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Studies on the Effect of Nutrients (Nitrogen and Phosphorus) on Growth and Development of Tuberose (*Polianthes tuberosa*) cv. Prajwal under Haryana Condition

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ABSTRACT

The present investigation was carried out at Research Farm of the Department of Horticulture, CCS Haryana Agricultural University, Hisar during 2016-17 and 2017-18. In the concerned experiment, Randomized Block Design with three replications was used, where four levels of nitrogen, i.e., 0, 10, 15 and 20 g/m^2 and three levels of phosphorus viz., 0, 5 and 10 g/m^2 were applied. The observations were recorded on Days taken to initiation of sprouting, Days taken to complete sprouting, Plant height (cm), Length of leaves (cm) and Number of leaves per clump. The lowest days taken to initiation of sprouting and days taken to complete sprouting in both the years were observed in treatments where nitrogen at 20 g/m^2 and phosphorus at 10 g/m^2 respectively was applied. The maximum plant height, Length of leaves and Number of leaves per clump were observed in where nitrogen at 20 g/m^2 and phosphorus at 10 g/m^2 was applied. Therefore, based on the study for better growth of tuberose plants nitrogen at 20 g/m^2 and phosphorus at 10 g/m^2 should be applied.

Key words: *Tuberose, Nitrogen, Phosphorus, Sprouting and Growth parameters*

INTRODUCTION

Tuberose (*Polianthes tuberosa* L.,) belongs to the family Asparagaceae, is a native of Mexico, from where it spread to different parts of the world during 16th century. It is believed that tuberose was brought to India in 16th century *via* Europe. The word tuberose has been derived from the Latin word *Tuberosa*, meaning swollen or tuberous in reference to its root system and *Polianthes* means *many flowers* in Greek language. It is an important flower crop in India and abroad both in terms of loose and cut flower. It is cultivated on large scale in France, South Africa, North Carolina and United States of America and in many tropical and subtropical areas of the world too. In India, the area under flower crops is around 306.28 thousand hectares with a production of 2392 thousand tonnes, out of which, the cut flower production is 692.83 thousand tonnes and loose flower production is around 1699.42 thousand tones.

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In India, the chief Centres of its commercial production are Karnataka Maharashtra, Pune, Nashik, Ahmednagar, Assam, Udaipur, Ajmer, Gujarat, Tamil Nadu Andhra Pradesh and West Bengal. In Haryana, the total area under flower crops is 5.51 thousand hectares with a production of loose flowers 56230 tonnes and cut flowers 3510 tonnes[9]. The major sites near and within Haryana for the production of tuberose are Fatehpur, Beri, Mehrauli, Farukha Nagar, Chattarpur, Ghaziabad, Faridabad, Gurgaon and Muradnagar.

Plant nutrition is an important aspect for good vegetative growth and also to increase the yield with better quality of flowers. Tuberose utilizes nitrogen, phosphorus and potassium in large amount, thus, it responds well to applied organic and inorganic fertilizers particularly the nitrogenous fertilizers[12]. The deficiency of both may causes adverse effect on plant growth parameters in maintaining the full supply of other nutrients responsible for better growth and development of plant and their excess may result in various nutritional problems including calcium and zinc deficiency. The nutritional requirement of tuberose varies with several factors like climatic conditions, soil types, cultivar and plant spacing. Nitrogen plays more important role in plant growth than phosphorus since it is a major constituent of chlorophyll and proteins, which are responsible for cell division and cell enlargement in plants, affecting the emergence, production and quality of spikes in tuberose[10]. Mukhopadhyay and Banker[8], reported that 20 g/m^2 of N in tuberose applied in two splits i.e. 1/3rd dose of nitrogen at 30 day and 1/3rd dose at 60 days after sowing resulted into maximum plant height, number of leaves per plant and number of spike per plant. Mukhopadhyay and Banker[8], in another experiment on tuberose reported application of nitrogen at 20g/m^2 resulted in an increase in plant height, number of leaves per plant. Kumar and Singh[6]. found that 300 kg N/ha in tuberose resulted into maximum number of leaves and height of plant, duration of flowering. However, days to flowering and weight of individual bulb was hastend by 200kg N/ha. The maximum plant height and number of leaves per plant in tuberose was found when nitrogen @ 40 g/m^2 was applied[4].

