HortFlora Research Spectrum, 2(1): 40-44 (Jan.-March 2013) ISSN : 2250-2823

INFLUENCE OF NITROGEN AND PHOSPHORUS FERTILIZERS WITH NITROGEN SOURCES ON FLORAL PARAMETERS OF TUBEROSE (*Polianthes tuberosa* L.)

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ABSTRACT: An experiment was laid out during two consecutive years in Horticulture garden of Chandra Shekhar Azad University of Agriculture and Technology Kanpur. There were three nitrogenous sources *viz.* urea, ammonium sulphate and calcium ammonium nitrate, four levels of nitrogen *viz.* 0, 50,100 and 150 kg/ha and four levels of phosphorus viz. 0,100,200 and 300 kg/ha, thus a total of fourty treatments were taken. The results showed that emergence of skipe under the influence of N sources ranged from 97.27-98.35 and 95.58-97.91 days during first and second year of study. Calcium ammonium nitrate caused 1.08 and 2.33 days earlier spike emergence than urea treatment. Nitrogen applied@ 150kg/ha proved more effective in delaying spike emergence but 300kg/ha phosphorus induced earliest emergence. Length and width of spikes was improved with ammonium sulphate followed by CAN recorded 78.19 and 80.99 cm long and 0.88 and 0.90 cm thick spikes, respectively. Nitrogen applied @150 kg/ha caused 78.16 and 81.14 cm length of spike and 0.88 and 0.89 cm thick spikes in first and second year, respectively. Length of rachis was registered 1.45 and 1.65 cm longer under ammonium sulphate. 150 kg nitrogen per hectare maximized length of rachis (26.74,27.85 cm) whereas, phosphorus @ 300kg/ha revealed maximum (26.26 and 27.38 cm) length of rachis. Number of flower maximum influenced by CAN revealed 39.69 and 40.83 flowers during both years. Nitrogen @ 150kg/ha maximized (40.80 and 41.20) number of flowers. Fertilization with calcium ammonium nitrate exhibited longest blossoming duration. Durability of spike increased consistently with increase in nitrogen levels up to 150/ha dose recording 21.41, 22.39 days duration during both experimental years. Phosphrous @ 200kg prolonged self life by 3.46 and 2.67 days when compared with control registering 20.89 and 22.33 days durability.

Keywords: *Nitrogen, phosphorus, urea, ammonium sulphate, calcium ammonium nitrate, rachis length.*

Tuberose, *Polianthes tuberosa* Linn. is native of Maxico and cultivated on large scale in many tropical and sub-tropical areas including India. It is however, adapted to North Indian climatic conditions yet it grows well in Uttar Pradesh. Tuberose occupies very selective special position among ornamental bulbous plants to flower loving people because of its prettiness, elegance and pleasantly sweet fragrance. Inspite of great ornamental importance, it has great economic potential for cut flower trade and essential oil industry (Sadhu and Bose, 10).

MATERIALS AND METHODS

The present investigations were conducted under the eco-edaphic conditions prevailing at Horticulture Garden of Chandra Shekhar Azad University of Agriculture and Technology Kanpur (U.P.), India during the year 1998-99 and 1999-2000. Uniform and healthy bulbs of tuberose cv. 'Double' having 2.5-3.0 cm diameter were procured from N.B.R.I. Lucknow. The required doses of nitrogen 50,100 and 150kg/ha and phosphorus 100, 200 and 300kg/ha as treatments were applied. K_2O@200 kg/ha and F.Y.M.@40 tonnes/ha were also applied as per reccommenda-tion. The sources of nitrogen were Urea, ammonium sulphate and calcium ammonium nitrate. Phosphorus and potash were applied with the help of super phosphate and muriate of potash, respectively. Full dose of phosphorus and potash with half dose of nitrogen were applied as basal dressing, remaining half dose of N was applied as

