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Effect of nitrogen, phosphorus and spacing on vase life of tuberose under eastern part of Uttar Pradesh conditions

Shailendra Vikram Singh and Abhimanyu Chaturvedi

Abstract
The field trials were conducted to study the effect of different doses of nitrogen, phosphorus and spacing on vase life of tuberose cv. Hyderabad double at Krishi Vigyan Kendra- 1, Azamgarh, during 2019-20 and 2020-21. The treatments consisted 4 levels of Nitrogen (100, 200, 300 and 400 kg/ha^{-1}), 3 levels of phosphorus (100, 150, and 200 kg/ha^{-1}) respectively and 3 spacing's: 30 x 20 cm, 30 x 30 cm, and 30 x 40 cm were evaluated in factorial randomized block design replicated thrice. The results revealed that vase life characters were significantly influenced by effect of nitrogen, phosphorus and spacing. The T-18 resulted best in respect of opening of 2nd pair of flowers (15.74 days), opening of 3rd pair of flowers (17.83 days), Length of 1st, 2nd and 3rd pair of flowers (13.17 cm), diameter of 1st, 2nd and 3rd pair of flowers (0.54 cm), no. of open florets/spike (34.40), percentage of open florets/spike (99.13), water uptake in vase (33.68 ml) and vase life of spike (19.43 days) while minimum values reported with T-1 @ 24.89 days, 25.88 days, 11.39 cm, 0.36 cm, 19.74 numbers, 97.05 %, 19.89 ml and 13.80 days respectively.

Keywords: Tuberose, vase life

Introduction
Among the ornamental bulbous plants which are valued much for their aesthetic, beauty and fragrance of flowers, the tuberose (*Polianthes tuberosa* L.) occupies a very selective and special position for flower loving people, because of their prettiness, elegance and sweet pleasant fragrance. It has a great potential for cut flower trade and essential oil industry (Sadhu and Bose, 1973) [13]. It is among a few flowers, which has got good export potential. The maximum flower yield and quality of flowers can be achieved by adopting standard package of cultural and management practices like spacing, optimum dose of fertilizers, irrigation, plant protection etc. To optimize the Spacing level and nitrogen levels is important as far as production is concerned. Nitrogen and phosphorous plays a vital role in obtaining maximum yield with good quality (Yadav, 1985) [18]. Azamgarh soils are rich in potash content and according to Chadha, 1986 potash has no role in growth and flowering, therefore study on effect of spacing, nitrogen and phosphorus on the vase life of the flowers in tuberose at the Farm of Krishi Vigyan Kendra-1, Azamgarh- Uttar Pradesh under the supervision of department of horticulture, S.D.J.P.G. college- Chandeshwer- Azamgarh district was considered to trial, to commercialize flower crop of this region in near future. At present no research work has been carried out on optimum spacing, nutrient management under Azamgarh- Agroclimatic condition. This research information will be useful for the florist and research workers in the other region also.

Materials and Methods
The experiment was conducted during 2020-21 and 2021-22 respectively (Kharif season, May to September month) at the Farm of Krishi Vigyan Kendra-1, Azamgarh. The KVK situated 05 km away from Azamgarh city in southern Uttar Pradesh. The soil of the field had pH of was 7.8 (measured by Beckman's glass electrode method), EC = 0.52 mmhos/cm, Organic carbon = 0.40% (low), available Nitrogen= 365 kg/ha (medium), available Phosphorus= 12 kg/ha (low) and available potassium=194 kg/ha (medium).
The trial was carried out by using Factorial Randomized Block design with 3 treatment (Nitrogen: 4 levels: N_1=100 kg/ha, N_2=200 kg/ha, N_3=300 kg/ha, N_4=400 kg/ha, Phosphorus: 3 levels: P_1 = 100 kg/ha, P_2 = 150 kg/ha, P_3 = 200 kg/ha and Spacing: 3 levels:

S_1= 30 x 20 cm, S_2= 30 x 30 cm and S_3= 30 x 40 cm) with 3 replications. The well rotten Farm Yard Manure was applied during last ploughing @ 5 kg/m^2. The fertilizers were applied before planting in form of Urea and Di-ammonium Phosphate as per treatment. The Variety- Hyderabad Double was used in research.

