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EFFECT OF NITROGEN AND PHOSPHORUS WITH NITROGEN SOURCES ON VEGETATIVE ATTRIBUTES OF TUBEROSE

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ABSTRACT: An experiment was laid out during two consecutive years in Horticulture garden of C. S. Azad University of Agri. and Tech., Kanpur. There were three nitrogen sources viz. Urea, Ammonium Sulphate, Calcium Ammonium Nitrate; four levels of each of nitrogen (0, 50,100 and 150kg/ha) and phosphorus (0,100,200 and 300 kg/ha), with a total of forty treatments. The results showed that there were no significant differences observed due to nitrogen sources in respect of sprouting of bulbs. Increasing doses of phosphorus caused relatively early sprouting during both the years of study. Phosphorus applied @ 200kg/ha expressed tallest plant during both the years of study. Number of leaves per plant improved under ammonium sulphate followed by calcium ammonium nitrate. Phosphorus @ 200kg/ha produced maximum number of leaves during both years. Application of 150kg N/ha or 200 kg phosphorus expressed highest leaf area followed by 100 kg N/ha.

Keywords: *Tuberose, nitrogen, phosphorus, leaf size, leaf area.*

Tuberose (*Polianthes tuberosa* Linn.), a native of Maxico, belongs to the family Amaryllidaceae. It is cultivated on large scale in France, Italy, South Africa, and North Carolina, U.S.A. and many tropical and sub-tropical areas including India. The chief centers of its production in India are Maharashtra, West Bengal, Tamil Nadu and Karnataka. It is, however, well adopted to North Indian climatic conditions yet its grow well in Uttar Pradesh. The tuberose occupies very selective and special position among the ornamental bulbous plants to flower loving people because of its prettiness elegance and pleasantly sweet fragrance. It has great economic potential for cut flower trade and essential oil industries.

MATERIALS AND METHODS

The present investigations entitled "Effect of nitrogenous and phosphorus fertilizers with nitrogen sources on vegetative attributes of tuberose (*Polianthes tuberosa* Linn.)" 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 two consicutive years-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. In order to assess to exact nature and composition of soil, samples up to 20 cm depth were collected and analyzed in the Department of Agriculture Chemistry and Soil Science for physio-chemical components. The experimental field was given a preplanting irrigation and at the proper field conditions, it was prepared by giving two cross-ploughings. The clods crushed with the help of disc harrow and soil was finally levelled and brought to a good tilth with removing the stubbles, weeds etc. The required dose of Nitrogen 50,100,150 kg/ha, and phosphorus 100,200,300 kg/ha as per treatments were applied. K_2O @ 200 kg/ha and F.Y.M @ 40 tonnes/ha were applied as recommendation. The sources of nitrogen were Urea, Ammonium Sulphate and Calcium Ammonium Nitrate. Phosphorus and potash were applied in form of single superphosphate and muriate of potash, respectively. Full dose of phosphorus and potash with half dose of nitrogen were applied as basal dressing and remaining half dose of N was applied as split doses at 60 and 90 days after planting. All the

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recommended cultural and plant protection measures were applied. The experiments were laid out by following Factorial Randomized Block Design in both consecutive years of experimentation with three replications. Thus, 120 plots (1.0x1.0m size) were used for 40 treatment combinations. Experiments were analyzed through computer as suggested by Panse and Sukhatme (7). Days to sprouting was observed by keeping a constant watch in different treatments during both the years of experimentation and indicted in the number of days. Plant height was measured with help of meter scale and number of leaves was counted in sampled plants. Leaf area (cm^2) was measured by taking length and width of longest leaf from the base and multiplying by adjustment factor 0.62 as suggested by Barbieri *et al.* (1).

RESULTS AND DISCUSSION

Effect on days to sprouting of tuberose bulbs

Sprouting of tuberose bulbs as influenced by different factors viz. N sources, and level of N and P was observed after planting of bulbs during both the years of study. The mean values presented in Table 1 clearly revealed that sources of N fertilization failed to exert significant variation on the days required for sprouting of tuberose bulbs under both years trials. Application of 150kg N/ha hastened the sprouting of bulbs significantly during first year but in the second year it was non-significant requiring 9.16 and 9.50 days respectively against 9.95 and 9.88 days under control. Among the three doses of N, 50kg treatment delayed the sprouting (10.47 and 9.77 days) markedly during both years.

