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Effect of plant spacing and foliar nutrition on growth and physiological parameters of tuberose (*Polianthes tuberose* L.) cultivar Prajwal

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Abstract
The present investigation on the effect of plant spacing and foliar nutrition on growth and physiological parameters of tuberose (*Polianthes tuberose* L.) cultivar Prajwal was carried out in the Department of Floriculture and Landscape Architecture, HC&RI, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu. The experiment was designed following the principle of factorial randomized block design with four spacings (S1-25 x 25, S2- 15 x 20,S3- 15 x15 andS4- 45 x 20 cm) and three foliar nutrition spray (F1 -0.5% N + 0.5% $ZnSO_4$ +0.5%$FeSO_4$+0.1% Boric acid, F2-0.5% $ZnSO_4$+0.5% $FeSO_4$+ 0.1% Boric acid and F3- 0.5% $ZnSO_4$+0.5% $FeSO_4$)consisting of twelve treatment combinations. Each treatment was replicated thrice. The result of the present investigation revealed that among the interaction effects, the highest values was observed for plant height (47.81 cm), number of leaves per plant (40.12), number of tillers/plant (7.70), leaf length (49.50 cm), leaf area (4807.67 cm^2), total chlorophyll content(1.30 mg/g), soluble protein (101.23 mg/g) and nitrate reductase activity (50.06 NO_2 $g^{-1}h^{-1}$) in S4F1 (spacing of 45 x20 cm, foliar application of 0.5%N+0.5%$ZnSO_4$+0.5%$FeSO_4$+0.1%Boric acid) and high leaf width (2.61 cm) was recorded in S4F3 (45 x20 cm, 0.5%$ZnSO_4$+0.5%$FeSO_4$) and the lowest growth and physiological parameters were recorded in S3F3 (spacing of 15 x15 cm, fo;iar application of 0.5% $ZnSO_4$+0.5% $FeSO_4$).

Keywords: Tuberose, spacing, foliar nutrition, growth, physiology

Introduction
Tuberose (*Polianthes tuberosa* L.) belongs to the family Amaryllidaceae is native of Mexico. It is a perennial bulbous ornamental plant well known for its fragrance, attractive spike and high economic value. Tuberose can be successfully cultivated under a wide range of climatic conditions ranging from tropical to sub-tropical regions. It is commercially cultivated for indoor decoration, garlands, bouquets, cut flower trade and oil extraction. The flowers remain fresh for a long time and can withstand long distance transportation. Tuberose are now available in different colours through value addition by dyes. Prajwal is a hybrid between Shringar x Mexican Single which bears single type flowers on tall stiff spikes. This hybrid was released by Indian Institute of Horticultural Research (IIHR), Bangalore. The flower buds are slight pink in colour, while the flowers are white in colour. In 2021, a total area of 20,000 hectars are under tuberose cultivation throughout the nation, it is widely grown in *Tamil Nadu, Karnataka, Maharashtra, Telangana*, Chhattishgrah, Assam, Madhya Pradesh, Uttarakhand and Andhra Pradesh (Indiastat, 2022).

Of the various agricultural practices, plant spacing is the most important criteria influencing plant growth. By increasing the number of plants, we can increase the yield of tuberose flowers. Proper plant spacing is an important practice to provide good open positions for sunlight, moisture availability, and nutrients essential for successful plant production and quality in gladioli (Sanjib *et al*., 2002) [11]. In tuberose, plant spacing has a great importance for manipulating flower quality and quantity characteristics. Therefore, inter and intra row spacing and balanced supply of nutrients are important for obtaining higher tuberose flower quality and quantity (Ahamed Ali Khan, 2016) [1].

Micronutrients administration is essential for healthy plant growth and flowering because flowering crops respond to micronutrients more readily (Jatav *et al*., 2020) [8]. Iron plays a major role in photosynthesis and respiration pertaining to its property of being an oxygen carrier. It is an important micronutrient for plant tissue growth. Zinc participates in synthesis of auxin thus results in enhanced plant growth (Tanvi *et al*., 2017) [7].

Boron is essential for plant growth, new cell division in meristematic tissues, translocation of sugar, starch, nitrogen, phosphorus, certain hormones, synthesis of amino acids and protein, etc. Deficiency of boron causes suppressed flowering (Karuppaiah, 2019) [2]. Foliar spray by direct application on aerial plant parts is an efficient strategy rather than root fertilization to correct micronutrient deficiency symptoms, maintain nutritional status and enhance growth and produce quality in marginal soils (Otalora *et al*., 2018).

Keeping the above mentioned importance of tuberose, the present study was designed to find out the suitable plant spacing and foliar nutrition for the growth of tuberose.

