Table 1. Heat unit efficiency of pearlmillet as influenced by different sowing dates

Year	Sowing date	Dry matter (g/m^2)	Grain yield (g/m^2)	Heat unit efficiency			Duration (Days)
				GDD	Dry matter	Grain	
1988	S_1 (22-6)	613.7	112.5	1932	0.318	0.058	94
	S_2 (08-07)	876.4	169.9	1937	0.311	0.088	92
	S_3 (21-07)	751.4	128.9	1978	0.380	0.065	91
1989	S_1 (10-07)	658.6	234.0	1992	0.451	0.117	92
	S_2 (26-07)	650.6	180.0	1913	0.332	0.094	90
	S_3 (09-08)	635.00	114.0	1884	0.337	0.061	87
1990	S_1 (08-06)	726.9	203.6	2114	0.421	0.096	90
	S_2 (23-06)	671.9	219.3	2080	0.352	0.105	89
	S_3 (08-07)	583.2	160.9	2091	0.412	0.077	90
1991	S_1 (11-06)	784.0	241.2	1883	0.416	0.128	86
	S_2 (26-06)	627.7	220.5	1761	0.356	0.125	81
	S_3 (15-07)	463.2	54.1	1756	0.264	0.031	80
1992	S_1 (24-06)	784.0	158.8	2202	0.356	0.072	93
	S_2 (09-07)	731.2	240.8	2018	0.362	0.119	86
	S_3 (24-07)	467.5	72.8	1918	0.244	0.038	83
Mean	S_1	713.4	190.0	2025	0.352	0.094	91
	S_2	711.6	205.9	1942	0.366	0.106	88
	S_3	580.1	106.1	1925	0.301	0.055	86

GDD : Growing degree days

like pearlmillet should be sown early immediately after receipt of sufficient rains (in last week of June or 1st week of July) for accumulating more GDD for better production of grain yield under dryland conditions.

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(Received : July 1995 Revised : August 1995)

Madras Agric. J., 83(9): 564-568 September 1996
https://doi.org/10.29321/MAJ.10.A01055

GROWTH CHARACTERS IN TUBE-ROSE

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ABSTRACT

To study the effect of three levels of nitrogen (N) (0.40 and 80 g/m^2) and three levels of phosphorus (P) (0.150 and 300 g/m^2) involving four varieties of tuberose, *viz* single, double, semidouble and variegated, experiments were conducted in 1990-91 and 1991-92. Application of highest dose of P contributed maximum plant height, while, N did not respond to this character. N and P applications were also not found effective for other vegetative attributes as compared to interaction application. Interaction influence of these nutrients in these strains was found to be very effective for almost all the growth characters except diameter of leaf. But the combined application of both the nutrients was not beneficial in the present set of material.

KEY WORDS : Tuberose, Nutritional Treatment, Cutflower.

Table 1. Effect of nitrogen and phosphorus on plant height and stem diameter (cm) in tuberose