Increasing dose of P enhanced in earlier sprouting of bulbs during both the years. Phosphorus application @ 300kg/ha took minimum period i.e. 9.66 and 9.37 days against maximum noted under its control (10.67 and 10.14 days). All P levels caused significantly earlier sprouting when compared with control barring 100kg dose during the second year of investigation.

Interaction between phosphorous and source of nitrogen was found non significant, only numerical variations on the sprouting of tuberose bulbs were seen. Application of 300 kg/ha interacting with CAN caused considerably earliest (9.63 and 9.30 days) sprouting when compared with P_0S_1 (urea without P) which took maximum duration (11.0 and 10.37 days) in this regard during both the years of study. The minimum 9.50 and 9.34 days required for sprouting for P_3N_3 against maximum period required by P_0N_1 (11.20 and 10.42 days).The interaction of S × N did not affect this parameter significantly. However, sprouting was hastened by S_3N_3 (9.30 and 9.41 days) numerically during both the years of study confirming to the reports of Mukhopadhyay *et al.* (5). Other interaction effect i.e. P×S and P× N were also found non-significant during both years of investigation. The interaction among P×S×N did not bring significant difference in this regard. Treated plants showed early sprouting when compared with control in the first year but the trend was contradictory during second year of study.

Effect on height of tuberose plant

It is evident from mean values (Table 2) that application of ammonium sulphate, remaining at par with calcium ammonium nitrate, proved more effective in increasing the plant height than urea during both years. In this way urea proved relatively less effective for increasing height of plant. Ammonoum sulphate produced 46.39 and 48.25 cm tall plants followed by CAN (45.92 and 47.79 cm) and urea (45.1 and 45.79 cm).

Among the dose of nitrogen nutrition, the highest one i.e. 150 kg excelled the rest of dose causing 47.14 and 48.82 cm height followed by 100 kg (45.96 and 47.19 cm) and 50 kg (44.31 and 45.81) during corresponding years of study. Application of phosphorus also caused significant alterations and P_2 (200kg/ha) proved significantly more superior than rest of dose barring 100 kg and 300 kg/ha (P_1 and P_3) during second year of study. The plants under P controls remained dwarf under

Table 1: Effect of nitrogenous and phosphorus fertilizers on the days to sprouting of bulb in tuberose cv. 'Double'.

1998-1999

P	P S			P N			Treated vs. control		Mean
	S_1	S_2	S_3	N_1	N_2	N_3	Treated	Control (N_0)	
P_0	11.00	10.49	10.52	11.20	10.86	9.96	10.67	10.66	10.67
P_1	10.18	9.96	10.19	10.43	10.31	9.60	10.11	10.10	10.11
P_2	9.93	9.84	9.85	10.18	10.06	9.38	9.87	9.80	9.87
P_3	9.77	9.78	9.63	10.06	9.54	9.50	9.70	9.24	9.66
Mean	10.20	10.02	10.05	10.47	10.19	9.16	10.09	9.95	
N_1	10.22	10.25	10.71						
N_2	10.29	10.14	10.14						
N_3	10.10	9.44	9.30		S	N	P	P S	P N	S N	T vs Cont.
S N				C.D. (P=0.05)	NS	0.46	0.53	NS	NS	NS	NS

1999-2000

P	P S			P N			Treated vs. control		Mean
	S_1	S_2	S_3	N_1	N_2	N_3	Treated	Control (N_0)	
P_0	10.37	10.20	9.81	10.42	10.26	9.69	10.13	10.32	10.14
P_1	9.36	9.70	9.90	9.77	9.67	9.52	9.65	10.30	9.72
P_2	9.30	9.56	9.60	9.53	9.50	9.43	9.49	9.60	9.50
P_3	9.34	9.50	9.30	9.36	9.44	9.34	9.38	9.32	9.37
Mean	9.59	9.74	9.65	9.77	9.22	9.50	9.66	9.88	
N_1	9.59	10.98	9.65						
N_2	9.58	9.67	9.91						
N_3	9.61	9.48	9.41		S	N	P	P S	P N	S N	T vs Cont.
S N				C.D. (P=0.05)	NS	NS	0.43	NS	NS	NS	NS

Table 2: Effect of nitrogenous and phosphorus fertilizers on the plant height (cm) in tuberose cv. 'Double'.