Received : 28.12.2012 *Accepted : 27.1.2013*

split doses at 60 and 90 days after bulb planting. All the recommended cultural and plant protection measures were applied. The experiments were laid out under Factorial Randomized Block Design in the both consecutive years of experimentation with three replications. Thus 120 plots (1.0 1.0 m size) were used for 40 treatment combinations. Data of experiments were analyzed as per Panse and Sukhatme (6). Days to emergence of spike were computed from the planting date of bulbs till first scape tip was visible. The length of spike was measured from the lower exposed portion up to apex of last floret with the help of meter scale. Diameter of spike was measured from 5cm above the ground level with the help of vernier calipers and length of rachis was measured from the first basipetal floret to apex of last floret with the help of meter scale. The number of flowers per spike was counted at different picking under each treatment. For fresh flower weight tagged spikes were picked and mixed gently treatment wise for obtaining homogeneous samples. Randomly selected ten fresh flowers were weighted (g) on electronic balance under each treatment. The period between opening of first and last floret on spike was noted and mean value was treated as duration of flowering. The duration between placing of spike in vase and fading of last floret was noted as vase life of spike. For obtaining of spike yield and the number of spike was counted treatment wise during entire experimental period on tagged plant and per hectare values were calculated. The yield per hectare (tonnes) was derived with the help of yield per plot under all the treatments and the data obtained were processed statistically during both the years of study.

RESULTS AND DISCUSSION

1. Effect on the days to emergence of spike and size of spike

Calcium ammonium nitrate induced significant earlier flowering when compared with other sources barring ammonium sulphate during first year (Table 1). Earliest emergence of spike under CAN was registered requiring 97.27 and 95.58 days against 98.35 and 97.91 days under urea treatment during first and second year of investigation. Nitrogen in increasing doses delayed the spike emergence significantly. The highest dose of nitrogen significantly delayed emergence showing 98.54 and 97.72 days against the earliest under control (96.22 and 94.44 days) during corresponding years of investigation.

Phosphorus in increasing dose caused earlier emergence of spike in tuberose. The highest dose *i.e.* 300 kg/ha required 96.27 and 95.15 days, followed by 200 kg/ha treatment (97.07 and 96.12 days). The plants under P control delayed the parameter exhibiting 99.08 and 97.67 days, respectively. These findings are in agreement with the reports of Sadhu and Bose (9) in tuberose and Niengboi and Singh (5) in gladiolus.

The size (length and diameter) of tuberose spikes was improved when the plants were fertilized with ammonium sulphate followed by calcium ammonium nitrate. It was recorded 78.19 and 80.99 cm long under ammonium sulphate treatment as compared to urea. Similarly, diameter of spike increased to the maximum (0.88 and 0.90 cm) under ammonium sulphate treatment. The trend of variation in diameter of tuberose spikes was similar to its length during both the years. Increasing levels of nitrogen caused significant increase in the length of spike. 150 kg N/ha produced 78.16 cm and 81.14 cm long spikes in respective years followed by 100 kgN/ha treatment. Similarly, 150 kg/ha nitrogen proved most effective in inducing 0.88 and 0.89 cm diameter during first and second year, respectively followed by its 100 kg dose (0.85 and 0.87 cm diameter).

Among the four levels of phosphorous nutrition, 200 kg/ha produced significantly longest spikes when compared with rest of doses expressing 77.21 and 80.28 cm values under both the years (Table 1). Similarly, out of four levels of phosphorus, 200 kg/ha induced significantly maximum diameter (0.87 and 0.88 cm) remaining at par with 300 kg/ha dose during both the years.

The present finding is in accordance with the reports of Mukhhopadhyay *et al.* (4) but contradictory to results of Preeti Hatibarua *et.al*. (7), Kumar and Mishra (3) and Bhattacharjee (2) in gladiolus.

2. Effect on the length of rachis and number of florets per spike

Ammonium sulphate produced significantly longest (26.78 and 28.00 cm) rachis than the rest of sources studied during both the years followed by CAN (26.34 and 27.17 cm) fertilization. Longest rachis measuring 26.74 and 27.85 cm were registered when 150 kg N was applied followed by 100 kg dose (26.46 and 27.17 cm) during both the years. N_2 and N_3 (100 kg and 150 kg N/ha), however, when compared between themselves showed non-significant variation under both the trials. Increasing levels of P increased the length of rachis consistently during both the years barring P_3 (300 kg/ha) during second year of study. The longest rachis were registered, 26.26 and 27.59 cm, under P_3 and P_2 (300 kg and 200 kg P/ha) during both the years of study. Results are in consonance with Singh (10).

Applications of ammonium sulphate produced maximum (39.97 and 40.91) florets per spike during both the years followed by CAN (39.69 and 40.83). Urea showed minimum number of florets (37.55 and 38.33) per spike during both the years of study. Maximum number of florets 40.80 and 40.20 revealed under 150 kg N/ha followed by 100 kg N (39.26 and 40.65) during both the years of investigation.

