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Effect of gibberellic acid on growth and flowering of tuberose

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Abstract
An experiment was conducted to study the effect of gibberellic acid on growth and flowering of five genotypes of tuberose, at Horticulture farm, College of Agriculture, Nagpur, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during the years 2015-16 and 2016-17.

The results revealed that, the maximum values in leaves plant^{-1} and spikes hectare^{-1} total chlorophyll content of leaves at 50 per cent flowering stage and length of spike, Inter florets length, longevity of spike and length and diameter of florets, minimum days required for opening of first pair of florets and 50 per cent flowering were recorded in the genotype Prajwal. Whereas, maximum days required for opening of first pair of florets and 50 per cent flowering were observed with the genotype NT-06. However, significantly maximum leaves plant-1 and chlorophyll content of leaves, early opening of first floret and 50 per cent flowering and the maximum spike yield and values for spike quality parameters *viz.* length of spike, Inter florets length, longevity of spike and length and diameter of florets and fresh weight of florets were noted under the treatment of GA_3 100 ppm.

Keywords: tuberose, genotypes, GA_3, growth, flowering, yield

Introduction
Among the ornamental bulbous plants, tuberose (*Polianthes tuberosa* L.) a member of *Amaryllidaceae* family occupies a very selective and special position due to its beauty, elegance, sweet pleasant fragrance and long keeping quality of spikes.

The spikes are useful as cut flowers for vase decoration, flower arrangements and bouquets, while loose flowers are used for making gajra, garland, button holes and for essential oil extraction. Since, the demand for cut and loose flowers of tuberose is rapidly increasing in day to day life, the standardization of production technology of this crop on commercial basis need to be explored. Awesome importance of growth regulating chemicals in the field of floriculture is well recognised. Synthetic growth regulators are reported to coordinate and control various phases of growth, flowering and bulb production in tuberose at optimum concentrations. The present study was undertaken to study the influence of gibberellic acid in the growth and flowering of tuberose in Vidarbha conditions.

Materials and Methods
An experiment was carried out at Horticulture Farm, College of Agriculture, Nagpur, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola (M.S.) during *kharif* season of the years 2015-16 and 2016-17. The experiment was laid out in split plot design with three replications and twenty treatment combinations. The main factor comprised of five tuberose genotypes *viz.* Prajwal (G_1), Shringar (G_2), NT-01 (G_3), NT-06 (G_4) and NT-09 (G_5) and sub factor comprised of four foliar applications of gibberellic acid *viz.* P_1 – Control (water spray), P_2- GA_3 50 ppm, P_3 - GA_3 100 ppm, P_4 – GA_3 150 ppm. The field was laid out with raised beds in 3 x 1.8 m. dimension. Healthy and uniform bulbs of 1.5-2.0 cm in diameter size having 25-30 g weighed bulb were used as planted at 30 x 30 cm spacing in the month of July in both the years.

Solution of gibberellic acid was sprayed as per the treatment along with control (water spray) at 30th and 60th day after planting. Uniform recommended package of practices were followed along with nutritional application. The various observations on growth, flowering and quality spike yield were recorded time to time upto 10 months after planting. Two years data were pooled and analyzed statistically.

Results and Discussion

Growth

The data presented in Table 1 indicated that, different tuberose genotypes exhibited significant differences in respect of leaves plant^{-1} at 210 days after planting and total chlorophyll content of leaves at 50 per cent flowering stage. Significantly the maximum leaves plant^{-1} and total chlorophyll content of leaves, were produced by the genotype Prajwal (69.12 and 2.43 mg g^{-1}, respectively) and it was followed by shringar and NT-09 genotypes (53.19 and 1.81 mg g^{-1}, respectively). Whereas, minimum leaves plant^{-1} and total chlorophyll content were observed with the genotype NT-01 (44.98 and 1.56 mg g^{-1}, respectively). The variations in leaves plant^{-1} of different genotypes of tuberose and total chlorophyll content of leaves might be due to the varied growth rate and differential genetic make-up of the genotypes Even the environmental factors i.e. temperature, relative humidity and light intensity also determine the production of leaves (Krishnamurthy, 1981) [7]. The present study confirms the findings of Chaturvedi *et al.* (2014) [3], and Dimri *et al.* (2017) [5] in tuberose.