1998-1999

P	P S			P N			Treated vs. control		Mean
	S_1	S_2	S_3	N_1	N_2	N_3	Treated	Control (N_0)	
P_0	43.23	45.06	44.48	42.59	44.46	45.71	44.25	37.83	43.6
P_1	45.08	46.70	45.90	44.40	46.17	47.12	45.90	42.26	45.5
P_2	46.91	48.35	47.48	46.16	47.76	48.83	47.58	43.71	47.1
P_3	45.17	45.33	45.84	44.09	45.46	46.90	45.48	43.28	45.2
Mean	45.10	46.39	45.92	44.31	45.96	47.14	45.00	41.77	
N_1	43.29	44.97	44.66						
N_2	45.24	46.45	46.19						
N_3	46.76	47.74	46.92		S	N	P	P S	P N	S N	T vs Cont.
S N				C.D. (P=0.05)	0.97	0.97	1.12	NS	NS	NS	1.26

1999-2000

P	P S			P N			Treated vs. control		Mean
	S_1	S_2	S_3	N_1	N_2	N_3	Treated	Control (N_0)	
P_0	44.99	47.05	46.21	44.43	46.43	47.39	46.08	39.21	45.4
P_1	45.78	48.59	47.85	46.12	47.29	48.80	47.40	43.70	47.0
P_2	46.42	49.57	49.50	46.80	48.21	50.47	48.49	44.19	48.0
P_3	45.98	47.79	47.59	45.90	46.84	48.63	47.12	46.80	47.0
Mean	45.79	48.25	47.79	45.81	47.19	48.82	47.28	43.48	
N_1	44.42	46.71	46.32						
N_2	45.42	48.17	47.96						
N_3	47.51	49.87	49.09		S	N	P	P S	P N	S N	T vs Cont.
S N				C.D. (P=0.05)	1.40	1.40	1.62	NS	NS	NS	1.81

Table 3: Effect of nitrogenous and phosphorus fertilizers on the number of leaves per plant in tuberose cv. 'Double'.

1998-1999

P	P S			P N			Treated vs. control		Mean
	S_1	S_2	S_3	N_1	N_2	N_3	Treated	Control (N_0)	
P_0	36.96	39.58	38.08	35.71	38.50	40.42	38.21	27.68	37.19
P_1	38.66	41.36	40.73	38.48	40.51	41.76	40.25	35.24	39.71
P_2	39.94	41.79	41.07	39.74	40.89	42.18	40.94	37.50	40.50
P_3	39.44	41.29	40.67	39.33	40.69	41.18	40.46	36.33	40.0
Mean	38.75	41.00	40.14	38.36	40.15	41.39	39.96	34.18	
N_1	37.39	39.36	38.33						
N_2	38.74	41.15	40.56						
N_3	40.13	42.50	41.53		S	N	P	P S P N S N	T vs Cont.
S N				C.D. (P=0.05)	1.23	1.23	1.42	NS NS NS	1.59

1999-2000

P	P S			P N			Treated vs. control		Mean
	S_1	S_2	S_3	N_1	N_2	N_3	Treated	Control (N_0)	
P_0	38.45	39.46	39.01	36.02	38.94	41.97	38.98	39.33	38.0
P_1	40.17	42.44	41.22	38.68	41.28	43.87	41.28	36.66	40.8
P_2	41.29	42.60	42.10	40.63	41.96	43.40	42.00	38.93	41.69
P_3	40.60	41.80	40.66	39.94	40.84	42.27	41.03	38.13	40.73
Mean	40.13	41.58	40.75	38.82	40.76	42.88	40.82	35.76	
N_1	38.05	39.55	38.91						
N_2	40.44	41.39	40.44						
N_3	41.94	43.79	42.90		S	N	P	P S P N S N	T vs Cont.
S N				C.D. (P=0.05)	0.97	0.97	1.13	NS NS NS	1.26

Table 4: Effect of nitrogenous and phosphorus fertilizers on the leaf area (cm^2) in tuberose cv. 'Double'.

1998-1999

P	P S			P N			Treated vs. control		Mean
	S_1	S_2	S_3	N_1	N_2	N_3	Treated	Control (N_0)	
P_0	46.24	48.00	48.81	44.50	47.83	51.63	47.98	36.12	46.80
P_1	48.44	50.72	50.85	47.20	49.67	53.14	50.00	42.53	49.26
P_2	50.28	52.88	52.60	49.34	51.90	54.51	51.92	46.42	51.37
P_3	50.90	52.44	52.11	48.92	52.14	54.38	51.81	45.32	51.16
Mean	48.96	51.23	51.09	47.49	50.38	53.42	50.43	42.59	
N_1	46.32	47.78	48.37						
N_2	49.01	51.06	51.08						
N_3	51.56	54.86	53.83		S	N	P	P S P N S N	T vs Cont.
S N				C.D. (P=0.05)	0.96	0.96	1.10	NS NS NS	1.24