Materials and Methods

The study on "Effect of plant spacing and foliar nutrition on growth and physiological parameters of tuberose (*Polianthes tuberose* L.) Cultivar Prajwal" was carried out in the Department of Floriculture and Landscape Architecture, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu during 2021-2022. Bulbs of tuberose cv. Prajwal was obtained from the farmer's field at Dharmapuri district, Tamil Nadu. The experiment consisted of four spacing (25 x 25, 15 x 20, 15 x15 and 45 x 20 cm) and three combinations of foliar spray (0.5%N+0.5% $ZnSO_4$+0.5% $FeSO_4$+0.1% Boric acid, 0.5% $ZnSO_4$+0.5% $FeSO_4$+ 0.1% Boric acid and 0.5% $ZnSO_4$+0.5% $FeSO_4$).The twelve treatment combinations of four levels of spacing and three levels of foliar spraying were randomly allocated in factorial randomized block design replicated three times. Half dose of nitrogen with full dose of FYM @ 5 kg/m2, P2O5 @ 20 g/m2 K2O and 20 g/m2 was applied at the time of field preparation as basal dose and other half dose of nitrogen at the time of spike emergence by top dressing method. Foliar spray of nutrition was done at 60,90 and 120 days after planting. The field was brought to fine tilth by ploughing and harrowing, the beds of 1.5 x 1m^2 area was prepared. Uniform sized bulbs were selected and planted at uniform depth. In each replication, five plants were tagged for observation leaving border rows. Data pertaining to vegetative characters such as plant height, leaf length, leaf width, number of side shoots and leaves, were recorded. Leaf area was measured using Leaf Area Meter (Licor Model 3100) and expressed as cm^2 $plant^{-1}$.Chlorophyll was estimated using acetone method (Arnon, 1949) and expressed as mg g^{-1}. Soluble protein content was estimated with tricarboxylic acid extract of leaf sample using Lowery's method (Lowery *et al*., 1957) [4] and expressed in milligrams per gram (mg g^{-1}) of fresh weight. The nitrate reductase activity of leaf samples were estimated using the method described by Sinha and Nicholas (1981) [13]. The values were expressed as µg NO_2 $g^{-1}h^{-1}$ on wet weight basis. The statistical analysis of the data was done by adopting the standard statistical procedure given by Panse and Sukhatme (1995) [9] at a critical difference of five per cent (P=0.05) probability.

Result and Discussion

Effect of plant spacing and foliar nutrition on growth parameters: It is evident from table 1a and 1 b. that the plant height, number of leaves per plant, number of tillers per plant and leaf length increases significantly with increased spacing. Wider spacing S4 (45 x 20cm) produced taller plants (38.93cm) with more number of leaves (32.06) and more number of tillers per plant(7.36) compared to plants that were planted at a closer spacing S3 (15x15 cm). Foliar spray, F1(0.5% N+0.5% $ZnSO_4$+0.5% $FeSO_4$+0.1% Boric acid) resulted in higher plant height (40.59 cm) with maximum number of leaves (33.30) and more number of tillers per plant(5.59) whereas,F3 (0.5%$ZnSO_4$+0.5%$FeSO_4$) resulted in comparatively lower plant height(38.93 cm) with less number of leaves(31.07) and minimum number of tillers per plant (4.86). The interaction effects of plant spacing and foliar nutrition were found significant. The interaction effect between spacing and foliar nutrition on plant height(47.81 cm), number of leaves per plant (40.12) and number of tillers/plant (7.70) were high in treatment S4F1 (45 x20 cm, 0.5%N+0.5%$ZnSO_4$+0.5%$FeSO_4$+0.1%Boric acid) and the least plant height(33.67 cm) was observed in S2F3 (15 x20 cm, 0.5%$ZnSO_4$+0.5%$FeSO_4$), number of leaves and tillers were found to be minimum in treatment S3F3(15 x15 cm, 0.5%$ZnSO_4$+0.5%$FeSO_4$) with 25.5 and 3.29,respectively.

Table 1a: Effect of plant spacing and foliar nutrition on plant height (cm) and number of leaves/plant in tuberose

Plant height(cm)					Number of leaves/plant				
	F1	F2	F3	MEAN		F1	F2	F3	MEAN
S1	38.25	40.83	36.35	38.47	S1	35.00	33.00	32.00	33.34
S2	39.55	34.33	33.67	35.84	S2	30.00	28.00	29.00	29.00
S3	36.75	35.89	36.80	36.48	S3	28.00	27.70	25.50	27.07
S4	47.81	41.77	45.23	44.93	S4	40.21	38.47	37.79	38.82
MEAN	40.59	38.21	38.01	38.93	MEAN	33.30	31.79	31.07	32.06
	S	F	S*F			S	F	S*F	
SED	0.413	0.358	0.716		SED	0.449	0.389	0.778	
CD @5%	0.857	0.742	1.485		CD@5%	0.932	0.807	1.614	