Treatment/ varieties	Plant height								Stem diameter							
	1990-91				1991-92				1990-91				1991-92			
	V_1	V_2	V_3	V_4	V_1	V_2	V_3	V_4	V_1	V_2	V_3	V_4	V_1	V_2	V_3	V_4
Nitrogen																
N_1	81.11	89.80	90.43	92.69	82.07	89.03	97.51	93.84	00.61	00.69	00.71	00.72	00.61	00.66	00.67	00.73
N_2	89.19	91.63	90.60	92.62	89.62	92.41	91.58	93.23	00.68	00.69	00.69	00.77	00.69	00.70	00.69	00.79
N_3	90.49	90.22	92.20	92.23	92.47	89.48	92.66	93.10	00.74	00.70	00.72	00.79	00.74	00.67	00.72	00.77
Phosphorus																
P_1	84.89	89.46	88.57	90.31	86.86	91.20	90.54	90.40	00.63	00.68	00.70	00.73	00.61	00.69	00.69	00.74
P_2	87.18	89.47	92.27	93.11	88.72	90.81	92.77	93.88	00.69	00.70	00.69	00.79	00.74	00.67	00.69	00.77
P_3	89.61	92.40	92.40	94.12	88.58	84.03	92.43	95.40	00.70	00.70	00.71	00.76	00.70	00.66	00.73	00.78
Interaction																
P_1	80.53	89.33	87.67	90.40	83.23	90.07	89.73	91.17	00.55	00.68	00.69	00.72	00.51	00.71	00.65	00.75
N_1 P_2	81.27	87.20	92.57	93.20	81.50	88.93	92.30	94.23	00.61	00.71	00.69	00.71	00.67	00.66	00.65	00.72
P_3	81.53	92.87	92.07	94.47	81.47	88.47	92.50	96.13	00.65	00.66	00.73	00.72	00.67	00.60	00.71	00.71
P_1	85.67	90.83	89.53	90.40	84.47	92.93	91.50	91.37	00.67	00.67	00.70	00.71	00.66	00.68	00.67	00.76
N_2 P_2	90.07	91.47	91.53	93.73	91.83	92.30	92.77	93.83	00.72	00.67	00.66	00.80	00.74	00.70	00.70	00.79
P_3	91.83	92.60	90.73	90.73	92.17	92.00	90.47	94.50	00.67	00.73	00.70	00.80	00.66	0.71	00.71	00.80
P_1	88.73	88.20	88.50	90.13	92.47	90.60	90.40	90.17	00.69	00.70	00.71	00.75	00.67	00.67	00.69	00.70
N_3 P_2	90.20	90.57	90.70	92.40	92.83	91.20	93.23	93.57	00.75	00.70	00.72	00.86	00.78	00.66	00.71	00.79
P_3	92.47	91.90	94.40	94.17	90.10	86.63	94.33	95.57	00.78	00.69	00.72	00.78	00.77	00.67	00.71	00.81
Combined	P_1	P_2	P_3	R	P_1	P_2	P_3		P_1	P_2	P_3		P_1	P_2	P_3	
N_1	86.98	88.31	90.21		88.53	89.23	89.64		00.66	00.68	00.69		00.66	00.68	00.67	
N_2	89.11	91.70	90.21		90.17	92.68	92.28		00.69	00.71	00.73		00.69	00.73	00.72	
N_3	80.89	91.72	93.22		90.91	92.71	92.16		00.71	00.76	00.74		00.68	00.74	00.75	
	VxN	VxP	VxNxP	NxP	VxN	VxP	VxNxP	NxP	VxN	VxP	VxNxP	NxP	VxN	VxP	VxNxP	NxP
SE(d)	0.52	0.52	0.90	0.45	0.54	0.54	0.94	0.47	0.01	0.01	0.02	0.01	0.02	0.02	0.03	0.01
CD at 5%	1.03	1.03	1.80	0.90	1.08	1.08	1.87	0.93	0.03	0.03	0.05	-	0.04	0.04	0.07	-

The importance of cut flower has gone up much due to its more export demand in comparison to other floricultural crops (Malik, 1980). Tube rose (*Polianthes tuberosa*L.) a very important bulbous cut flower as it is being grown around the big cities on commerical basis. It can be grown in any season and its cut spike is of great commercial value because of its excellent keeping quality and fragrance. Its flowers are equally important for table decoration. Nutrients have been found very helpful to make the improvement in vegetative growth characters. Studies made so for in relation to nutrient application in tuberose are very scanty. Therefore, the present study was made for increasing the production of tuberose.

MATERIALS AND METHODS

The present study consisted of the application of nitrogen (N) and phosphorus (P) on the vegetative growth characters of tuberose in the year

Table 2. Effect of nitrogen and phosphorus on leaf length and leaf diameter (cm) in tuberose

