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Effect of pre soaking of bulbs in plant growth regulators on flowering and vase life of tuberose (*Polianthes tuberosa* Linn.)

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Abstract
The field experiment entitled "Effect of pre soaking of bulbs in plant growth regulators on flowering and vase life of tuberose (Polianthes tuberosa Linn.)" was conducted during 2015-2016 at the Department of Floriculture and Landscape Architecture, College of Horticulture, Mandsaur, RVSKVV, (M.P.). Bulbs of tuberose cultivar 'Shringar' were treated with four concentrations each of GA3 (50 ppm,100 ppm, 150 ppm, 200 ppm), NAA (50 ppm, 75 ppm, 100 ppm, 125 ppm) and control (Distilled Water) for 24 hours before planting after removal of scales. The observations were recorded for flowering, and vase life. Among the PGRs treatments, (GA3 200 ppm) was found to be effective for flowering parameters like days to first spike emergence, days to 50% flowering, number of spikes per plant, length of spike, number of florets per spike, length of floret, diameter of floret and flower duration and also GA3 200 ppm recorded the longest vase life of cut spike (days) and the maximum (g) of cut spike at harvest.

Keywords: PGRs, tuberose, flowering and vase life

Introduction
Tuberose (*Polianthes tuberosa* Linn.) commonly known as 'Rajnigandha' is a bulbous summer flowering perennial ornamental plant. It is a multipurpose flower which is used for artistic garlands, floral ornaments, bouquets and buttonholes. The long flower spikes are excellent as a cut flower for table decoration when arranged in vases. It is commercially cultivated for cut and loose flower trade, and also for extraction of it's highly valued natural flower oil which is used in high value perfumes and cosmetic products. The concrete yield from fresh flower is 0.08 to 0.11 percent, of which 18 to 23 percent constitute alcohol soluble absolute.

Tuberose is a half hardy, bulbous perennial, perpetuating itself through the bulblets. Bulbs are made up of scales and leaf bases and the stem is a condensed structure which remains concealed within scales. Numerous lanceolate leaves are green, narrow, linear, long and arise in rosette. The flowers have a funnel shaped perianth, waxy white about 25 mm long, single or double and borne in spike. 'Single' varieties are more fragrant than 'Double' type. The terminal flower spikes arising from the bulb, produces flowers for a number of days.

Plant growth regulators play a vital role in overall performance including flowering and bulb production (Biswas *et al.,* 1983) [2]. The control over flowering time and floral characteristics according to the demand of market has been achieved in many cut flowers by adopting modern production techniques including the use of plant growth regulators (PGRs). Plant growth regulators are known to co-ordinate and control various phases of growth and development, including flowering at optimum concentrations. It is generally accepted that exogenously applied growth substances act through the alteration in the levels of naturally occurring hormones, thus modifying the growth and development of the plant. Gibberellic acid treatments are known to play important role in promoting diverse processes throughout the development of plant. They induce early flowering, increase length or height of plant, number of leaves, chlorophyll content, yield and quality in different flowering crops. Soaking of bulbs in GA_3, ethrel, kinetin, NAA and thiourea solution before planting improve the flowering and vase life of tuberose.

Materials and methods

The present investigation was conducted during 2015- 2016 at the Department of Floriculture and Landscape Architecture, K.N.K. College of Horticulture, Mandsaur, RVSKVV, (M.P.). The experiment was conducted in Randomized block design with three replications. Tuberose cultivar Shringar was treated with four levels each of GA_3 (50 PPM, 100 PPM, 150 PPM and 200 PPM) and NAA (50 ppm, 75 ppm, 100 ppm and 125 ppm) as a corm dipping for 24 hours before planting after removal of scales. The treatment combinations are T_1 - control, T_2 – GA_3 50 ppm, T_3 – GA_3 100 ppm, T_4 – GA_3 150 ppm, T_5 – GA_3 200 ppm, T_6 – NAA 50 ppm, T_7 – NAA 75 ppm, T_8 – NAA100 ppm and T_9 – NAA125 ppm. One healthy corm was planted at the spacing of 30 cm x 30 cm in pit at 10 cm depth and watered immediately. Standard cultural practices were followed during the entire crop period. Soil Data was recorded for various flowering and vase life parameters and statistically analyzed using the method of Analysis of Variance as described by Panse and Sukhatme (1984) [12] for Randomized Block Design at 5% level of significance.