Phosphorus has been called as *the key to life* since it is directly involved in most of the life processes and an essential part of many sugar phosphates, which are involved in photosynthesis, respiration and other metabolic processes, thus, it is one of the major limiting factors. Phosphorus also improves the plant root system in tuberose, which helps in more uptakes of plant nutrients[1]. Larger bulbs in gladiolus at wider spacing influenced the productivity as well as the quality of flowers in terms of vegetative growth, flowering and vase life. Singh *et al*.[14], found that application of N, P, K at 30, 30 and 20 g/m^2 respectively, reduced the days to spouting time, increased the sprouts per bulb, leaves per plant, length of leaves and plant height. The maximum plant height was recorded with combined application of 180 ppm N and 40 ppm P level but maximum number of leaves per plant (29.0) was recorded with 180 ppm N and 60 ppm Pi tuberose[1]. Kumar and Mishra[5] found that application of $N_{80}P_{20}$ g/m^2 produced significantly maximum leaves per shoots but tallest plant were produced at $N_{80}P_{10}$ g/m^2 in gladiolus. Keeping in view the above facts, the present experiment entitled "Studies on the effect of nutrients (nitrogen and phosphorus) on growth and development of tuberose (*Polianthes tuberosa* L.) cv. Prajwal" was planned with the following objectives:

1. To find out the effect of nitrogen and phosphorus on growth and development of tuberose
2. To standardize the optimum dose of nitrogen and phosphorus for better sprouting and growth of tuberose

MATERIAL AND METHODS

The present investigation was carried out at Research Farm of the Department of Horticulture, CCS Haryana Agricultural University, Hisar during 2016-17 and 2017-18.

Hisar is situated in the subtropics at an altitude of 215.2 meter above mean sea level with North latitude 29º10´ and East longitude 75º46´. The general features of this region are semiarid climate with hot and dry winds during summer and dry severe cold in winter. The soil of the experimental field was sandy loam and clayey with slightly high pH of 8.10 and 7.05 and EC of 1.13 and 1.4 dS/m in 2016-2017 and 2017-2018, respectively. The soil was low in nitrogen, high in phosphorus and medium in available potassium (118.15, 23 and 270 kg/ ha, respectively) in 2016-2017 while the soil was low in nitrogen, high in phosphorus and medium in available potassium (140.23, 19 and 280 kg/ ha, respectively) in 2017-2018. The planting material (bulbs) was procured from the Horticulture Farm, CCS Haryana Agricultural University, Hisar. The bulbs of 3.5 cm diameter were planted on 16th March 2016 at Experimental Orchard of the Department of Horticulture and in second year, the bulbs bulbs of 3.5 cm diameter were planted on 25th February 2017 at Botanical Garden of the Department of Plant Physiology, CCS Haryana Agricultural University, Hisar. To keep the tuberose field weed free and to conserve moisture, hoeing and weeding were done at a regular interval depending upon weed intensity in crop field. Irrigation was given at regular intervals ranging from 5-15 days depending upon the weather and the availability of water. The experiment was laid out in Randomized Block Design with three replications. Four levels of nitrogen, *i.e*., 0, 10, 15 and 20 g/m^2 and three levels of phosphorus *viz*., 0, 5 and 10 g/m^2 were applied in well ploughed beds of 1.5 × 1.5 m^2 size with a planting distance 30 cm × 30 cm. A basal dose of farmyard manure @ 5 kg/m^2 with one-third dose of nitrogen as per the treatment and phosphorus and potassium each @ 10 g/m^2 was applied and mixed thoroughly into the soil. The remaining two-third dose of nitrogen was applied in two splits first one third at 30 days after planting and second one third at 60 days after planting. The data were collected on days taken to initiation of sprouting, days taken to complete sprouting, plant height (cm), length of leaves (cm) and number of leaves per clump.