Table 1: Treatment detail used to test in experiment

Treatment No.	Treatment Notation	Treatment detail		
		Spacing (S)- cm×cm	Nitrogen (N)- kg ha^{-1}	Phosphorus (P)- kg ha^{-1}
T1	S1N1P1	30×20	100	100
T2	S1N2P1	30×20	200	100
T3	S1N3P1	30×20	300	100
T4	S1N4P1	30×20	400	100
T5	S1N1P2	30×20	100	150
T6	S1N2P2	30×20	200	150
T7	S1N3P2	30×20	300	150
T8	S1N4P2	30×20	400	150
T9	S1N1P3	30×20	100	200
T10	S1N2P3	30×20	200	200
T11	S1N3P3	30×20	300	200
T12	S1N4P3	30×20	400	200
T13	S2N1P1	30×30	100	100
T14	S2N2P1	30×30	200	100
T15	S2N3P1	30×30	300	100
T16	S2N4P1	30×30	400	100
T17	S2N1P2	30×30	100	150
T18	S2N2P2	30×30	200	150
T19	S2N3P2	30×30	300	150
T20	S2N4P2	30×30	400	150
T21	S2N1P3	30×30	100	200
T22	S2N2P3	30×30	200	200
T23	S2N3P3	30×30	300	200
T24	S2N4P3	30×30	400	200
T25	S3N1P1	30×40	100	100
T26	S3N2P1	30×40	200	100
T27	S3N3P1	30×40	300	100
T28	S3N4P1	30×40	400	100
T29	S3N1P2	30×40	100	150
T30	S3N2P2	30×40	200	150
T31	S3N3P2	30×40	300	150
T32	S3N4P2	30×40	400	150
T33	S3N1P3	30×40	100	200
T34	S3N2P3	30×40	200	200
T35	S3N3P3	30×40	300	200
T36	S3N4P3	30×40	400	200

Result and Discussion

The results depicted in table no-2-A and 2-B showing that vase life characters were significantly influenced by effect of nitrogen, phosphorus and spacing. The T-18 resulted best in respect of opening of 2nd pair of flowers (15.74 days) followed by T-23 (16.54 days), opening of 3rd pair of flowers (17.83 days) followed by T-23 (18.96 days), Length of 1st, 2nd and 3rd pair of flowers (13.17 cm) followed by T-24 (13.18 cm), diameter of 1st, 2nd and 3rd pair of flowers (0.54 cm) followed by T-23 (0.53 cm), no. of open florets/spike (34.40) followed by T-23 (33.29), percentage of open florets/spike (99.13) followed by T-24 (98.64), water uptake in vase (33.68 ml) followed by T-23 (32.37 ml) and vase life of spike (19.43 days) followed by T-23 (18.98 days) while minimum values reported with T-1 @ 24.89 days, 25.88 days, 11.39 cm, 0.36 cm, 19.74 numbers, 97.05 %, 19.89 ml and 13.80 days respectively.

The pooled data of two years in table- 2-A and 2-B, showing that there was significant difference for days to the 2nd pair of flowers in tuberose due to years. This may have been due to environmental differences during years and especially temperature. Temperature has been known to affect the rate of flower development (Bunt, 1973; Kosugi and Kimura, 1961) [5, 9]. High temperatures were reported to be necessary for flower initiation, development and maturation in tuberose (Kosugi and Kimura, 1961) [9]. Combined effect of all three factors had a significant influence on days for the 2nd pair of flowering. Interaction effect is not significant which implies interaction is absent indicating that treatments behave indecently over years.