Results and discussion

It is evident from the tabulated data (Table 1 and 2) that the flowering was significantly affected by different PGRs concentrations.

It is clear from the Table 1 that the earliest first spike emergence was recorded with the application of GA_3 200ppm followed by GA_3 150 PPM. This might be due to early flower primordial development, cell differentiation and early utilization of nutrients. GA_3 at higher concentration might have reduced the vegetative period, resulting in induction of early flower development. Likewise, GA_3 treatments at the highest concentration significantly shortened the time taken from planting to flowering in *Iris* sp. (Taha *et al.,* 2012) [17]. Similar results of earliest spike emergence in tuberose with higher concentration of GA_3 has been reported by Reddy *et al*., 1997 [15]; Panwar *et al*., 2006 [13]; Asil *et al*., 2011 [1]; Rani and Singh, 2013 [14] in tuberose.

Table 1. Shows that the earliest 50% flowering was recorded with the application of GA_3 200ppm followed by GA_3 150ppm. It might be due to the early production of florigen in GA_3 treated plants, as GA_3 is a component of florigen, which is required for formation of flowers in plant system and this is in agreement with Padmapriya and Chezhiyan, (2002) [11]. GA_3 200ppm recorded maximum number of spikes per plant followed by GA_3 150 ppm, while the minimum number of spikes per plant was recorded with control. This might be due to the action of GA, stimulating the conversion of storage polymers (polysaccharides, proteins and fats) into sucrose or mobile amino acids to facilitate their translocation via phloem into and throughout the young root and shoot system and thus influencing spikes production. (Ganesh *et al*., 2013) [4] and it may also be due to increase in cell division and cell elongation with GA_3 (Kumar and Gautam, 2011) [5], the present findings are in accordance with Narayan and Shyamal (2002) [9] in tuberose. Maximum length of spikes was recorded with the application of GA_3 200 ppm. The increased spike length might be due to rapid internode elongation as a result of increased in cell division and cell elongation in intercalary meristem. Similar results were obtained by Mukhopadhyay and Banker (1983) [8], Kumar and Gautam (2011) [5] in tuberose.

GA_3 200ppm recorded maximum number of florets per spike Table 2. The number of flowers per spike depends on the number of initial flower buds which varies with genotype. The favourable effect of GA_3 might be attributed to the greater amount of carbohydrate accumulation and increase in metabolic activities. Similar results were observed indicating the significant role of GA_3 in increasing the flower number (Padaganur *et al.,* 2005; Kumar and Gautam, 2011; Wagh *et al*., 2012 and Singh *et al*., 2013) [10, 5, 18, 16] in tuberose.

Maximum length of florets was recorded with the application of GA_3 200ppm Table 2 The increase in length of floret may be due to the role of these plant growth regulators in activation of enzymes important in cell elongation process. The findings are in conformity with Padaganur *et al.,* (2005) [10]; Devadanam *et al*., (2007) [3] and Singh *et al*., (2013) [16] in tuberose.

It can be seen from the Table 2 that GA_3 200ppm recorded maximum diameter of floret. Favourable effect of application of gibberellins on floret diameter might be due to improved physiological efficiency, selective ion uptake and sufficient water uptake causing high rate of accumulate deposition. The results are in close conformity with the findings of Padaganur *et al.,* (2005) [10]; Devadanam *et al*., (2007) [3] and Singh *et al*., (2013) [16] in tuberose.

Maximum flower duration was recorded with the application of GA_3 200ppm. Application of GA_3 pretreatment also increased the durability of flowers. Gibberellic acid application results in continuous supply of photosynthetic assimilate for longer duration due to high source strength at higher concentration. The findings are in close conformity with (Rani and Singh, 2013) [14] and (Singh *et al*., 2013) [16] in tuberose.

It is evident from the tabulated data (Table 3 and 4) that the vase life characteristics were significantly affected by different PGR concentrations.