Treatment/ varieties	Leaf length								Diameter of leaf							
	1990-91				1991-92				1990-91				1991-92			
	V_1	V_2	V_3	V_4	V_1	V_2	V_3	V_4	V_1	V_2	V_3	V_4	V_1	V_2	V_3	V_4
Nitrogen																
N_1	25.17	30.61	30.82	32.29	25.42	29.69	30.62	30.92	2.16	2.24	2.42	2.74	2.21	2.30	2.50	2.62
N_2	26.73	31.84	32.00	34.67	26.99	31.81	33.14	35.25	2.17	2.30	2.50	2.52	2.22	2.26	2.41	2.53
N_3	27.24	31.97	32.49	36.36	27.27	32.20	32.62	36.42	2.37	2.31	2.46	2.64	2.30	2.41	2.50	2.53
Phosphorus																
P_1	25.79	32.53	32.53	32.99	26.04	30.86	32.37	33.61	2.28	2.24	2.49	2.41	2.19	2.24	2.46	2.28
P_2	26.71	31.71	31.64	34.32	26.54	31.21	32.09	34.58	2.20	2.32	2.50	2.73	2.30	2.41	2.50	2.67
P_3	26.64	31.93	31.93	36.00	27.09	31.68	31.93	36.44	2.23	2.47	2.42	2.77	2.24	2.31	2.46	2.74
Interaction																
N_1 P_1	24.43	29.80	32.93	31.67	24.63	28.90	32.47	42.47	2.20	2.43	2.47	2.70	2.30	2.20	2.57	2.43
P_2	25.50	31.03	28.57	31.27	25.23	30.53	28.60	31.63	2.13	2.37	2.40	2.73	2.30	2.53	2.60	2.70
P_3	25.77	31.00	30.97	33.93	26.40	29.43	30.80	34.67	2.20	2.60	2.40	2.80	2.10	2.17	2.33	2.73
N_2 P_1	26.50	31.03	31.43	32.60	26.81	31.57	31.40	33.13	2.30	2.27	2.47	2.97	2.20	2.23	2.30	2.10
P_2	27.33	31.00	34.53	35.53	27.37	30.87	35.57	35.93	2.10	2.30	2.70	2.67	2.27	2.27	2.40	2.70
P_3	26.37	32.80	32.43	35.87	26.37	32.13	32.47	36.80	2.10	2.33	2.43	2.73	2.20	2.27	2.53	2.30
N_3 P_1	26.63	32.83	32.23	34.70	26.63	32.10	33.32	35.23	2.33	2.17	2.53	2.37	2.13	2.30	2.50	2.30
P_2	27.30	31.37	32.83	36.17	27.03	32.23	32.10	36.17	2.37	2.30	2.40	2.30	2.33	2.43	2.50	2.60
P_3	27.80	31.70	32.00	38.20	28.13	32.27	32.53	37.87	2.40	2.47	2.43	2.77	2.43	2.50	2.50	2.30
Combined	P_1	P_2	P_3		P_1	P_2	P_3		P_1	P_2	P_3		P_1	P_2	P_3	
N_1	29.66	29.04	30.42		26.62	29.00	30.37		2.45	2.41	2.50		2.30	2.53	2.33	
N_2	30.49	32.17	31.87		30.74	32.34	32.34		2.30	2.44	2.40		2.21	2.41	2.45	
N_3	31.85	31.67	32.53		31.80	31.88	32.70		2.35	2.47	2.52		2.31	2.47	2.53	
	VxN	VxP	VxNxP	NxP	VxN	VxP	VxNxP	NxP	VxN	VxP	VxNxP	NxP	VxN	VxP	VxNxP	NxP
SE(d)	0.26	0.26	0.49	0.24	0.31	0.31	0.54	0.27	0.09	0.09	0.16	0.08	0.08	0.08	0.15	0.07
CD at 5%	0.57	0.57	0.99	0.49	0.63	0.63	1.09	0.54	0.18	0.18	0.32	0.16	0.17	0.17	0.29	0.14

990-91 and 1991-92 at C.S.Azad University of griculture and Technology, Kanpur. Experiments ere conducted in randomised block design with iree replications to study the effects of all the ombinations of three levels of N (0, 40 and 80 /m) and P (0, 150 and 300 g/m^2) in four varieties, ngle, double, semi-double and variegated bulbs. It as sown in the month of June 1990-91 and 991-92 at a distance of 30 cm in the bed of 1.5 x 5 m. The plot was prepared in a fine tilth and full time. The balance N was given after a month of planting as top dressing. Five plants were randomely selected in each plot replication-wise and tagged for record of various observations.