1999-2000

P	P S			P N			Treated vs. control		Mean
	S_1	S_2	S_3	N_1	N_2	N_3	Treated	Control (N_0)	
P_0	47.02	50.04	49.30	45.66	49.11	51.60	48.79	38.24	47.73
P_1	49.36	52.42	52.54	48.15	51.75	54.41	51.44	42.24	50.62
P_2	51.67	54.65	53.71	50.67	53.71	55.64	53.34	47.11	52.72
P_3	51.98	53.61	52.76	50.24	52.84	55.26	52.78	44.27	51/93
Mean	50.01	52.68	52.08	48.68	51.85	54.23	51.59	43.21	
N_1	47.32	40.77	48.95						
N_2	50.39	52.61	52.55						
N_3	52.31	55.65	54.73		S	N	P	P S P N S N	T vs Cont.
S N				C.D. (P=0.05)	0.99	0.99	1.14	NS NS NS	1.28

both years conditions. The results are in conformity with El-Khateep *et al.* (2) and Nair *et al.* (6).

The first order interaction i.e. P × S, P × N and S × N remaining non significant during both years of study increased the height of tuberose plants numerically under P_2S_2 (48.35, 49.57 cm), $P_2 N_3$ (48.83, 50.47 cm) and $S_2 N_3$ (47.74, 49.87 cm), respectively. Among the second order interactions $P_2S_2N_3$ maximized the height of tuberose plants but the differences remained non significant during both the years of study. Treated vs. control plants showed significant variations on the height of tuberose plants during both the years of study and treated ones attained the height of 45.00 and 47.28 cm, whereas, the control plants expressed 41.77 and 43.48 cm height.

Effect on number of leaves per plant

Ammonium sulphate proved significantly superior (Table 3) than other nitrogen sources i.e. urea and CAN during both the years of investigation (41.0 and 41.58 leaves during first and second year, respectively) barring CAN during second year of investigation where it was observed to be statistically at par with ammonium sulphate. However, urea observed to be less effective regarding 38.75 and 40.13 leaves per plant. Application of 150 kg/ha proved more effective (41.39 and 42.88 leaves) and produced significantly greater number of leaves followed by 100 kg and 50 kg/ha (40.15, 38.36 and 40.76, 38.82 leaves, respectively).

Interactions between P×S, P×N and S×N improved the number of leaves per plant numerically during both the years of trial recording 41.79, 42.60, 42.18, 43.40 and 42.50, 43.79 leaves per plant under $P_2 S_2$, P_2N_3 and $S_2 N_3$ treatments during first and second year of investigation, respectively. The second order interaction failed to exert significant influence on the leaf count during both years. The comparison of treated plants with control revealed significant variation in increasing the number of leaves per plant in the former (39.96 and 40.82) during both the years.

Effect on the leaf area

Increasing dose of nitrogen induced significantly greater leaf area (Table 4). Application of 150 kg N/ha expressed 53.42 and 54.23 cm^2 leaf area followed by 100 kg N/ha revealing 50.38 and 51.85 cm^2 area under both the year of study, respectively. Application of phosphorus through super phosphate @200 kg/ha induced significantly highest leaf area compared with its control as well as 100 kg dose during both the years. Application of 200 kg/ha when compared with 300 kg/ha level showed statistically similar leaf area under both the year's trials. The highest values were however, recorded to be 51.37 and 52.72 cm^2 under 200 kg/ha dose against the lowest 46.80 cm^2 and 47.73 cm^2 noted under control.

The interactive effect of P ×S, P×N and S×N remaining non significant improved the leaf area further expressing maximum values under P_2 S_2 (52.88, 54.65 cm^2), $P_2 N_3$ (54.51, 55.64 cm^2) and S_2 N_3 (54.86, 55.65 cm^2) during the corresponding years of study. The second order interactions did not bring significant variations in this regard during both the years of experimentation. Treated plants when compared with control revealed significant increase in leaf area in tuberose expressing 50.43, 51.59 and 42.59,43.21 cm^2 values during first and second year of investigation, respectively. The present findings are in agreement with the reports of Fernadez et al. (3) and EI-Khateep *et al.* (2) in gladiolus Mukhopadhyay *et al.* (5) and Nair *et al.* (6) in tuberose and Sang (9) in dahlia who noted significant improvement in the growth parameters of bulbous ornamentals. But Hober (4) and Preeti-Hatibarua *et al.* (8) found calcium ammonium nitrate to be more effective in chrysanthemum and gladiolus, respectively.

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