The 3rd pair of flowering in tuberose influenced by due to years like temperature, humidity etc could have been varying. Temperature has been known to affect the rate of flower development (Bunt, 1973; Kosugi and Kimura, 1961) [5, 9]. High temperatures were reported to be necessary for flower initiation, development and maturation in tuberose (Kosugi and Kimura, 1961) [9]. Interaction effect is not significant which implies interaction is absent indicating that treatments behave indecently over years.

In respect of length of 1st, 2nd& 3rd pair of flowers; there was significant difference reported due to years. However, nitrogen application was hoped to promote the development of the distal florets to full maturity. The maturing of the distal florets would then lead to the delay of their yellowing and

senescence and probably result in the full opening of the spike. This would improve postharvest quality. Similar results were obtained by Kumar *et al*. (2003) [10]. The Minimum length of 1st, 2nd& 3rd pair of flowers significantly influenced by Interaction effect; which indicating that treatments behave decently over years. There was significant difference in diameter of 1st, 2nd& 3rd pair of flowers in tuberose due to years. The difference between the sizes of the distal florets may have been due to different temperatures over years. On the other hand, the distal floret size was significantly influenced by the combined effect of all three factors rates for both years. The distal floret 'size' was suggested as simple parameters which could be used as indicators to predict the expected vase life of the cut flower. However, increased application of N may have led to increased plant growth resulting in the production of larger florets. Also, higher N levels promoted the production of longer and thicker spikes with longer rachis which were able to bear larger distal florets. Similar results were obtained by Bashir *et al*. (2016) [4]. The minimum diameter of 1st, 2nd& 3rd pair of flowers significantly influenced by years.

No. of open florets/ spike for had also be influenced due to combined effect of spacing, nitrogen and phosphorus rate. However, the number of florets tended to decrease with increasing application of N at the same levels of spacing and phosphorus. Therefore, although N increase was found to result in the delay of yellowing and senescence of sepals and of the distal unopened florets, it may not influence or may have some detrimental effect on the period to wilting and senescence of the last open florets.

The Percentage of open florets/ spike was not significantly influenced due to years irrespective of treatments meanwhile combined effect of spacing, nitrogen and phosphorus rates had a significant influence on the percentage of open florets/ spikes. Naidu and Reid (1989) reported that solution uptake in tuberose was positively correlated with the size of the flower spikes and that high uptake resulted in increased opening of florets and better display quality. In the current study increase in N&P levels resulted in an increase in percentage of open florets per spike. Therefore, this increase may have resulted in increased N&P uptake and subsequently we would expect the increased opening of florets. Similarly, the total water uptake during the vase life resulted due to years irrespective of treatments. Combined effect of spacing, nitrogen and phosphorus rates had a significant influence on total water uptake during vase life. Naidu and Reid (1989) reported that solution uptake in tuberose was positively correlated with the size of the flower spikes. Interaction effect is not significant which implies interaction is absent indicating that treatments behave indecently over years

The result of Vase life of spike was no significantly different due to years irrespective of treatments. Meanwhile. combined effect of spacing, nitrogen and phosphorus rates had significant influence on vase life of spike. Khalaj and Edrisi (2012) [7] also reported increased vase life of flowers with wider spacing. Apart from spacing and phosphorus, Nitrogen plays an active role in synthesis of cytokinins in the plants thus resulting in delayed senescence. Thus, spikes produced from plants with increased N level resulted in the delay of yellowing by preventing chlorophyll loss and the delay of senescence by delaying protein loss in the sepals and the unopened distal florets. The delay in yellowing may also have been due to the increase in chlorophyll content with increases of N levels. This was attributed to increased cytokinin level in cut flowers which delayed chlorophyll breakdown and hence delayed leaf senescence. The maximum vase life of flowers was observed with the application of higher nitrogen dose @200 kg/ha which might be due to the fact that, more number of flower buds were produced per spike with higher nitrogen doses and those were also bolder in size as well as heavier in weight promoting the spikes to show an extended length of vase life (Khalaj and Edrisi, 2012) [7]. These results are in line with the findings of Verma *et al*. (2014) [16], Verma *et al*. (2015) [17] and Agrawal *et al*. (2017) [1].