RESULTS AND DISCUSSION

Vegetative growth of plant was found to be significantly increased due to N application at 40 and 80 g/m^2 as compared to control P application (300 g/m^2) also showed significant effect for

ble 3. Effect of nitrogen and phosphorous on number of flowers/spike, diameter of flower (cm) and flowering vega of spike in tuberose

eatments/ arieties	1990-91				1991-92				1990-91				1991-92				1990-91				1991-92			
	V_1	V_2	V_3	V_4	V_1	V_2	V_3	V_4	V_1	V_2	V_3	V_4	V_1	V_2	V_3	V_4	V_1	V_2	V_3	V_4	V_1	V_2	V_3	V_4
itrogen																								
N_1	26.67	27.80	33.10	36.50	24.51	28.04	31.36	36.70	1.40	1.27	1.27	1.26	1.51	1.30	1.26	1.30	11.03	13.63	1.59	16.94	10.93	13.51	15.32	16.59
N_2	24.11	30.86	34.12	36.64	24.89	30.99	32.36	37.10	1.41	1.26	1.22	1.43	1.33	1.29	1.26	1.37	11.17	14.04	16.20	16.49	11.29	14.38	15.71	16.69
N_3	25.16	32.17	36.80	36.16	26.07	33.27	36.50	36.39	1.36	1.23	1.21	1.56	1.43	1.19	1.23	1.50	12.83	15.26	16.37	17.34	12.58	15.32	15.56	17.26
osphorus																								
P_1	24.34	29.88	33.01	36.02	24.72	30.29	32.71	36.42	1.38	1.28	1.19	1.40	1.38	1.24	1.23	1.39	11.49	13.81	15.63	16.73	11.33	14.18	15.29	16.42
P_2	24.44	30.31	35.02	36.91	25.03	30.23	33.02	37.02	1.41	1.21	1.33	1.40	1.42	1.26	1.23	1.38	11.50	14.20	16.31	17.08	11.29	14.33	15.57	16.86
P_3	25.12	30.63	35.99	36.37	25.71	31.78	34.48	36.74	1.38	1.27	1.18	1.44	1.48	1.28	1.28	1.40	12.04	14.92	16.21	16.47	12.18	14.70	15.13	17.26
traction																								
P_1	24.93	25.73	31.90	36.87	25.10	24.73	31.37	36.97	1.33	1.27	1.30	1.20	1.37	1.23	1.13	1.37	11.17	13.57	15.20	17.03	11.23	13.33	15.30	15.87
P_2	25.03	28.50	33.30	37.00	24.07	28.40	30.80	36.47	1.47	1.23	1.30	1.20	1.50	1.37	1.23	1.33	10.53	13.67	15.33	17.20	10.50	13.30	15.63	16.93
P_3	24.03	29.17	34.10	35.63	24.37	31.00	31.90	36.67	1.40	1.30	1.20	1.37	1.67	1.30	1.40	1.20	11.40	13.67	16.23	16.60	11.07	13.90	15.03	16.97
P_1	24.17	31.07	32.60	36.50	23.60	31.20	32.27	37.47	1.37	1.40	1.10	1.40	1.27	1.27	1.27	1.30	10.80	13.67	15.73	16.60	10.70	14.73	14.90	16.57
P_2	24.47	30.60	34.13	36.90	26.13	30.60	31.47	37.93	1.37	1.10	1.40	1.43	1.37	1.23	1.30	1.40	11.23	13.53	16.97	16.03	11.43	13.80	15.53	16.47
P_3	23.70	30.90	35.63	36.53	24.43	31.17	33.33	25.90	1.50	1.27	1.17	1.47	1.37	1.37	1.20	1.50	11.47	14.97	15.90	16.83	11.73	14.60	16.70	17.03
P_1	23.93	32.83	34.53	34.70	25.47	34.93	34.50	34.83	1.43	1.17	1.17	1.60	1.50	1.23	1.30	1.40	12.50	14.23	15.97	16.57	12.07	14.47	15.67	16.83
P_2	23.90	31.83	37.63	36.83	24.90	31.70	36.80	36.67	1.40	1.30	1.30	1.57	1.40	1.17	1.17	1.60	12.73	15.40	16.63	18.00	11.93	15.90	15.53	17.17
P_3	27.63	31.83	38.23	36.93	27.83	33.17	38.20	37.67	1.23	1.23	1.17	1.50	1.40	1.17	1.23		13.27	16.13	16.50	17.47	13.73	15.60	15.47	17.77
mbines	P_1	P_2	P_3		P_1	P_2	P_3		P_1	P_2	P_3		P_1	P_2	P_3		P_1	P_2	P_3		P_1	P_2	P_3	
N_1	29.06	30.96	30.73		29.34	29.93	30.98		1.27	1.30	1.32		1.27	1.36	1.39		14.24	14.18	14.47		13.93	14.09	14.24	
N_2	31.08	31.53	31.69		31.13	31.53	31.33		1.33	1.33	1.35		1.27	1.33	1.33		14.19	14.44	14.49		14.23	14.31	15.02	
N_3	31.50	32.55	33.66		32.43	32.52	34.22		1.34	1.39	1.28		1.38	1.28	1.35		14.82	15.69	15.84		14.76	15.13	15.64	
	VxN	VxP	VxNxP	NxP	VxN	VxP	VxNxP	NxP	VxN	VxP	VxNxP	NxP	VxN	VxP	VxNxP	NxP	VxN	VxP	VxNxP	NxP	VxN	VxP	VxNxP	NxP
SE(d)	0.57	0.57	0.99	0.49	0.68	0.68	0.59	1.18	0.05	0.05	0.01	0.51	0.05	0.05	0.97	0.04	0.27	0.27	0.98	0.03	0.29	0.29	0.99	0.04
D at 5%	1.14	1.14	1.97	0.98	1.36	1.36	1.18	2.36	0.11	0.11	0.20	0.10	1.11	1.11	0.19	0.09	0.55	0.55	1.06	0.09	0.58	0.58	1.11	0.10