Table 3 shows that Longest vase life of cut spike was recorded with the application of GA_3 200ppm. Vase life might be due to accumulation of more food materials in spike due to mobilization and translocation of photosynthates from increased number of leaves and leaf area in treated bulbs. Kumar and Singh (2004) [6] and Singh *et al*., (2013) [16] also reported similar results in tuberose.

Maximum fresh weight of cut spike at harvest was recorded with the application of GA_3 200ppm Table 4 Maximum fresh weight of cut spike might be due to the fact that these spikes had more number of florets per spike with increased length and diameter. Accumulation of respirable substrates in spike due to increased mobilization and photosynthates to the spike could have resulted in higher fresh weight of cut spikes. The findings in the present investigation are in conformity with Padaganur *et al.,* (2005) [10] in tuberose.

Table 1: Effect of PGR on the number of days taken to first spike emergence, days to 50% flowering, number of spikes per plant, length of spike

Treatment	Days taken to first spike emergence	Days to 50% flowering	Number of spikes per plant	Length of spike(cm)
T_1 - control	135.37	149.53	1.00	57.97
T_2 – GA_3 50 ppm	130.20	144.40	1.23	67.40
T_3 – GA_3 100 ppm	126.20	137.97	1.30	71.20
T_4 – GA_3 150 ppm	122.30	135.30	1.43	76.20
T_5 – GA_3 200 ppm	120.40	131.40	1.50	78.97
T_6 – NAA 50 ppm	131.10	145.40	1.10	63.97
T_7 – NAA 75 ppm	126.60	140.07	1.20	67.30
T_8 – NAA100 ppm	124.87	138.40	1.33	75.30
T_9 – NAA125 ppm	127.16	139.07	1.37	69.97
S.Em.±	0.572	0.646	0.095	0.768
C.D. at 5%	1.715	1.938	0.285	2.304

Table 2: Effect of PGR on the number of florets per spike, length of florets, diameter of florets, flower duration

Treatment	Number of florets per spike	Length of florets (cm)	Diameter of florets (cm)	Flower duration (days)
T_1 - control	15.20	3.70	2.50	15.20
T_2 – GA_3 50 ppm	18.73	4.34	2.83	15.50
T_3 – GA_3 100 ppm	25.43	4.81	3.17	16.40
T_4 – GA_3 150 ppm	27.87	4.95	3.30	18.40
T_5 – GA_3 200 ppm	29.40	5.23	3.57	19.30
T_6 – NAA 50 ppm	22.63	4.17	2.73	15.40
T_7 – NAA 75 ppm	23.30	4.50	3.13	16.30
T_8 – NAA100 ppm	26.53	4.79	3.03	16.97
T_9 – NAA125 ppm	24.17	4.63	3.07	17.20
S.Em.±	0.669	0.139	0.190	0.591
C.D. at 5%	2.005	0.418	0.568	1.772

Table 3: Effect of PGR on vase life of cut spike

Treatments	Vase life of cut spike (days)
T_1 - control	7.00
T_2 – GA_3 50 ppm	8.33
T_3 – GA_3 100 ppm	10.33
T_4 – GA_3 150 ppm	11.00
T_5 – GA_3 200 ppm	12.33
T_6 – NAA 50 ppm	8.00
T_7 – NAA 75 ppm	9.33
T_8 – NAA 100 ppm	11.33
T_9 – NAA 125 ppm	9.00
S.Em.±	0.498
C.D. at 5%	1.494

Table 4: Effect of PGR on fresh weight (g) of cut spikes at harvest

Treatments	Fresh weight (g) of cut spikes at harvest
T_1 - control	14.70
T_2 – GA_3 50 ppm	19.50
T_3 – GA_3 100 ppm	20.63
T_4 – GA_3 150 ppm	22.37
T_5 – GA_3 200 ppm	24.20
T_6 – NAA 50 ppm	18.90
T_7 – NAA 75 ppm	19.53
T_8 – NAA 100 ppm	21.30
T_9 – NAA 125 ppm	20.43
S.Em.±	0.958
C.D. at 5%	2.873

