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Research Article

EFFECT OF DIFFERENT CONCENTRATION LEVELS OF NPK ON GROWTH, FLOWERING AND YIELD OF TUBEROSE (*Polianthes tuberosa* L.) *Cv.* SHRINGAR

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Abstract- The experiment was conducted at the Department of Horticulture, Sam Higginbottom Institute of Agriculture Technology & Sciences, Allahabad, (U.P.) during the period from March to November (2013) to investigate the Effect of different concentration levels of NPK on growth, flowering and yield of tuberose (*Polianthes tuberosa* L.) *cv.* Shringar. Twelve treatments were included in the trial *viz;* T_0 (Control), T_1 (25:50:20), T_2 (50:80:40), T_3 (75:110:60), T_4 (100:140:80), T_5 (125:170:100), T_6 (150:200:120), T_7 (175:230:140), T_8 (200:260:160), T_9 (225:290:180), T_{10} (250:320:200) and T_{11} (275:350:220) N,P,K kg ha^{-1} were tested in three replication. The experimental design was Randomized Block Design. The results reveal that fertilizer treatments had significant response on all parameters. The maximum plant height (70.90 cm), number of leaves/plant (33.53), number of tillers/clump (3.40), number of spike/clump (5.67), yield of spike/ha (656.31), number of bulbs/clump(17.38 g), weight of largest bulb (77.74 g) and diameter of largest bulb (5.58 cm) were produced by the treatment (T_9) of N:P:K in the ratio of 225:290:180 kg/ha. It was the best treatment for good vegetative as well as reproductive growth. Application of N, P_2O_5 and K_2O at 225:290:180 kg/ha may be applied.

Keywords- NPK, Tuberose (*Polianthes tuberosa*), Rechis, Spike

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Introduction

Tuberose (*Polianthes tuberosa* L.) is a member of family amaryllidaceae, native to Mexico (True blood, 1973).It is perennial flowering plants, grown in the tropical and subtropical areas for cut flower and fragrance. The crop is a bulbous perennial, which is day neutral, flowers are tubular, usually in pairs, forming a terminal spike. It grows well in the open field where temperatures range from 20 - 30°C (Arora, 2011). Flowering performance of tuberose has been demonstrated to vary according to the temperature regime. The rate of first floret emergence is directly influenced by the mean air temperature and 21 -22 °C gave the maximum rate of development [11]. Warm temperature promotes flower initiation while water maximizes quality and yields; hence irrigation is required for high quality flowers [7]. Under water stress the flowering period, flower quality and bulb yield are reduced [6]. It is perennial crop, therefore, a high amount of organic and inorganic fertilizers are needed to maintain sustainable growth and flowering over a long period. Tuberose is a gross feeder and requires a large quantity of NPK, both in the form of organic and inorganic fertilizers [1]. Nitrogen, phosphorus and potassium have a significant effect on spike production and floret quality [15]. Duration of flower in the field was improved through using chemical fertilizer.

Materials and Methods

The experiment on different concentration levels of NPK was carried out during the summer season of 2013 at the Department of Horticulture, SHIATS Allahabad (U.P.). The soil of the experimental area was sandy loamy fertile with low clay and high sand percentage with a pH of 7.2. The experiment was conducted in Randomized Block Design (RBD) in three replications in 2m^2 plot size, consisted with different levels of N,P,K kg ha^{-1} (T_0-Control, T_1-25:50:20, T_2-50:80:40, T_3-75:110:60, T_4-100:140:80, T_5-125:170:100, T_6-150:200:120, T_7-175:230:140, T_8-200:260:160, T_9-225:290:180, T_{10}-250:320:200 and T_{11}-275:350:220).The bulbs of tuberose (*cv.* Shringar) were collected from Department of Horticulture, Sam Higginbottom Institute of Agriculture Technology &Sciences (SHIATS) Allahabad, (U.P.) Healthy and uniform bulbs (2.5 to 3.0 cm in diameter) were planted in each plot with 30 cm x 30 cm spacing at 5 cm depth in first week of March 2013. Urea, Single Super Phosphate (SSP) and Muriate of Potash (MOP) were used as source of nitrogen, phosphorus and potassium respectively. Full dose of FYM (50 t ha^{-1}), and NPK (as per treatment) were incorporated during final land preparation. The total dose of nitrogen, phosphorus and potash were applied in two times. The first time was applied at before planting. The second time was applied at 45 days after the spikes of tuberose were harvested when the first floret in the rachis opened. Harvesting was done during second week of July to October, 2013 and bulb and bulblet were harvested on October, 2013. Data were collected on different growth and flowering related parameters and were analyzed statistically following the analysis of variance (ANOVA) procedure. Least significant difference (LSD) at 5% level was used to compare treatment means and the mean differences were adjudged by Duncan's Multiple Range Test (DMRT) using the statistical computer package program.