From the results, it may be concluded that combined impact of spacing @ 30 x 30 cm, N & P_2O_5 200 kg & 150 kg per ha^{-1} respectively had the significant impact on vase life of tuberose flowers. Thus, it seems quite logical to apply nitrogen and phosphorus with sufficient does under Azamgarh district of Uttar Pradesh for good quality keeping as well as transportation purpose.

Table 2 (A): Vase life parameters

Treatments	Days to opening of 2nd pair of flowers			Days to opening of 3rd pair of flowers			Length of 1st, 2nd and 3rd pair of flowers (cm)			Diameter of 1st, 2nd and 3rd pair of flowers (cm)		
	2020	2021	Mean	2020	2021	Mean	2020	2021	Mean	2020	2021	Mean
S1N1P1	25.26	24.51	24.89	26.04	25.73	25.88	11.38	11.41	11.39	0.35	0.37	0.36
S1N2P1	24.85	24.31	24.58	25.04	24.41	24.73	11.50	11.89	11.69	0.39	0.40	0.40
S1N3P1	24.90	23.35	24.13	25.00	24.71	24.86	11.51	11.75	11.63	0.41	0.42	0.41
S1N4P1	23.20	22.80	23.00	25.41	24.53	24.97	11.36	11.96	11.66	0.43	0.44	0.43
S1N1P2	24.36	23.66	24.01	25.48	25.14	25.31	11.58	11.94	11.76	0.41	0.42	0.41
S1N2P2	24.04	23.46	23.75	24.31	23.83	24.07	11.25	11.98	11.61	0.43	0.44	0.43
S1N3P2	23.17	22.50	22.84	24.58	23.87	24.22	11.53	12.32	11.93	0.44	0.45	0.44
S1N4P2	22.58	21.95	22.27	24.38	24.07	24.22	10.81	11.64	11.22	0.46	0.47	0.47
S1N1P3	19.51	18.99	19.25	20.87	20.44	20.66	11.97	12.58	12.28	0.44	0.45	0.44
S1N2P3	21.17	20.24	20.71	19.80	19.58	19.69	11.98	12.48	12.23	0.45	0.46	0.46
S1N3P3	22.22	21.89	22.05	21.06	20.82	20.94	11.60	12.18	11.89	0.46	0.47	0.47
S1N4P3	21.64	21.43	21.53	20.88	20.66	20.77	12.36	13.58	12.97	0.49	0.50	0.50
S2N1P1	16.29	15.98	16.14	24.86	24.17	24.51	11.93	12.13	12.03	0.47	0.49	0.48
S2N2P1	16.90	16.78	16.84	23.25	22.67	22.96	11.93	12.40	12.17	0.51	0.52	0.52
S2N3P1	18.58	18.19	18.38	23.96	23.18	23.57	11.87	12.54	12.20	0.50	0.51	0.51
S2N4P1	18.03	17.73	17.88	23.77	23.12	23.45	11.76	12.44	12.10	0.49	0.50	0.50
S2N1P2	16.29	15.79	16.04	23.76	23.37	23.57	12.48	13.02	12.75	0.48	0.50	0.49
S2N2P2	16.67	16.10	16.39	22.91	22.24	22.58	12.13	12.90	12.52	0.51	0.53	0.52
S2N3P2	16.77	16.75	16.76	23.15	22.34	22.74	12.05	12.95	12.50	0.50	0.52	0.51