In was observed that N and P application showed marked improvement in vegetative growth of plant. perusal of data (Table 1-3) indicated that the plant growth of tube rose (height and diameter of stem) significantly increased due to N application. Maximum height of plant (92.69, 93.89 cm) was noted in variety V_4 (variegated) and diameter of stem (0.79, 0.74 cm) in the same variety at 40 and 80 g/m^2 of N application in 1990-91 and 1991-92 respectively. Highest level of P caused beneficial effect on plant height as the maximum height (94.12 cm) in variety V_4 (variegated) and 43.40 cm in variety V_1 (single) with 300 g/m^2 of P application in two season of flowering, 1990-91 and 1991-92 in order of sequence.

It is quite obivious that the application of N and P was very important major nutrients to enhance the plant height and diameter of stem. P application (300 g/m^2) also significantly influenced the diameter of stem in both the years of study. Earlier, Singh *et al.* (1976) and Biswas (1993) reported that N and P favourably affected the plant growth in Dahlia and tuberose. N and P application also proved to be beneficial for leaf growth characters, such as length and diameter of leaf. Maximum length of leaf (36.36 cm, 36.42 cm) was found at 80 g/m^2 of N in 1990-91 and 1991-96 respectively. As for as the effect of P application was concerned, it was seen that with the increased level of P, there was significant increase in length of leaf with highest level in both the years. N application alone did not help much but it could be increased when it was applied with higher dose of P. These results are in confirmity with the findings of Sharga (1989), Singh (1990) and Kumar (1991).

The interaction influence of N and P for various vegetative grwoth characters at higher levels gave maximum values in both the years of study in different genotypes. The interaction effect of VxNxP on plant height and stem diameter revealed that interaction of $V_4xN_3xP_2$ and $V_4xN_3xP_3$ were found significantly superior. The diameter due to N_3xP_3 combination was recorded to be 0.75 cm in both the seasons. The combined use of N and P had no significant effect on the length of leaf which indicated that the individual effect of N and P was independent of each other. The combined use of N and P showed significant response for diameter of leaf. The application of (80 g/m^2) N with P (300 g/m^2) significantly increased the diameter of leaf of plant in comparison to control in both the years. These results clearly indicated that N and P together would be helpful in increasing the diameter of leaf.

The interaction effect of VxNxP was found to be significant for length of leaf in the years of study. Maximum values were recorded as 38.20 and 37.38 on with $V_4xN_3xP_3$ in 1990-91 and 1991-92, respectively. These interactions were also found to be significant for diameter of leaf as the maximum value 2.77 and 2.70 were noticed in 1990-91 and 1991-92 in order. The interaction application of $V_3xN_3xP_3$ was found to be most useful application for maximum number of flower/spike and the highest values were as 38.23 and 38.23 in variety V_3 (Semi-double) in both the years of study. The Diameter of flower was enhanced as 1.60 cm due to $V_4xN_3xP_1$ in variety V_4 (variegated), while the interaction application of $V_4xN_3xP_2$ proved to be the best combination for flowering vase of spike and the value found was 18.00 days in variety V_4 (variegated).

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(Received : September 1995 Revised : January 1996)