Result and Discussion

Plant height

Result showed that plant height increased with increasing levels of NPK up to 250:320:200 kg NPK/ha. [Table-1] had a significant effect on plant growth at 30, 60 and 90 days after planting. The maximum plant height (45.41 cm) at 30 DAP, (59.85 cm) at 60 DAP and (70.90 cm) at 90 DAP were recorded under the treatment receiving 250:320:200 kg NPK/ha (T_{10}), which though at par with that of 275:350:220 kg/ha showed significant increases over the rest of treatments

including control. This result is in agreement with that of [3] reported that plant height increased with increased N rate of tuberose up to 250 kg N/ha.

Number of leaves

Different levels of NPK application on tuberose had significant effect on number of leaves [Table-1] Results revealed that number of leaves was greater in NPK applied plots than control plots indicating effect of NPK on number of leaves. Result further revealed that number of leaves increased with increasing NPK levels up to 225:290:180 NPK kg ha^{-1}. The maximum number of leaves $plant^{-1}$ (31.52), at 60 DAP and (33.53), at 90 DAP were recorded under the treatment receiving T_9 which though at par with that of T_{10} showed significant increases over the rest of treatments including control. [4] Observed that application of nitrogen fertilizer increased number of leaves in tuberose that supported the present experimental result.

Table-1 *Effect of different concentration levels of NPK on vegetative growth of tuberose cv. Shringar*

	Plant height (cm)			Number of leaves $plant^{-1}$			Number of tillers $clump^{-1}$		
Treatment	30 DAP	60 DAP	90 DAP	30 DAP	60 DAP	90 DAP	30 DAP	60 DAP	90 DAP
T_0	38.05	50.30	59.31	10.03	19.81	21.47	1.20	1.90	1.93
T_1	39.4	51.24	61.01	10.99	22.92	24.27	1.49	2.15	2.17
T_2	40.12	53.00	62.41	11.79	24.84	26.14	1.51	2.42	2.43
T_3	41.14	53.94	63.42	11.69	25.14	26.90	1.84	2.48	2.56
T_4	41.39	54.51	64.32	13.30	27.23	28.92	1.92	2.53	2.60
T_5	42.32	55.19	65.02	13.13	27.07	29.02	2.02	2.58	2.71
T_6	42.17	55.18	65.55	13.04	28.20	29.13	2.04	2.70	2.8
T_7	42.89	55.46	65.50	14.11	28.77	29.32	2.18	2.75	2.87
T_8	44.03	56.02	66.52	14.50	29.46	30.99	2.24	2.90	3.10
T_9	44.09	58.06	68.41	13.33	31.52	33.53	2.61	3.36	3.40
T_{10}	45.41	59.85	70.90	14.89	30.26	33.18	2.6	2.97	3.28
T_{11}	44.25	58.50	69.41	14.87	30.05	32.24	2.52	2.90	3.28
C.D.(P=0.05)	0.95	0.65	0.67	0.94	0.90	0.71	0.33	0.16	0.23

Number of tillers^{-1}:

Result showed that number of tillers increased with age till 60 DAP followed by a decline due to some tillers died at later growth stages [Table-1]. Result further showed that number of tillers increased with increasing NPK levels up to 225:290:180 kg NPK/ha. The highest numbers of tillers/clump (3.36) at 60 DAP and (3.40) at 90 DAP were recorded under the treatment receiving 225:290:180 kg NPK/ha which though at par with that of 250:320:200 kg NPK/ha showed significant increases over the rest of treatments including control. This result is in full agreement with that of [9] stated that the number of tillers increased with increasing NK levels in tuberose.

Days to flowering

Results further revealed that days to flowering increased with increasing NPK rate [Table-2]. The minimum days to flowering was recorded in control at all growth stages followed by 20:50:20. The NPK at the rate of 250:320:200 kg NPK/ha had the height days to flowering. This result indicates that N has tremendous effect on days to flowering. [4]Observed that application of nitrogen fertilizer increased days to flowering of tuberose that supported the present experimental result.

