



## Effect of nitrogen and growth retardants on growth and flowering behaviour of tuberose (*Polianthes tuberosa* L.) cv. Hyderabad Double

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**Abstract:** The experiment was laid out in randomized block design with factorial concept, replicated thrice with twenty one treatment combinations, comprising three nitrogen levels  $N_1$  (225 Kg ha<sup>-1</sup>),  $N_2$  (300 Kg ha<sup>-1</sup>) and  $N_3$  (375 Kg ha<sup>-1</sup>) and two growth retardants viz. Cycocel (1000, 1500 and 2000 ppm) and Alar (1000, 1500 and 2000 ppm) and control sprayed at 30 and 60 days after planting. All the nitrogen and growth retardants were found effective in improving vegetative growth and flowering characters of tuberose. The application of 375 kg N ha<sup>-1</sup> with foliar spray of Cycocel 1500 ppm was found most effective to improve number of sprout per bulb, plant height (cm), number of leaves per clump, minimum days taken for spike initiation, length of spike and number of spike per clump and per hectare.

**Key words:** Tuberose, Spike, Foliar spray, Nitrogen and Growth retardants

### Introduction

Tuberose (*Polianthes tuberosa* L.) is one of the most important bulbous ornamental plants cultivated for production of long lasting flower spike in tropical and subtropical areas. It is widely-grown as a cut flower and loose flower trade and also for the extraction of essential oil is important component of high-grade perfumes. Tuberose is quite hardy bulbous plant and its cultivation can also be extended economically in almost unproductive soils affected by salinity and alkalinity (Yadav and Maity, 1989). Nutrients such as nitrogen play a major role in the growth and development of plants (Scott, 2008). Nitrogen as an essential element that improves chemical and biological properties of soil thereby stimulates the growth and production of higher yield in plants. Plant growth regulators are known to coordinate and control various phases of growth and development, including flowering at optimum concentrations (Reddy *et al.*, 1997). 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. The growth retardants are a diverse group of synthetic compounds that reduce stem elongation and generally increase the green colour of leaves. They also reduce water consumption, retard senescence and improve resistance to environmental stress. As a result of this, the economically most important use of growth retardants is in improving lodging resistant and yield particularly in cereals (Bruinsma, 1982).

Hence, keeping in view the importance of the crop, in order to explore the possibilities of the use of different doses of nitrogen with various concentrations of growth retardants and their interaction effect, the present investigation was carried out to determine the optimum doses of nitrogen and growth retardants on growth and flowering behaviour of tuberose.

### Materials and Methods

The present investigation was carried out at Main Experimental Station, Department of Horticulture, College of Horticulture and Forestry, Narendra Deva University of Agriculture and

Technology during the year 2010-11 and 2011-12 to study the effect of nitrogen and growth retardants on growth and flowering behaviour of tuberose (*Polianthes tuberosa* L.) cv. Hyderabad Double. The experiment was laid out in randomized block design with factorial concept, replicated thrice with twenty one treatment combinations, comprising three nitrogen levels  $N_1$  (225 Kg ha<sup>-1</sup>),  $N_2$  (300 Kg ha<sup>-1</sup>) and  $N_3$  (375 Kg ha<sup>-1</sup>) and two growth retardants viz. Cycocel (1000, 1500 and 2000 ppm) and Alar (1000, 1500 and 2000 ppm) and control. Growth retardants were applied in an aqueous solution as foliar spray at 30 and 60 days after planting. Control plants were sprayed with distilled water. The land was brought to a good tilth by repeated ploughing and harrowing. Individual plot size was 1.2 m x 1.5 m. A basal dose of FYM @ 20 tonnes per hectare was applied two weeks before planting of bulbs and phosphorus and potassium each @ 200 Kg/ha was incorporated into the soil before planting (Yadav, 2007). Nitrogen was applied as per treatments. Half of the dose was applied before planting and remaining half 30 days after planting. The various parameters of growth and flowering observations were recorded in five plants randomly selected in each treatment. The data collected on various parameters of crop during two consecutive years were statistically analyzed as per method given by Panse and Sukhatme (1985) and the results were evaluated at 5% level of significance.