Observations recorded

For the data collection from the field, five plants were selected randomly and tagged in each treatment (plot) leaving the border plants.

Days taken to initiation of sprouting

The number of days taken for the initiation of sprouting of bulbs was recorded from date of planting to the date of appearance of cotyledonary leaves and the average was worked out.

Days taken to complete sprouting

The number of days taken from date of planting to complete sprouting of bulbs was recorded and average time taken for complete sprouting was worked out.

Plant height (cm)

Plant height was measured from base of plant to the tip of spike at the time of peak flowering stage and the average plant height was worked out.

Length of leaves (cm)

Length of leaves was measured when all the leaves were fully developed and no new leaf was emerging. Five leaves at a particular node were measured and average length was recorded for all the five selected plants in a replication.

Number of leaves per clump

The number of leaves produced by the plants was recorded by counting them and average number of leaves per plant was worked out.

RESULTS AND DISCUSSION

The data presented in Table 1 indicated the effect of different nutrients on days taken to initiation of sprouting during 2016-17 and 2017-18. The increasing levels of nitrogen and phosphorus significantly decreased the days taken to initiation of sprouting. Nitrogen level @ 20 g/m^2 significantly reduced the days taken to initiation of sprouting (31.11 and 48.11) as compared to control, where nitrogen was not applied (37.16 and 52.76), respectively. Similarly, phosphorus level @ 10 g/m^2 significantly decreased the days taken to sprouting (33.08 and 49.59) as compared to control, where no phosphorus was applied

(34.60 and 52.39), respectively. The interaction of nitrogen and phosphorus significantly reduced the number of days taken to initiation of sprouting of bulb. Maximum number of days (38.67 and 54.15) taken to initiation of sprouting of bulbs were recorded in control, where nitrogen and phosphorus were not applied while minimum number of days (30.47 and 46.37) were observed under nitrogen and phosphorus @ 20 and 10 g/m^2, during both the years, respectively.

Table 1: Effect of nitrogen and phosphorus on days taken to initiation of sprouting in tuberose

Nitrogen levels (g/m^2)	Phosphorus levels (g/m^2)							
	2016-17				2017-18			
	0	5	10	Mean	0	5	10	Mean
0	38.67	36.93	35.87	**37.16**	54.15	52.91	51.23	**52.76**
10	34.73	34.13	33.73	**34.20**	53.88	51.51	50.45	**51.95**
15	33.33	32.87	32.27	**32.82**	52.24	51.39	50.30	**51.31**
20	31.67	31.20	30.47	**31.11**	49.28	48.68	46.37	**48.11**
Mean	**34.60**	**33.78**	**33.08**		**52.39**	**51.12**	**49.59**	

CD at 5% level of significance	:	**2016-17**	**2017-18**
Nitrogen	:	0.37	0.49
Phosphorus	:	0.32	0.43
Nitrogen x Phosphorus	:	0.64	0.85

The effect of different nitrogen and phosphorus levels on days taken to complete sprouting in tuberose cv. Prajwal are presented in Table 2. The nitrogen as well as phosphorus levels had significantly decreased the days to complete the sprouting (33.40 and 47.84) as compared to control, where neither nitrogen nor phosphorus had been applied (39.84 and 56.30) during 2016-17 and 2017-18, respectively. The increased levels of phosphorus @ 10 g P_2O_5/m^2 significantly reduced the days to complete sprouting (35.52 and 50.87) as compared to control i.e. without phosphorus (37.10 and 53.24) during both the years, respectively. The interaction effects between nitrogen and phosphorus significantly reduced the days to complete sprouting and minimum number of days (32.80 and 46.52) was observed with nitrogen and phosphorus levels at 20 and 10 g/m^2 in tuberose, during 2016-17 and 2017-18, respectively. These results were in close confirmatory with the results of Mukhopadhyay and Banker[7]. and Kour and Sharma. This might be due to absorption of nitrogen through surface of bulbs which have resulted in early sprouting.