Spike length (cm)

Results showed that spike length increased with increasing NPK rate [Table-2]. The longest spike was recordedin T_{10} (119.29 cm) followed by 250:320:200 kg NPK/ha. The shortest spike was recorded in control plant (96.47 cm). This result indicates that nitrogen has tremendous effect on spike growth and development in tuberose. This result is in full agreement with that of[3]stated that the spike length increased with increasing nitrogen levels in tuberose.

Rachis length (cm)

Result showed that rachis length was higher in T_{10} applied plants than control plants [Table-2]. The highest rachis length was recorded in 250:320:200 kg NP K/ha (32.29 cm) and the lowest were recorded in control plant (21.97 cm). These results are consistent with [4]reported that application nitrogen increased rachis length in tuberose.

Number of florets spike^{-1}

Result revealed that number of florets increased with increasing NPK levels [Table-2]. The highest number of florets was observed in (T_{10}) 250:320:200 kg NPK/ha (35.96) followed by (T_{11}) 275:350:220 kg NPK ha^{-1} (33.05). The lowest number of florets was recorded in control plant (27.49) that was significantly different than the other treatments.[13] observed that application of NPK fertilizer increased number of florets of tuberose that supported the result of present experiment.

Table-2 *Effect of different concentration levels of NPK on floral parameter of tuberose cv. Shringar*

Treatment	Days to flowering	Spike length(cm)	Rachis length(cm)	No. of florets $spike^{-1}$	No. of spikes $clump^{-1}$	Duration of flowering	Yield of spikes ha^{-1}
T_0	98.86	96.47	21.97	27.49	2.17	17.71	297.83
T_1	100.43	97.12	22.65	29.38	2.63	18.52	308.22
T_2	101.40	98.39	23.21	29.30	2.88	20.08	338.43
T_3	106.04	100.51	24.17	30.43	2.93	20.64	384.32
T_4	107.74	102.92	25.63	31.83	3.23	21.08	423.74
T_5	109.7	102.24	24.76	30.42	3.59	20.50	538.28
T_6	108.70	105.61	25.74	31.60	3.48	21.49	493.02
T_7	111.05	110.44	26.71	32.58	4.11	21.61	593.57
T_8	112.60	110.96	27.72	33.28	4.85	22.13	606.67
T_9	112.66	114.81	28.98	34.82	5.67	22.43	656.31
T_{10}	114.17	119.29	32.29	35.96	4.89	24.46	644.00
T_{11}	113.09	117.53	31.06	35.05	4.73	23.1	634.15
C.D.(P=0.05)	1.27	1.14	0.92	0.75	0.29	0.11	1.87

Number of spike clump^{-1}

Result revealed that number of spike plant^{-1} increased with increasing NPK levels [Table-2] The highest number of spikes/clump was observed in (T_9) 225:290:180 kg NPK/ha (5.67) followed by (T_{10}) 250:320:200 kg NPK ha^{-1} (4.89). The lowest number of spikes/clump was recorded in control plant (2.17) that was significantly different than the other treatments.[3] observed that application of nitrogen fertilizer increased number of spikes/clump of tuberose that supported the result of present experiment

Duration of flowering: Results revealed that duration of flowering increased with increasing NPK levels [Table-2]. The maximum duration of flowering (24.46) was recorded in (T_{10}) 250:320:200 kg NPK/ha followed by (T_{11}) 275:350:220 kg NPK/ha (23.1). The minimum duration of flowering (17.71) was recorded in control plant. [8] Observed that application of nitrogen fertilizer increased duration of flowering that supported the present experimental result.

Yield of spikes ha^{-1}: Result revealed that yield of spikes/ha increased with increasing NPK levels [Table-2]. The highest yield of spikes/ha was observed in (T9) 225:290:180 kg NPK/ha (656.31) followed by (T10) 250:320:200 kg NPK/ha (644). The lowest yield of spike /ha was recorded in control plant (297.83) that was significantly different than the other treatments. These results are in conformity with reported that application of nitrogen fertilizer increased yield of spike /ha that supported the present experimental result.

Number of bulbs clump^{-1}: Results showed that number of bulbs/clump increased with increasing [Table-3] NPK rate up to 225:290:180 kg NPK/ha. The highest number of bulbs/clump was recorded in (T_9) 225:290:180 kg NPK/ha 17.38 followed by (T_{10}) 250:320:200 kg NPK/ha (16.20). The lowest number of bulbs/clump was recorded in control plant (9.84). This result indicates that NK has tremendous effect on number of bulbs/clump in tuberose. This result is in agreement with that of that of [9] reported that number of bulbs clump^{-1} increased with increased NK rate of tuberose till 225:180 kg NK ha^{-1}.