S2N4P2	17.28	16.98	17.13	22.84	22.45	22.64	12.21	12.53	12.37	0.50	0.51	0.51
S2N1P3	15.76	15.34	15.55	19.24	19.15	19.20	12.89	13.72	13.31	0.50	0.52	0.51
S2N2P3	15.84	15.65	15.74	18.08	17.58	17.83	13.44	13.96	13.70	0.53	0.55	0.54
S2N3P3	16.78	16.30	16.54	19.08	18.85	18.96	12.80	13.44	13.12	0.52	0.54	0.53
S2N4P3	16.74	16.53	16.63	19.36	18.66	19.01	13.13	13.23	13.18	0.49	0.51	0.50
S3N1P1	17.36	16.43	16.89	18.91	18.78	18.85	12.58	13.02	12.80	0.42	0.45	0.44
S3N2P1	18.04	17.23	17.64	20.29	19.63	19.96	12.34	12.93	12.64	0.44	0.46	0.45
S3N3P1	18.41	17.92	18.16	20.10	19.77	19.94	12.56	12.70	12.63	0.44	0.47	0.46
S3N4P1	18.87	18.41	18.64	20.67	19.88	20.28	11.90	12.51	12.20	0.48	0.49	0.49
S3N1P2	18.51	18.07	18.29	20.96	20.31	20.64	13.02	13.58	13.30	0.49	0.50	0.50
S3N2P2	19.59	19.32	19.46	20.48	19.73	20.11	12.72	13.43	13.08	0.48	0.51	0.49
S3N3P2	19.66	18.96	19.31	21.58	20.76	21.17	12.68	13.08	12.88	0.51	0.52	0.52
S3N4P2	18.48	18.23	18.36	22.10	21.41	21.75	12.38	13.07	12.72	0.50	0.49	0.50
S3N1P3	16.91	16.56	16.73	19.59	18.93	19.26	12.63	13.20	12.92	0.49	0.50	0.50
S3N2P3	16.99	16.63	16.81	19.20	18.56	18.88	12.71	13.43	13.07	0.52	0.54	0.53
S3N3P3	18.44	17.77	18.10	20.04	19.23	19.64	12.98	13.17	13.08	0.49	0.51	0.50
S3N4P3	17.75	17.54	17.64	20.63	20.33	20.48	13.02	13.24	13.13	0.48	0.48	0.48
SED	0.96	0.99	0.27	0.93	0.95	0.21	0.91	0.98	0.24	0.00	0.00	0.01
CD	1.91	1.98	0.53	1.86	1.89	0.42	1.81	1.76	0.41	0.00	0.00	0.02
t Tab	1.99	1.99	1.98	1.99	1.99	1.98	1.99	1.99	1.98	1.99	1.99	1.98