Phosphorus nutrition influenced the production of florets/spike during both the years of trial. It was however, significantly maximized under 200kg P_2O_5 ha level when compared with rest of doses barring second year of trial, where it was observed to be akin with 300 kg dose. P_2 (200 kg P_2O_5/ha) produced the maximum (39.87 and 40.63) florets per spike followed by 300 kg/ha (P_3) dose revealing 38.97 and 40.03 florets per spike during both the year of trial, respectively.

3. Effect on the weight of fresh flowers(g) and duration of flowering (days)

Among three sources of nitrogenous fertilizers, ammonium sulphate (33.36 and 33.86 g) proved superior over CAN and urea revealed 33.26, 33.63g and 32.04, 33.29g fresh flower weight, respectively during both the year of study. Ammonium sulphate, however, remained statistically at par with CAN during both the years. Nitrogen in increasing doses recorded greater test weight of fresh flower during both the years. 150 kg N/ha (N_3) revealing 33.55 and 34.15g values were found statistically akin to N_2 (100 kg N/ha) exhibiting 33.15, 33.67g fresh weight in both years, respectively.

Application of 200kg P/ha had increased the test weight of fresh flowers to the maximum (32.99g) during first year but in second year it was noted greater under 100 kg /ha (33.49 g fresh weight).

Calcium ammonium nitrate (CAN) proved more effective exhibiting 21.06 and 22.40 days flowering span of spikes followed by ammonium sulphate (20.17 and 21.76 days) during both the years of study. However, 150 kg/ha dose being superior than the rest of levels expressed maximum 21.41 and 22.39 days blooming, respectively. The maximum of 20.89 and 22.33 days shelf life of tuberose spikes were shown during both the years were obtained with 200 kg/ha. However, 200 kg and 300 kh P/ha remained statistically akin in this regard.

4. Effect on the vase life and yield of tuberose

The mean values obviously indicated that among three sources of nitrogenous fertilizers, (Table 1) CAN revealed the longest (9.59 and 9.52 days) vase life followed by ammonium sulphate (9.27 and 9.40 days) during both the year of study. However in comparison of CAN and ammonium sulphate, the former was significantly most effective. Nitrogen applied in varied levels affected the vase life significantly. Its increasing levels consistently showed longer keeping quality up to 150 kg N dose during both the year recording 9.55

Table 1: Effect of nitrogenous and phosphorus fertilizers on the floral parameters in tuberose cv. Double.