Table 2: Effect of nitrogen and phosphorus on days taken to complete sprouting in tuberose

Nitrogen levels (g/m^2)	Phosphorus levels (g/m^2)							
	2016-17				2017-18			
	0	5	10	Mean	0	5	10	Mean
0	41.47	39.87	38.20	**39.84**	58.10	57.14	53.66	**56.30**
10	37.53	36.67	36.33	**36.84**	53.05	52.27	52.15	**52.49**
15	35.40	35.07	34.73	**35.07**	52.02	52.02	51.15	**51.73**
20	34.00	33.40	32.80	**33.40**	49.79	47.22	46.52	**47.84**
Mean	**37.10**	**36.25**	**35.52**		**53.24**	**52.16**	**50.87**	

CD at 5% level of significance	:	**2016-17**	**2017-18**
Nitrogen	:	0.47	0.66
Phosphorus	:	0.42	0.57
Nitrogen x Phosphorus	:	0.84	1.14

The data observed for plant height of tuberose at different nitrogen and phosphorus presented in Table 3, which clearly indicated that both increasing levels of nitrogen and phosphorus levels significantly increased the plant height in tuberose. Maximum plant height was observed with nitrogen 20 g/m^2 (88.34 and 100.20 cm) as compared to control (75.57 and 86.62 cm), respectively, during both the years of study. Further, interpretation of the data from the Table 4.3, revealed that increased level of phosphorus 10 g/m^2 significantly produced the higher plants (83.48 and 96.83 cm) as compared to control, where no phosphorus had been applied (80.58 and 93.53 cm), respectively, during 2016-17 and 2017-18. The interaction effects between increased levels of nitrogen and phosphorus levels (20 and 10 g/m^2) significantly resulted into taller plants (89.40 and 101.60 cm), respectively. The results confirmed the findings of Devi and Singh[2]; Kour and Sharma.

Table 3: Effect of nitrogen and phosphorus on plant height in tuberose

Nitrogen levels (g/m^2)	**Phosphorus levels (g/m^2)**							
	2016-17				**2017-18**			
	P_0: 0	**P_1: 5**	**P_2: 10**	**Mean**	**P_0: 0**	**P_1: 5**	**P_2: 10**	**Mean**
N_0: 0	74.90	75.60	76.20	**75.57**	82.20	87.27	90.40	**86.62**
N_1: 10	77.13	79.00	82.27	**79.47**	94.87	95.47	96.60	**95.64**
N_2: 15	83.60	84.20	86.07	**84.62**	97.73	97.93	98.73	**98.13**
N_3: 20	86.67	88.97	89.40	**88.34**	99.33	99.67	101.60	**100.20**
Mean	**80.58**	**81.94**	**83.48**		**93.53**	**95.08**	**96.83**	

CD at 5% level of significance	:	**2016-17**	**2017-18**
Nitrogen	:	0.73	0.95
Phosphorus	:	0.63	0.82
Nitrogen x Phosphorus	:	1.26	1.65

Analysis of data given in Table 4 revealed that the length of leaves of tuberose was significantly affected by the nitrogen and phosphorus levels. Maximum length of leaves (43.30 and 42.30 cm) was observed with nitrogen level 20 g/m^2 as compared to control, where no nitrogen was applied (38.43 and 34.09 cm) during both the years, respectively. Increased levels of phosphorus also led to increase the length of leaves and significantly maximum length was observed at 10 g P_2O_5/m^2 i.e. 41.53 and 39.03 cm, respectively, during both the years of study. Further, the analysis of data clearly indicated that the interaction effect between nitrogen and phosphorus affect the length of leaves in tuberose. The length of leaves was significantly higher (45.19 and 44.19 cm) with increased levels of nitrogen (20 g/m^2) and phosphorus (10 g/m^2), respectively, during 2016-17 and 2017-18.