The influence of gibberellic acid on total chlorophyll content of tuberose leaves was found to be non-significant. However, leaves plant^{-1} was found to be significant, foliar application of 100 ppm GA_3 was recorded maximum (52.15) number of leaves plant^{-1} at 210 days after planting which was followed by foliar application of 150 ppm GA_3. Whereas, minimum (46.39) number of leaves plant^{-1} at 210 days after planting was recorded in the control treatment. The results obtained are in close conformity with the findings of Patidar (2014) [8], Akand *et al.* (2016) [1] in tuberose.

An interaction effect due to the tuberose genotypes and foliar application of gibberellic acid treatments on leaves plant^{-1} and total chlorophyll content of leaves was also found to be non-significant.

Flowering

The data revealed that, in respect of days to opening of first florets and 50 per cent flowering significant differences were observed due to the tuberose genotypes and foliar application of gibberellic acid. Significantly early opening of first florets and 50 per cent flowering were registered with the genotype Prajwal (15.04 and 113.36 days, respectively), however, the maximum days were required for opening of first florets and 50 per cent flowering in the genotype NT-06 (16.49 and 129.13 days, respectively). Differential behaviour of the tuberose genotypes might be primarily governed by the genetic makeup as well as prevailing climatic conditions. Similar results are also obtained by Gaidhani *et al.* (2016) [6] in tuberose.

Among the different foliar application of gibberellic acid treatments, spraying with 100 ppm GA_3 was recorded earlier opening of first florets and 50 per cent flowering (15.57 and 121.47 days, respectively). However, significantly late opening of first florets and 50 per cent flowering (16.18 and 123.88 days) was observed in control. It might be due to early production of florigen in GA_3 treated plants, as GA_3 is a component of florigen, ultimately development of flowers in plant system (Devadanam *et al*., 2007) [4]. The results obtained are in close conformity with the findings of Singh and Ranjan (2009) [10] in tuberose.

An interaction effect due to the tuberose genotypes and gibberellic acid spraying on days required for opening of first florets and 50 per cent flowering was found to be significant. The treatment combination of the genotype Prajwal treated with GA_3 100 ppm took significantly minimum period for opening of first florets and 50 per cent flowering. However, the genotype NT-06 treated with GA_3 50 ppm was recorded maximum days required for 50 per cent flowering, whereas, shringar genotype was recorded late for first floret opening of tuberose spike.

Flower yield and quality

In the present investigation, the flower yield (Table 1) and quality parameters (Table 2) were significantly influenced by tuberose genotypes and foliar application of gibberellic acid. Significantly the maximum tuberose spike yield hectare^{-1}, spike length, Inter florets length, length and diameter of floret, longevity of spike and fresh weight of flower (5.33 lakh, 93.63, 3.86, 7.54, 4.23 cm, 20.30 days and 13.98 g. respectively) were recorded with the genotype Prajwal. However, the genotype NT-06 had recorded significantly the minimum spike yield hectare^{-1}, fresh weight of flower, longevity of spike and length of floret (3.67 lakh and 11.70 g, 14.30 and 3.77 cm, respectively), whereas, minimum length of spike and Inter florets length was recorded with the genotype Shringar. Minimum diameter of floret (3.28 cm) was recorded with the genotype NT-01. The variations in flower quality parameters might be attributed due to the genetic differences in the varieties. Similar variations due to the cultivars are reported earlier by the workers like Rao and Sushma (2015) [12], Gaidhani *et al.* (2016) [6], Dimri *et al.* (2017) [5], Singh and Dakho (2017) [9].

Among the different levels of gibberellic acid treatments, foliar application with GA_3 100 ppm had registered significantly the maximum spikes hectare^{-1} (4.62 lakh), length of spike (83.84 cm), Inter florets length (3.66 cm), longevity of spike (17.69 days), length (5.90 cm) and diameter (3.61 cm) of florets and fresh weight of florets (12.80 g) which were found to be at par with the treatment of GA_3 150 ppm. However, significantly minimum spike yield (3.91 lakh) and inferior quality parameters *viz*. length of spike (78.00 cm), Inter florets length (3.25 cm), longevity of spike (16.81 days) and length (5.45 cm) and diameter (3.43 cm) of floret and fresh weight of florets (11.99 g) were recorded with the control treatment. Gibberelin is well known for the cell division and cell elongation due to which the tuberose plants might have produced the good quality spikes with the better physical parameters. These results are in line with the findings of Rani and Singh (2013) [11], Anno (2016) [2] and Akand e*t al*. (2016) [1] in tuberose.