Treatments	Days to emergence of spike		Length of spike (cm)		Diameter of spike (cm)		Length of rachis (cm)		Number of florets per spike		Weight of fresh flower (g)		Duration of flowering (days)		Vase life of spike (days)		Yield of spike (Lac/ha)		Yield of flower (tonnes/ha)	
	1998-99	1999-2000	1998-99	1999-2000	1998-99	1999-2000	1998-99	1999-2000	1998-99	1999-2000	1998-99	1999-2000	1998-99	1999-2000	1998-99	1999-2000	1998-99	1999-2000	1998-99	1999-2000
Urea (S_1)	98.35	97.91	74.76	78.48	0.81	0.82	25.33	26.35	37.55	38.33	32.04	33.29	20.13	21.38	8.41	8.67	3.81	3.92	18.19	19.83
Ammonium Sulphat (S_2)	97.40	96.40	78.19	80.99	0.88	0.90	26.78	28.00	39.97	40.91	33.36	33.87	20.17	21.76	9.27	9.40	4.23	4.43	19.93	21.96
Calcium Ammonium Nitrate (S_3)	97.27	95.58	75.87	79.36	0.87	0.88	26.34	27.17	39.69	40.83	33.26	33.63	21.06	22.40	9.59	9.52	4.18	4.29	19.59	21.25
50 Kg N/ha (N_1)	96.80	95.66	74.34	77.71	0.83	0.84	25.23	26.50	37.15	38.22	31.96	32.97	19.15	21.19	8.49	8.64	3.61	3.87	17.29	19.06
100 Kg N/ha (N_2)	97.48	96.50	76.37	79.99	0.85	0.87	26.46	27.17	39.26	40.65	33.15	33.67	20.68	21.95	9.23	9.37	4.18	4.26	19.56	21.43
150 Kg N/ha (N_3)	98.54	97.72	78.16	81.14	0.88	0.89	26.74	27.85	40.80	41.20	33.55	34.15	21.41	22.39	9.55	9.58	4.43	4.51	20.86	22.55
0 Kg P/ha (P0)	99.08	97.67	73.52	77.25	0.82	0.84	24.82	25.62	36.55	38.17	31.94	33.13	17.06	19.47	8.68	8.88	3.66	3.76	16.45	18.18
100 Kg P/ha (P_1)	97.69	96.71	75.56	79.04	0.84	0.86	25.77	26.82	38.59	39.67	32.67	33.49	19.93	21.44	8.97	9.03	4.02	4.12	18.12	20.30
200 Kg P/ha (P_2)	97.07	96.12	77.21	80.28 .	0.87	0.88	26.20	27.59	39.87	40.63	32.99	33.48	20.89	22.33	9.10	9.20	4.20	4.34	20.92	22.34
300 Kg P/ha (P_3)	96.27	95.15	76.33	79.31	0.86	0.87	26.26	27.38	38.97	40.03	32.71	33.24	20.52	22.14	9.02	9.08	4.08	4.31	19.79	21.37
CD (P=0.05)																				
S	0.69	0.52	1.25	1.03	0.01	0.01	0.69	0.68	0.50	0.68	0.46	0.49	0.43	0.66	0.31	0.35	0.32	0.33	0.86	0.98
N	0.69	0.52	1.25	1.03	0.01	0.01	0.69	0.68	0.50	0.68	0.46	0.49	0.43	0.66	0.31	0.35	0.32	0.33	0.86	0.90
P	0.80	0.60	1.45	1.18	0.01	0.02	0.80	0.78	0.58	0.78	0.53	NS	0.50	0.76	NS	NS	0.37	0.38	1.00	1.13

and 9.58 days vase life. 150 kgN/ha when compared with N_2 (100 kg/ha) proved significantly superior in prolonging the vase life of tuberose spikes under first year trial. Phosphorus nutrition at 200 kg/ha remaining par with 100 and 300 kg/ha showed the longest vas life (9.10 days) when compared with its control during first year of trial but in second year varying doses of P failed to cause significant differences in this parameter.

Varying sources of nitrogenous fertilizers brought about significant differences in yield of tuberose spikes during both the years of investigation. Fertilization with ammonium sulphate maximized the production (4.23 and 4.43 lac spikes/ha) followed by CAN(4.18 and 4.29 lac spikes/ha). However, both of these fertilizers when compared with each other remained statistically at par revealing greater yield as compared to urea during both the years of trials. 150kg N/ha produced yield of 4.43 and 4.51 lac spikes followed by 100 kg N treatment (4.18 and 4.26 lac).All the levels of nitrogen increased positively production of spike in this regard. Phosphorus @ 200 kg/ha maximized spikes production i.e.4.20 and 4.34 lac spikes/ha followed by its 300 kg dose (4.08, 4.31 lac spikes).

In three sources of nitrogenous fertilizers, ammonium sulphate gave 19.93 and 21.96 tonnes/ha yield being significantly higher than urea (18.19 and 19.83 tonnes) fertilization but remaining at par with CAN (19.59 and 21.25 tonnes) during both the years.150 kg nitrogen/ha proved significantly superior than the rest of dose as well as control yielding 20.86 and 22.55 tonnes/ha flowers during first and second years of trial, respectively. Increasing dose of P fertilization up to 200 kg/ha brought about significant increase in the yield of flower when compared with rest of doses barring 300 kg/ha during second year trial.

The yield of spike and fresh flowers/ha was obtained maximum when the plant were fertilized with ammonium sulphate. The improvement in these attributes brought about by ammonium sulphate are obviously due to increased number of spikes/plant and flowers/spike which caused the significant increase in the yield/ha. The plants nourished by ammonium sulphate also availed the benefit of sulphur which aids in the synthesis of oils and appears to be associated with chlorophyll synthesis therefore it plays a vital role in the physiology of bulbous plants. The findings of the present investigations are in agreement with the reports of Bhattacharjee (1), Mukhhopadhyay *et al.* (4) and Robber and Hecher (8) in tuberose and chrysanthemum.

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