### Results and Discussion

The various levels of nitrogen and growth retardants had distinct effect on growth parameters and their interaction also showed significant effect on growth parameters except number of sprouts per plant (Table 1). Increasing levels of nitrogen (375 Kg ha<sup>-1</sup>) showed a significant effect in increasing number of sprouts per bulb, tallest plant and maximum number of leaves per clump as compared to lower levels of nitrogen during both the years of investigation indicating the role of nitrogen in plant growth. The increase in various growth parameters of tuberose as a result of nitrogen application might be attributed to the association of nitrogen in the synthesis of protoplasm, chlorophyll "a", "b", amino acid and carbohydrate from which the

**Table-1:** Effect of nitrogen and growth retardants on growth characters of tuberose

Treatment combinations	No. of sprout/plant		Height of plant (cm)		No. of leaves/clump	
	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12
N <sub>1</sub> (225 kg ha <sup>-1</sup> )	6.25	6.34	37.66	38.45	30.34	31.18
N <sub>2</sub> (300 kg ha <sup>-1</sup> )	8.41	8.46	41.76	42.61	33.62	34.55
N <sub>3</sub> (375 kg ha <sup>-1</sup> )	9.02	9.05	44.00	44.95	35.46	36.49
SEm ±	0.16	0.14	0.71	0.72	0.59	0.61
CD at 5%	0.46	0.40	2.03	2.08	1.69	1.76
G <sub>0</sub> – Control	7.33	7.35	46.22	47.20	37.25	38.27
G <sub>1</sub> - CCC 1000 ppm	8.17	8.25	42.97	43.87	34.62	35.58
G <sub>2</sub> - CCC 1500 ppm	8.42	8.50	42.02	42.88	33.83	34.77
G <sub>3</sub> - CCC 2000 ppm	7.53	7.63	38.27	39.12	30.27	31.72
G <sub>4</sub> - Alar 1000 ppm	7.93	7.95	42.18	43.08	33.98	35.05
G <sub>5</sub> - Alar 1500 ppm	8.27	8.33	39.88	40.72	32.13	33.02
G <sub>6</sub> - Alar 2000 ppm	7.63	7.65	36.38	37.17	29.32	30.12
SEm ±	0.24	0.21	1.08	1.11	0.90	0.94
CD at 5%	0.70	0.62	3.11	3.17	2.58	2.70
N <sub>1</sub> G <sub>0</sub>	5.62	5.65	43.10	44.00	34.75	32.70
N <sub>1</sub> G <sub>1</sub>	6.56	6.61	38.15	38.9	30.75	32.60
N <sub>1</sub> G <sub>2</sub>	6.76	6.89	36.95	37.70	29.75	30.55
N <sub>1</sub> G <sub>3</sub>	5.73	6.14	36.00	36.75	29.00	29.80
N <sub>1</sub> G <sub>4</sub>	6.31	6.26	37.50	38.30	30.20	31.05
N <sub>1</sub> G <sub>5</sub>	6.64	6.65	38.25	39.05	30.80	31.65
N <sub>1</sub> G <sub>6</sub>	6.16	6.18	33.70	34.40	27.15	27.90
N <sub>2</sub> G <sub>0</sub>	7.83	7.68	45.70	46.70	36.85	37.85
N <sub>2</sub> G <sub>1</sub>	8.72	8.78	43.45	44.35	35.00	36.00
N <sub>2</sub> G <sub>2</sub>	8.87	8.93	40.00	40.80	32.20	33.10
N <sub>2</sub> G <sub>3</sub>	8.13	8.24	40.70	41.55	32.80	33.70
N <sub>2</sub> G <sub>4</sub>	8.54	8.62	43.75	44.70	35.25	36.20
N <sub>2</sub> G <sub>5</sub>	8.83	8.88	37.65	38.45	30.35	31.20
N <sub>2</sub> G <sub>6</sub>	7.98	8.12	40.85	41.75	32.90	33.80
N <sub>3</sub> G <sub>0</sub>	8.53	8.73	49.85	50.90	40.15	41.25
N <sub>3</sub> G <sub>1</sub>	9.24	9.35	47.30	48.30	38.10	39.15
N <sub>3</sub> G <sub>2</sub>	9.64	9.67	49.10	50.15	39.55	40.65
N <sub>3</sub> G <sub>3</sub>	8.72	8.50	38.12	39.05	30.80	31.65
N <sub>3</sub> G <sub>4</sub>	8.94	8.97	45.30	46.25	36.50	37.90
N <sub>3</sub> G <sub>5</sub>	9.34	9.45	43.75	44.65	35.25	36.00
N <sub>3</sub> G <sub>6</sub>	8.76	8.66	34.60	35.35	27.90	28.65
SEm ±	0.42	0.37	1.88	1.92	1.56	1.63
CD at 5%	NS	NS	5.39	5.50	4.47	4.67

phytohormones like auxins, gibberellins, cytokinines have been synthesized resulting of increased meristematic activities and hence the vegetative growth of plant increased (Tisdale and Nelson, 1975). Similar results were reported by Devi and Singh (2010); Sharma *et al.* (2007); Rathore and Singh (2009) and Yadav (2007) in tuberose.