The data regarding interaction effect due to the tuberose genotypes and foliar application of gibberellic acid on spike yield and quality parameters was found to be non-significant except length of tuberose spike and diameter of florets.

Table 1: Effect of gibberellic acid on growth, flowering and spike yield of tuberose (pooled means)

Treatments	Leaves plant-1 at 210 DAP	Total chlorophyll content of leaves (mg g-1) at 50 per cent flowering stage	Days to opening of first florets	Days to 50 per cent flowering	Spikes hectare-1 (lakh)
Main factor – Genotypes (G)					
G1 – Prajwal	69.12	2.43	15.04	113.36	5.33
G2 – Shringar	53.19	1.64	16.46	120.64	4.06
G3 – NT-01	44.98	1.56	16.19	123.98	3.84
G4 –NT-06	45.11	1.68	16.49	129.13	3.67
G5– NT-09	48.75	1.81	15.21	126.10	4.53
'F' test	Sig.	Sig.	Sig.	Sig.	Sig.
SE (m)±	1.27	0.10	0.26	1.77	0.14
CD at 5%	3.81	0.29	0.76	5.31	0.42
Sub factor – Foliar application of GA3 (P)					
P1–Control	46.39	1.71	16.18	123.88	3.91
P2–GA350 ppm	47.63	1.84	15.68	122.88	4.13
P3–GA3100 ppm	52.15	1.85	15.57	121.47	4.62
P4 – GA3 150 ppm	47.92	1.88	15.92	122.33	4.49
'F' test	Sig.	N.S.	Sig.	Sig.	Sig.
SE (m)±	1.26	0.07	0.12	0.47	0.15
CD at 5%	3.64	-	0.36	1.35	0.44
Interaction effect (G X P)					
'F' test	N.S.	N.S.	Sig.	Sig.	N.S.
SE (m)+	2.82	0.17	0.28	1.05	0.34
CD at 5%	-	-	0.80	3.03	-

Table 2: Effect of gibberellic acid on quality of tuberose spikes (pooled means)

Treatments	Length of spike (cm)	Inter florets length (cm)	Longevity of spike (days)	Length of floret (cm)	diameter of floret (cm)	Fresh weight of florets (g)
Main factor – Genotypes (G)						
G_1 – Prajwal	93.63	3.86	20.30	7.54	4.23	13.98
G_2 – Shringar	73.06	2.84	18.30	5.84	3.36	11.75
G_3 – NT-01	78.68	3.32	16.28	5.41	3.28	12.59
G_4 –NT-06	77.60	3.59	14.30	3.77	3.41	11.70
G_5– NT-09	80.80	3.82	18.02	5.83	3.49	12.38
'F' test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
SE (m)±	1.03	0.08	0.32	0.11	0.05	0.27
CD at 5%	3.05	0.22	0.95	0.32	0.14	0.80
Sub factor – Foliar application of GA_3 (P)						
P_1–Control	78.00	3.25	16.81	5.45	3.43	11.99
P_2–$GA_3$50 ppm	78.48	3.55	17.63	5.48	3.56	12.58
P_3–$GA_3$100 ppm	83.84	3.66	17.69	5.90	3.61	12.80
P_4 – GA_3 150 ppm	82.68	3.48	17.64	5.88	3.60	12.55
'F' test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
SE (m)±	0.75	0.09	0.24	0.09	0.04	0.18
CD at 5%	2.17	0.25	0.70	0.26	0.11	0.55
Interaction effect (G X P)						
'F' test	Sig.	N.S.	N.S.	N.S.	Sig.	N.S.
SE (m)+	1.68	0.19	0.55	0.21	0.09	0.41
CD at 5%	4.86	-	-	-	0.26	-

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