Weight of bulbs clump^{-1}: Result revealed that weight of bulbs/clump increased with increasing NPK levels [Table-3]. The highest weight of bulbs/clump was observed in (T_9) 225:290:180 kg NPK/ha 109.7 g followed by (T_{10}) 250:320:200 kg NPK/ha (106.4 g). The lowest weight of bulbs/clump was recorded in control plant (64.98 g) that was significantly different than the other treatments. These results are in conformity with. [10] reported that weight of bulbs/clump increased with increased nitrogen rate of tuberose till 250 kg/ha.

Weight of largest bulb (g): Results revealed that weight of largest bulb increased with increasing NPK levels [Table-3]. The maximum weight of largest bulb was recorded in (T_9) 225:290:180 kg NPK/ha 77.74 g followed by (T_{10}) 250:320:200 kg NPK/ha (73.86 g). The minimum weight of largest bulb (39.88 g) was recorded in control plant. [9] reported that weight of largest bulb increased with increased NK rate of tuberose till 225:180: kg NK/ha.

Diameter of largest bulb (cm): Result showed that diameter of largest bulb was higher in T_9 applied plants than control plants [Table-3]. The highest diameter of largest bulb was recorded in 225:290:180 kg NPK/ha (5.58 cm) and the lowest were recorded in control plant (3.2 cm). In the present experiment, 225 kg N /ha showed the highest diameter of largest bulb. [4] reported that diameter of largest bulb increased with increased N rate of tuberose till 180 kg ha^{1}.

Yield of bulbs (t ha^{-1}): Results showed that yield of bulbs (t ha^{-1}) increased with increasing NPK levels [Table-3]. The highest yield of bulbs (t ha^{-1}) was recorded in (T_9) 225:290:180 NPK kg ha^{-1} 18.17 followed by (T_{10}) 250:320:200 NPK kg ha^{-1}(18.03). The lowest yield of bulbs (t ha^{-1}) was recorded in (T_0) control plot (10.54). This result indicates that NK has tremendous effect on yield of bulbs in tuberose. This result is in agreement with that of[9]reported that the yield of bulbs (t ha^{-1}) increased with increased NK rate of tuberose till 225:180: NK kg ha^{-1}.

Table-3 *Effect of different concentration levels of NPK on bulb parameter of tuberose cv. Shringar*

Treatment	Number of bulbs clump^{-1}	Weight of bulbs clump^{-1} (g)	Weight of largest bulb (g)	Diameter of largest bulb (cm)	Yield of bulbs (t ha^{-1})	Vase life of flower (days)
T_0	9.84	64.98	39.88	3.2	10.54	7.03
T_1	10.31	67.13	41.99	3.59	10.84	7.36
T_2	12.41	72.57	44.02	3.69	11.34	8.07
T_3	12.49	76.71	47.36	3.82	12.44	8.26
T_4	12.99	79.60	50.28	4.35	13.32	8.57
T_5	13.71	89.46	54.78	4.4	14.80	8.56
T_6	13.10	85.41	53.35	4.36	14.1	8.82
T_7	14.00	96.68	58.95	4.8	16.53	9.16
T_8	14.6	101.89	65.11	5.04	16.8	9.56
T_9	17.38	109.7	77.74	5.58	18.17	10.34
T_{10}	16.20	106.4	73.86	5.24	18.03	9.79
T_{11}	15.47	105.67	71.39	5.23	17.60	9.72
C.D.(P=0.05)	0.29	2.14	1.09	0.44	0.87	0.56

Vase life (days)

Results showed that the vase life of cut flower [Table-3] in normal water indicated that, maximum vase life of flower was obtained in treatment T_9-225:290:180 NPK kgha^{-1} (10.34 days) followed by treatment T_{10}-250:320:200 NPK kg ha^{-1} (9.79 days) and T_{11}275:350:220 NPK kg ha^{-1} (9.72 days). Lowest vase life of flower was observed in treatment T_0 control (7.03 days).

Conclusion

On the basis of present findings it is concluded that, with 2 respect to cultivation of tuberose, the application of NPK up to 250kg N_2, 320 kg P_2O_5 and 200 kg K_2O/ha (T_{10}) that increased rachis length, spike length & floret number. So the tuberose should be sown with application rate of 250:320:200 kg/ha N,P,K and application of NPK up to 225 kg N_2, 290 kg P_2O_5 and 180 kg K_2O/ha (T_9) that increased vase life of flower (10.34 days), yield of spikes (656316 spike ha^{-1}) and yield of bulb (18.17 t ha^{-1}).

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Conflict of Interest: None declared

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