Table 4: Effect of nitrogen and phosphorus on length of leaves in tuberose

Nitrogen levels (g/m^2)	**Phosphorus levels (g/m^2)**							
	2016-17				**2017-18**			
	P_0: 0	**P_1: 5**	**P_2: 10**	**Mean**	**P_0: 0**	**P_1: 5**	**P_2: 10**	**Mean**
N_0: 0	37.44	38.37	39.48	**38.43**	32.43	34.37	35.48	**34.09**
N_1: 10	39.95	39.97	40.22	**40.05**	36.28	36.97	37.22	**36.82**
N_2: 15	40.71	41.00	41.24	**40.98**	38.04	39.00	39.24	**38.76**
N_3: 20	42.12	42.60	45.19	**43.30**	40.12	42.60	44.19	**42.30**
Mean	**40.05**	**40.49**	**41.53**		**36.72**	**38.24**	**39.03**	

CD at 5% level of significance	:	**2016-17**	**2017-18**
Nitrogen	:	0.57	0.60
Phosphorus	:	0.50	0.52
Nitrogen x Phosphorus	:	0.99	1.04

It is evident from the data presented in Table 5. showed that with the increasing levels of nitrogen and phosphorus resulted into increased the number of leaves per clump in tuberose during 2016-17 and 2017-18. Highest numbers of leaves were observed with nitrogen level 20 g /m^2 (48.93 and 49.31) as compared to control, where no nitrogen was applied (39.20 and 37.64), respectively during both the years under study. Further the interpretation of the data revealed that increased levels of phosphorus also increased the number of leaves per clump. Highest numbers of leaves per clump (45.70 and 45.30) were achieved with phosphorus levels at 10 g /m^2 as compared to control where no phosphorus was applied (43.17 and 42.00). Nitrogen and phosphorus interaction significantly increased the number of leaves during both the years. Higher number of leaves (49.20 and 52.40) were recorded in nitrogen (20 g/m^2) with phosphorus (10 g/m^2), respectively, during both the years under study. The Increase in plant height, length of leaves and number of leaves per clump have been reported by Singh *et al*[13], Dhar *et al.*[3], Dahiya *et al.*[1], Yadav *et al.*[15], in tuberose. It is also interesting to know that the nitrogen and phosphorus being constituents of protoplasm affected the chlorophyll contents in leaves which have been stated by Mukhopadhay and Banker[7].

Table 6: Effect of nitrogen and phosphorus on number of leaves per clump in tuberose

Nitrogen levels (g/m^2)	**Phosphorus levels (g/m^2)**							
	2016-17				**2017-18**			
	P_0: 0	**P_1: 5**	**P_2: 10**	**Mean**	**P_0: 0**	**P_1: 5**	**P_2: 10**	**Mean**
N_0: 0	36.07	39.87	41.67	**39.20**	36.13	36.20	40.60	**37.64**
N_1: 10	42.60	43.00	45.27	**43.62**	41.73	41.80	43.07	**42.20**
N_2: 15	45.27	46.53	46.67	**46.16**	43.93	45.07	45.13	**44.71**
N_3: 20	48.73	48.87	49.20	**48.93**	46.20	49.33	52.40	**49.31**
Mean	**43.17**	**44.57**	**45.70**		**42.00**	**43.10**	**45.30**	

CD at 5% level of significance	:	**2016-17**	**2017-18**
Nitrogen	:	0.66	0.70
Phosphorus	:	0.57	0.60
Nitrogen x Phosphorus	:	1.14	1.21

CONCLUSION

The present investigation indicates that nitrogen and phosphorus affects the growth parameters of tuberose. The study revealed that all the parameters were found best when nitrogen at 20 g/m^2 and phosphorus at 10 g/m^2 were applied. Therefore, for better growth of tuberose plants nutrients must be applied as nitrogen at 20 g/m^2 and phosphorus at 10 g/m^2.

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