Table 2 (B): Vase life parameters

Treatments	No. of open florets/ spike			Percentage of open florets/spike			Water uptake in vase (ml)			Vase life of spike (days)		
	2020	2021	Mean	2020	2021	Mean	2020	2021	Mean	2020	2021	Mean
S1N1P1	19.92	19.55	19.74	96.74	97.36	97.05	19.78	20.01	19.89	13.64	13.96	13.80
S1N2P1	20.56	20.65	20.61	97.44	97.41	97.42	21.77	22.04	21.90	14.43	14.64	14.53
S1N3P1	20.24	20.15	20.20	96.97	97.39	97.18	21.48	21.30	21.39	15.32	15.49	15.40
S1N4P1	19.81	19.97	19.89	97.25	97.49	97.37	21.17	21.08	21.13	15.35	15.86	15.60
S1N1P2	20.78	21.09	20.93	97.37	97.86	97.62	21.68	21.83	21.75	14.97	14.96	14.97
S1N2P2	21.85	22.19	22.02	97.91	98.17	98.04	23.86	23.95	23.91	15.43	15.64	15.53
S1N3P2	21.44	21.69	21.57	98.31	98.13	98.22	23.30	23.48	23.39	16.62	16.49	16.56
S1N4P2	21.31	21.51	21.41	97.59	97.50	97.55	23.08	23.17	23.13	16.68	16.86	16.77
S1N1P3	27.59	27.65	27.62	97.56	97.91	97.74	24.06	24.67	24.36	15.97	15.96	15.97
S1N2P3	27.23	27.15	27.19	98.12	98.70	98.41	26.36	26.33	26.35	15.43	16.64	16.03
S1N3P3	26.81	26.97	26.89	98.05	98.57	98.31	25.70	25.80	25.75	17.61	17.49	17.55
S1N4P3	27.66	28.09	27.88	97.49	97.61	97.55	25.61	25.55	25.58	17.68	17.86	17.77
S2N1P1	30.24	30.45	30.35	97.79	97.91	97.85	26.61	26.79	26.70	17.29	16.96	17.13
S2N2P1	30.59	30.65	30.62	97.61	97.89	97.75	28.24	28.45	28.35	17.76	17.64	17.70
S2N3P1	30.44	30.47	30.46	98.09	97.66	97.88	27.93	27.98	27.95	18.30	18.49	18.39
S2N4P1	30.52	30.28	30.40	97.45	97.24	97.35	27.55	27.61	27.58	18.68	18.86	18.77
S2N1P2	32.92	32.95	32.94	98.02	97.98	98.00	29.62	29.89	29.75	17.34	17.46	17.40
S2N2P2	33.24	33.15	33.20	97.88	98.31	98.09	30.94	31.42	31.18	18.08	18.14	18.11
S2N3P2	32.79	32.97	32.88	97.71	97.70	97.71	30.80	30.98	30.89	18.73	18.99	18.86
S2N4P2	32.44	32.78	32.61	97.60	97.28	97.44	30.73	30.43	30.58	18.63	18.69	18.66
S2N1P3	32.76	33.34	33.05	97.88	98.60	98.24	31.89	32.61	32.25	19.02	18.93	18.98
S2N2P3	34.35	34.45	34.40	98.78	99.48	99.13	33.68	33.68	33.68	19.41	19.44	19.43
S2N3P3	33.08	33.50	33.29	98.61	98.79	98.70	32.25	32.49	32.37	18.98	19.16	19.07
S2N4P3	33.29	32.96	33.13	98.66	98.63	98.64	32.03	32.20	32.11	18.36	18.63	18.50
S3N1P1	28.57	28.45	28.51	97.93	97.98	97.95	25.09	25.56	25.32	16.29	15.96	16.13
S3N2P1	28.59	28.65	28.62	97.64	98.11	97.88	26.98	27.16	27.07	16.43	16.64	16.53
S3N3P1	28.44	28.47	28.46	97.68	97.61	97.64	26.42	26.57	26.50	17.28	17.49	17.38
S3N4P1	28.20	28.28	28.24	97.27	97.28	97.28	25.84	26.51	26.17	17.35	17.86	17.60
S3N1P2	30.38	30.20	30.29	97.55	97.68	97.61	25.85	26.07	25.96	15.67	16.46	16.07
S3N2P2	30.17	30.40	30.29	98.09	98.20	98.15	27.54	27.75	27.65	17.08	17.14	17.11
S3N3P2	30.71	30.22	30.47	97.96	97.76	97.86	26.57	26.95	26.76	17.76	17.99	17.88
S3N4P2	29.86	30.03	29.95	97.37	97.40	97.39	26.72	26.69	26.71	17.63	17.69	17.66
S3N1P3	30.70	31.00	30.85	98.07	98.10	98.09	26.35	26.50	26.42	16.66	16.63	16.64
S3N2P3	31.64	31.30	31.47	98.23	98.32	98.28	27.19	27.15	27.17	16.58	16.89	16.74
S3N3P3	30.54	30.65	30.59	98.10	98.26	98.18	26.98	26.94	26.96	16.23	16.39	16.31
S3N4P3	31.12	30.52	30.82	97.74	98.11	97.93	26.37	26.45	26.41	15.93	16.09	16.01
SED	0.93	0.93	0.25	0.92	0.93	0.22	0.97	0.98	0.21	0.99	0.99	0.26
CD	1.95	1.96	0.48	1.95	1.96	0.48	1.94	1.96	0.41	1.97	1.98	0.52
t Tab	1.99	1.99	1.98	1.99	1.99	1.98	1.99	1.99	1.98	1.99	1.99	1.98

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