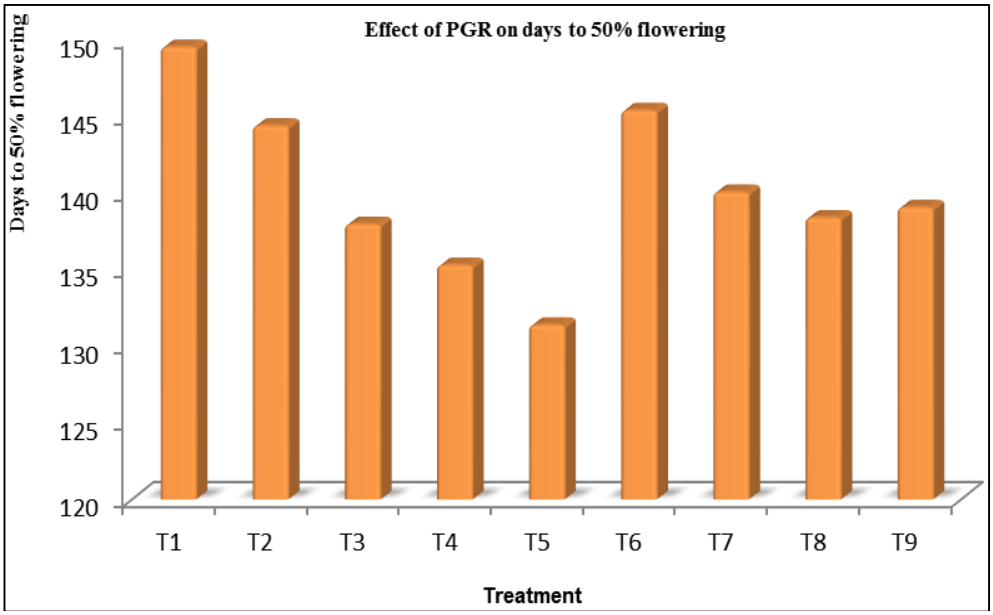

Fig 1: Effect of PGR on days to 50% flowering

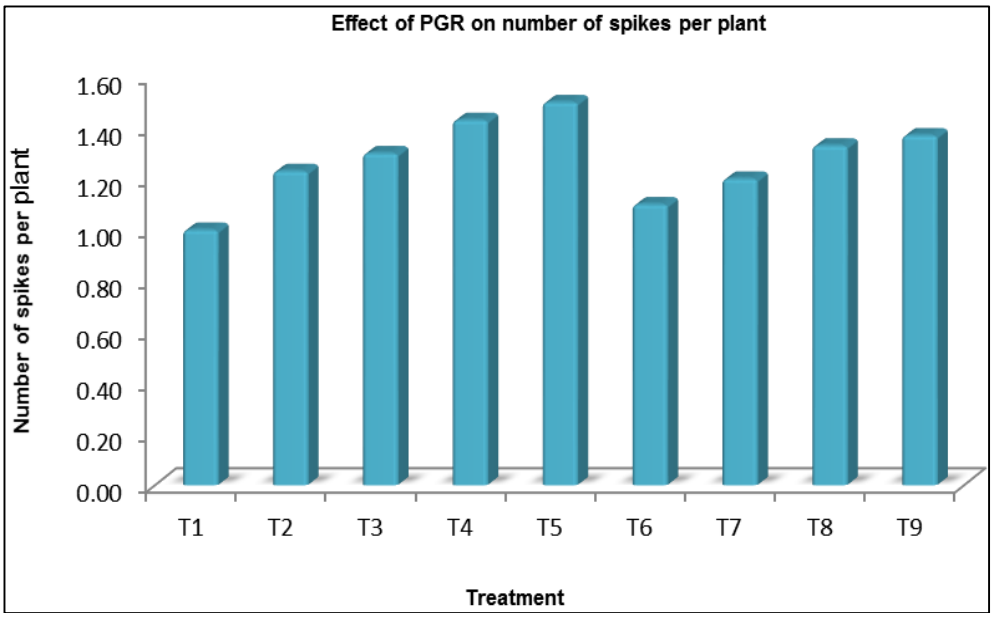

Fig 2: Effect of PGR on number of spikes per plant

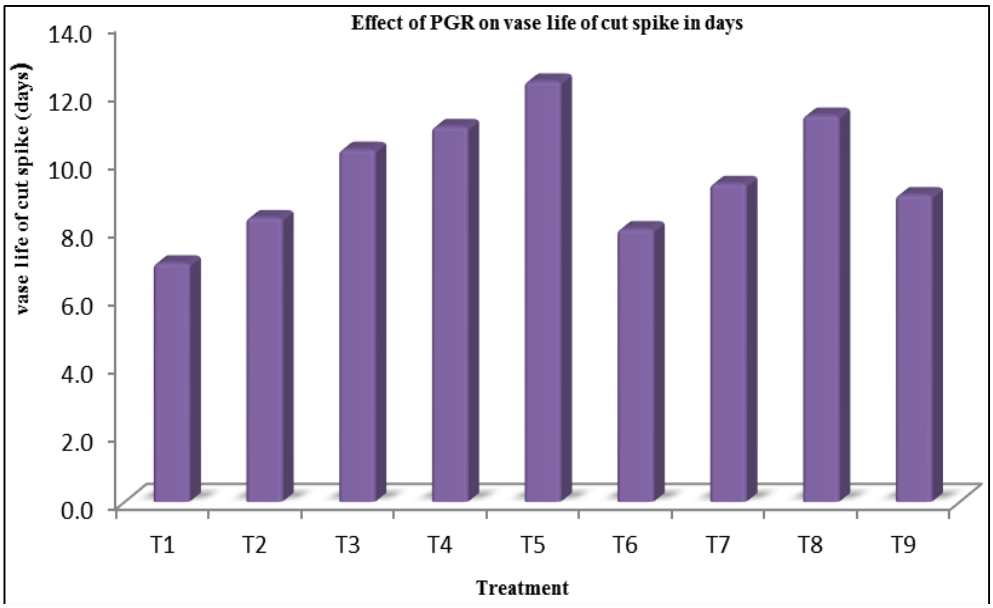