The observations in Table 1 revealed that maximum number of sprouts were recorded with foliar spray of Cycocel 1500 ppm however significantly maximum reduction in plant height and number of leaves per clump were reported with foliar application of Alar 2000 ppm followed by Cycocel 2000 ppm as compared to untreated plants during both the years of investigation. The reduction in plant height with cycocel and alar application over control might be due to inhibitory role of growth retardants on cell division and cell elongation of apical meristematic cells and also act as anti-gibberellin synthesis (Cathey, 1961). These results are in proximity to Baskaran and Misra (2007) in gladiolus; Tak *et al.* (1999) in tuberose; Joshi and Reddy (2006) in china aster; Kumar *et al.* (2012) in African marigold and Ragaa and Taha (2012) in Iris. The interaction between nitrogen and growth retardants on number of sprouts per bulb did not found significant whereas plant height and number of leaves per clump significantly influenced during both the years of experimentation. The maximum number of sprouts per bulb was recorded by application of 375 kg N ha<sup>-1</sup> with Cycocel 1500 ppm while minimum sprouts were observed in 225 kg

N ha<sup>-1</sup> without growth retardants. However, significantly maximum reduction in plant height and number of leaves per clump was recorded in treatment 225 kg N ha<sup>-1</sup> with Alar 2000 ppm during both the years of investigation.

The data shown in Table 2 revealed that various levels of nitrogen and growth retardants had distinct effect on flowering parameters such as minimum days taken for spike initiation, duration of flowering (days), length of spike (cm) and number of spike per clump and per hectare. Days taken to spike initiation were earliest with lowest levels of nitrogen whereas maximum duration of flowering, spike length, number of spike per clump and per hectare was achieved by increasing levels of nitrogen during both years of study. Balanced nitrogen promotes the translocation of phytohormones to the shoot to which probably induces flower initiation (Marschner, 1983). The increase in duration of flowering might be due to spikes receiving higher doses of nitrogen resulted in more number of florets per spike consequently increased duration of flowering. The results are in close conformity with the observation of Kumar and Mishra (2003) and Kumar *et al.* (2006) in gladiolus. Khalaj and Edrisi (2012); Kadu *et al.* (2009) and Yadav (2007) in tuberose. Foliar application of growth retardants significantly decreased the number of days taken to spike initiation with Cycocel 1500 ppm whereas, maximum duration of flowering, length of spike, number of spike per clump and per hectare were recorded with same treatment as compared to rest of the treatments during both years of investigation. The early flowering due to the application of cycocel might be due to the fact that such plants have developed sufficient food reserve at initial stages. These reserved foods could have been utilized for the reproductive growth with restriction in vegetative growth, which was evident in the plants treated with cycocel. Parallel findings to this experiment have been cited in other research work by Kumar *et al.* (2006) and Jacob *et al.* (1991) and Reddy *et al.* (1997) in tuberose. Data on interaction effect of nitrogen and growth retardants had no significant effect on number of days taken to spike initiation, length of spike, number of spike per clump and per hectare whereas duration of flowering was significantly influenced. The combination of nitrogen 375 kg ha<sup>-1</sup> with Cycocel 1500 ppm resulted in maximum duration of flowering during both the years of investigation.

