.55
CD at 5%	NS	NS	0.99	NS	NS	NS	NS	NS	NS	0.53	NS

Table 3. Effect of plant growth regulators on water balance (g/spike/day) of cut tuberose spikes

Treatment	Days										
	1	2	3	4	5	6	7	8	9	10	11
Benzyl adenine 50 ppm	11.22	10.44	9.33	5.99	4.67	4.33	5.33	5.33	5.45	5.67	5.67
	(5.22)	(4.44)	(3.33)	(-0.01)	(-1.33)	(-1.67)	(-0.67)	(-0.67)	(-0.55)	(-0.33)	(-0.33)
Benzyl adenine 100 ppm	11.67	11.22	9.89	6.66	5.33	3.55	5.00	5.45	6.11	6.00	5.67
	(5.67)	(5.22)	(3.89)	(0.66)	(-0.67)	(-2.45)	(-1.00)	(-0.55)	(0.11)	(0.00)	(-0.33)
GA 50 ppm	11.55	10.99	8.11	6.89	4.33	6.67	7.00	5.11	6.55	6.00	5.67
	(5.55)	(4.99)	(2.11)	(0.89)	(-1.67)	(0.67)	(1.00)	(-0.89)	(0.55)	(0.00)	(-0.33)
GA 100 ppm	11.67	10.67	8.44	7.44	5.45	5.45	5.44	5.99	6.00	6.11	5.55
	(5.67)	(4.67)	(2.44)	(1.44)	(-0.55)	(-0.55)	(-0.56)	(-0.01)	(0.00)	(0.11)	(-0.45)
NAA 50 ppm	11.67	9.78	5.11	4.45	4.22	4.55	6.22	5.56	6.22	5.78	6.22
	(5.67)	(3.78)	(-0.89)	(-1.55)	(-3.78)	(-1.45)	(0.22)	(-0.44)	(0.22)	(-0.22)	(0.22)
NAA 100 ppm	11.44	9.55	4.78	2.33	2.11	4.22	6.44	6.00	5.78	6.11	6.11
	5.44)	(3.55)	(-1.22)	(-3.67)	(-3.89)	(-1.78)	(0.44)	(0.00)	(-0.22)	(0.11)	(0.11)
MH 50 ppm	10.67	9.33	5.45	4.78	3.78	6.33	6.89	6.22	6.11	5.67	5.89
	(4.67)	(3.33)	(-0.55)	(-1.22)	(-2.22)	(0.33)	(0.89)	(0.22)	(0.11)	(-0.33)	(-0.11)
MH 100 ppm	10.89	9.89	6.00	4.33	3.56	5.89	6.66	6.11	5.89	6.00	6.33
	(4.89)	(3.89)	(0.00)	(-1.67)	(-2.44)	(-0.11)	(0.66)	(0.11)	(-0.11)	(0.00)	(0.33)
Control	10.11	8.99	5.45	5.34	5.44	5.00	6.76	6.22	6.44	6.11	6.11
	(4.11)	(2.99)	(-0.55)	(-0.66)	(-0.56)	(-1.00)	(0.76)	(0.22)	(0.44)	(0.11)	(0.11)
Mean	11.20	10.09	6.95	5.36	4.32	5.11	6.19	5.78	6.01	5.94	5.91
S.Em±	0.32	0.25	0.42	0.49	0.83	0.67	0.42	0.42	0.38	0.19	0.40
CD at 5%	0.95	0.76	1.27	1.47	NS	NS	1.26	NS	NS	NS	NS

Parenthesis represents original values
The data were analysed statistically after the uniform addition of a base value '6'

Per cent change in fresh weight

On day 2, except MH 50 ppm, all other plant growth regulators significantly improved fresh weight (Table 4) over control. BA 100 ppm was superior to NAA and MH, whereas, GA was at par with BA. There were no differences between the concentrations of any given plant growth regulator. On day 3 and 4, BA and GA significantly increased the fresh weight, whereas, NAA and MH were at par with control. On day 5 to 8, the trend was similar as on day 3 and 4 except that NAA significantly reduced the fresh weight compared to control. On day 9 and 10, BA significantly increased the fresh weight over control, whereas, GA and MH were at par with control. There were no differences between the concentrations. On day 11, BA significantly increased the fresh weight with no difference between the concentrations followed by GA and MH. BA and GA in the vase water increased the water uptake, maintained normal levels of transpirational loss of water and improved the water balance thereby contributing increased fresh (Mayak and Halevy, 1974) weight. From day 3 onwards, NAA generally reduced the fresh weight among all the plant growth regulators till the end of vase life period.

Vase life (days) and per cent of opened florets (per spike)

All plant growth regulators significantly influenced the vase life and floret opening

Table 4. Effect of plant growth regulators on fresh weight change (% of initial weight) of cut tuberose spikes

Treatment	Days										
	1	2	3	4	5	6	7	8	9	10	11
Benzyl adenine 50 ppm	108.2	115.2	119.9	118.6	109.3	95.0	81.9	75.0	70.2	66.9	63.2
Benzyl adenine 100 ppm	108.7	116.6	121.7	123.6	115.9	96.8	85.1	75.9	71.8	67.5	65.4
GA 50 ppm	107.7	114.6	117.3	117.3	102.7	89.3	71.7	67.9	61.1	52.4	46.3
GA 100 ppm	108.5	115.3	117.8	118.6	106.6	95.3	81.2	73.6	64.3	57.2	41.2
NAA 50 ppm	108.6	113.7	110.5	102.4	72.3	58.6	50.6	45.0	40.9	38.3	36.5
NAA 100 ppm	108.3	113.6	109.7	94.8	66.9	49.9	40.7	36.7	32.7	30.4	27.7
MH 50 ppm	107.9	113.1	110.0	103.2	85.6	72.2	63.3	56.6	52.2	50.0	47.8
MH 100 ppm	107.7	113.5	11.3	102.7	79.3	69.4	63.7	57.7	52.4	46.9	45.5
Control	106.7	111.0	108.7	103.9	87.5	71.7	63.76	57.5	54.1	49.7	46.4
Mean	108.0	114.1	114.1	109.4	91.8	77.5	67.5	60.6	55.5	51.0	46.7
S.Em±	0.42	0.81	1.31	2.90	4.15	4.24	3.71	3.91	3.75	3.55	3.78
CD at 5%	NS	2.39	3.89	8.63	12.33	12.60	11.02	11.61	11.16	10.55	11.24

Table 5. Effect of plant growth regulators on floret opening (per cent/spike) and vase life (days) of cut tuberose spikes

Treatment	Opened florets (%)	Vase life (days)
Benzyl adenine 50 ppm	57.81	9.67
Benzyl adenine 100 ppm	61.73	10.22
GA 50 ppm	52.95	9.67
GA 100 ppm	56.89	10.33
NAA 50 ppm	38.42	6.33
NAA 100 ppm	49.11	6.22
MH 50 ppm	47.13	6.22
MH 100 ppm	46.03	6.77
Control	49.68	6.45
Mean	51.08	7.99
S.Em±	2.45	0.32
CD at 5%	7.30	0.97

(Table 5) of tuberose flower spikes. BA and GA at higher concentrations significantly increased the vase life (10.22 and 10.33 days) as well as per cent of opened florets (61.73 and 56.89%, respectively) which were at par with each other followed by their lower concentrations. MH and NAA were on par with control. BA, a natural anti-senescence factor delayed the senescence of tuberose flower spikes and increased the vase life. GA was also more effective in increasing the vase life and floret opening of cut tuberoses which was also reported by Mukhopadhyay (1982). NAA and MH hastened the abscission of young buds.

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