Fig 3: Effect of PGR on vase life of cut spike in days

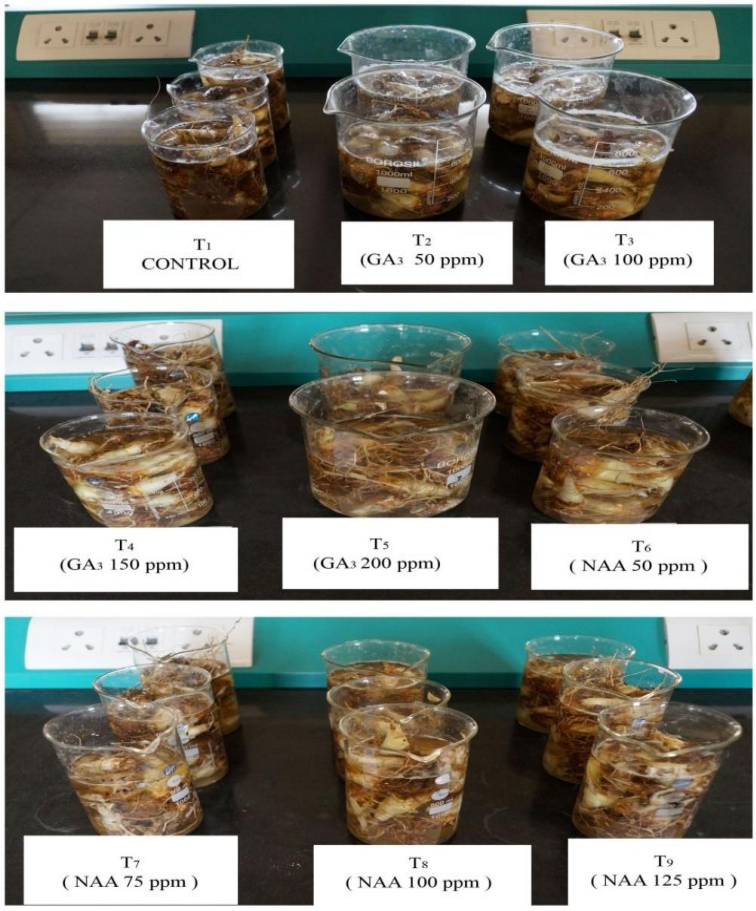

Plate 1: Bulb dipping in PGR solution

Plate 2: Vase life study in the laboratory

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