**Table-2:** Effect of nitrogen and growth retardants on flowering behaviour of tuberose

Treatment combinations	Days taken for initiation of spike		Duration of flowering (days)		Length of spike (cm)		Number of spike /clump		Spike yield/ha lacs)	
	2010	2011	2010	2011	2010	2011	2010	2011	2010	2011
	-11	-12	-11	-12	-11	-12	-11	-12	-11	-12
N <sub>1</sub> (225 kg ha <sup>-1</sup> )	126.54	127.22	23.62	24.72	82.78	84.22	2.74	2.84	2.43	2.52
N <sub>2</sub> (300 kg ha <sup>-1</sup> )	127.30	128.78	26.17	27.39	84.44	85.75	3.11	3.20	2.77	2.83
N <sub>3</sub> (375 kg ha <sup>-1</sup> )	128.65	129.55	27.61	28.89	85.00	86.61	3.37	3.51	3.01	3.12
SEm ±	0.29	0.39	0.31	0.35	0.32	0.44	0.05	0.06	0.04	0.09
CD at 5%	0.83	1.13	0.90	1.02	0.93	1.27	0.16	0.19	0.13	0.28
G <sub>0</sub> - Control	134.03	136.63	22.82	23.88	80.03	81.60	2.27	2.37	2.00	2.10
G <sub>1</sub> - CCC 1000 ppm	127.66	129.06	25.01	26.18	83.66	85.20	3.13	3.30	2.80	2.93
G <sub>2</sub> - CCC 1500 ppm	124.70	125.33	28.99	30.34	87.00	88.53	3.70	3.87	3.30	3.43
G <sub>3</sub> - CCC 2000 ppm	125.86	126.23	26.94	28.20	85.00	86.56	2.77	2.80	2.47	2.48
G <sub>4</sub> - Alar 1000 ppm	128.46	128.80	24.03	25.15	82.53	84.06	3.30	3.47	2.93	3.08
G <sub>5</sub> - Alar 1500 ppm	125.66	126.26	26.34	27.56	86.26	87.53	3.53	3.70	3.13	3.28
G <sub>6</sub> - Alar 2000 ppm	126.60	127.33	26.46	27.69	84.03	85.23	2.83	2.80	2.53	2.48
SEm ±	0.44	0.60	0.48	0.54	0.49	0.67	0.08	0.10	0.07	0.15
CD at 5%	1.28	1.73	1.38	1.56	1.43	1.94	0.24	0.29	0.21	0.43
N <sub>1</sub> G <sub>0</sub>	132.40	134.70	21.13	22.11	78.30	80.70	2.00	2.10	1.80	1.86
N <sub>1</sub> G <sub>1</sub>	126.60	127.20	23.99	25.10	82.50	83.90	2.70	2.80	2.40	2.48
N <sub>1</sub> G <sub>2</sub>	123.60	124.00	27.04	28.29	85.90	87.30	3.30	3.50	2.90	3.11
N <sub>1</sub> G <sub>3</sub>	124.80	125.10	23.93	25.04	83.70	84.60	2.50	2.50	2.20	2.22
N <sub>1</sub> G <sub>4</sub>	127.30	127.60	22.58	23.63	81.30	82.10	2.90	3.10	2.60	2.75
N <sub>1</sub> G <sub>5</sub>	125.20	125.70	23.16	24.23	85.10	86.80	3.20	3.50	2.80	3.11
N <sub>1</sub> G <sub>6</sub>	125.90	126.30	23.52	24.62	82.70	84.20	2.60	2.40	2.30	2.13
N <sub>2</sub> G <sub>0</sub>	134.20	137.30	25.63	26.82	80.20	81.80	2.30	2.40	2.00	2.13
N <sub>2</sub> G <sub>1</sub>	127.40	129.80	23.62	24.72	84.10	85.60	3.10	3.30	2.80	2.93
N <sub>2</sub> G <sub>2</sub>	124.20	125.30	28.67	30.01	87.20	88.70	3.80	4.00	3.40	3.55
N <sub>2</sub> G <sub>3</sub>	125.80	126.20	27.25	28.51	85.60	87.30	2.80	2.70	2.50	2.39
N <sub>2</sub> G <sub>4</sub>	128.70	129.10	25.53	26.72	82.50	83.90	3.40	3.50	3.00	3.11
N <sub>2</sub> G <sub>5</sub>	125.70	126.30	25.07	26.23	86.60	87.40	3.60	3.70	3.20	3.28
N <sub>2</sub> G <sub>6</sub>	126.60	127.50	27.44	28.72	84.90	85.60	2.80	2.80	2.50	2.48
N <sub>3</sub> G <sub>0</sub>	135.50	137.90	21.71	22.72	81.60	82.30	2.50	2.60	2.20	2.31
N <sub>3</sub> G <sub>1</sub>	129.00	130.20	27.44	28.72	84.40	86.10	3.60	3.80	3.20	3.37
N <sub>3</sub> G <sub>2</sub>	126.30	126.70	31.26	32.71	87.90	89.60	4.00	4.10	3.60	3.64
N <sub>3</sub> G <sub>3</sub>	127.00	127.40	29.66	31.04	85.70	87.80	3.00	3.20	2.70	2.84
N <sub>3</sub> G <sub>4</sub>	129.40	129.70	23.99	25.10	83.80	86.20	3.60	3.80	3.20	3.37
N <sub>3</sub> G <sub>5</sub>	126.10	126.80	30.80	32.23	87.10	88.40	3.80	3.90	3.40	3.46
N <sub>3</sub> G <sub>6</sub>	127.30	128.20	28.42	29.74	84.50	85.90	3.10	3.20	2.80	2.84
SEm ±	0.77	1.04	0.83	0.94	0.86	1.17	0.15	0.17	0.12	0.26
CD at 5%	NS	NS	2.39	2.70	NS	NS	NS	NS	NS	NS

Different nitrogen doses and growth retardants proved affective for growth and flowering parameters in tuberose. Increasing rate of nitrogen and concentration of growth retardants increased the number of sprouts per bulb, plant height, maximum number of leaves per clump, duration of flowering, length of spike and number of spike per clump and per hectare. The results indicate that application of nitrogen 375 kg ha<sup>-1</sup> along with foliar spraying of Cycocel 1500 ppm 30 and 60 days after planting can be used to get maximum growth and spike yield of tuberose.

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