Table 1b: Effect of plant spacing and foliar nutrition on number of tillers/plant and leaf length (cm) in tuberose

Number of tillers/plant					Leaf length (cm)				
	F1	F2	F3	MEAN		F1	F2	F3	MEAN
S1	6.18	5.65	5.25	5.69	S1	42.40	41.84	41.28	41.84
S2	4.74	4.36	3.94	4.35	S2	37.68	38.36	36.21	37.41
S3	3.75	3.52	3.29	3.52	S3	35.59	33.67	34.33	34.53
S4	7.70	7.41	6.97	7.36	S4	49.50	43.39	45.76	46.22
MEAN	5.59	5.24	4.86	5.23	MEAN	41.29	39.31	39.39	40.00
	S	F	S*F			S	F	S*F	
SED	0.048	0.041	0.083		SED	0.427	0.370	0.740	
CD @5%	0.099	0.086	0.171		CD@5%	0.886	0.768	1.536	

The data on leaf length, leaf width and leaf area was influenced by different spacing and foliar nutrition on tuberose are presented in table 1b-1c.Among the four spacing, S4 (45 x 20 cm) recorded highest leaf length, leaf width and leaf area (46.22 cm, 2.51 cm and 4423.29 cm^2) followed by S1 (25 x25 cm) with (41.84cm, 2.11 cm and 29678.78 cm2) respectively. Among the foliar nutrition F1(0.5%N+ 0.5%$ZnSO_4$+ 0.5%$FeSO_4$+ 0.1%Boric acid) recorded highest leaf length and leaf area (41.29cm and 2968.61 cm2) and F3(0.5%$ZnSO_4$+ 0.5%$FeSO_4$) recorded highest leaf width (2.13 cm).The interaction effect between plant spacing and foliar nutrition showed that the treatment combination S4F1 (45 x20 cm, 0.5%N +0.5%$ZnSO_4$+0.5%$FeSO_4$+0.1%Boric acid) recorded the highest leaf length and leaf area(49.50 cm and 4807.67 cm^2) respectively, and the treatment combination S4F3 (45 x20 cm, 0.5%$ZnSO_4$+0.5%$FeSO_4$) recorded highest leaf width (2.61 cm).The lowest leaf length and leaf width was recorded in S3F2 (15 x15 cm, 0.5%$ZnSO_4$+0.5%$FeSO_4$+0.1%Boric acid) with 33.67cm and 1.64 cm respectively and the lowest leaf area was recorded in S3F3 (15 x15 cm, 0.5%$ZnSO_4$+0.5%$FeSO_4$) with 1482.20 cm^2. Planting density has an impact on plant canopy growth through light absorption. Increased plant spacing will increase light absorption and solar energy conversion, which may account for variations in plant height and the number of side shoots per plant at various spacings. This is in line with the findings of Sudhagar *et al*., (2019) [19] in tuberose. In tuberose, Yadav *et al*. (2005) [18] found that wide row spacing led to significantly more leaves and leaf area per plant due to increased lateral plant spread and decreased competition for moisture, nutrients, and light.

Table 1c: Effect of plant spacing and foliar nutrition on leaf width (cm) and leaf area (cm^2) in tuberose

Leaf Width (cm)					Leaf area (cm^2/plant)				
	F1	**F2**	**F3**	**MEAN**		**F1**	**F2**	**F3**	**MEAN**
S1	2.11	2.03	2.2	2.11	S1	3150.27	2885.97	2870.10	2968.78
S2	1.8	1.9	2	1.9	S2	2043.90	2001.47	2161.07	2068.81
S3	1.8	1.64	1.72	1.72	S3	1872.60	1513.37	1482.20	1622.72
S4	2.42	2.5	2.61	2.51	S4	4807.67	4144.07	4318.13	4423.29
MEAN	2.03	2.01	2.13	2.06	MEAN	2968.61	2636.22	2707.88	2770.90
	S	F	S*F			S	F	S*F	
SED	0.023	0.02	0.04		SED	30.933	26.789	53.577	
CD @5%	0.0485	0.042	0.084		CD @5%	64.151	55.556	111.113	

Effect of plant spacing and foliar nutrition on physiological parameters

The leaf chlorophyll content is an important physiological factor as it directly influences the photosynthesis and it occurs in chloroplast as green pigments in all photosynthetic plant tissues. The ability of the plant to use the absorbed solar radiation for the creation of dry matter is also regarded as a measure of its metabolic efficiency. Chlorophyll is a group of pigments that converts sun energy into chemical energy. The amount of soluble protein in a crop plant has a significant impact on how effectively it can photosynthesize. Proteins that are soluble are also a sign of higher levels of carboxylation during a plant's active growth phase. The "N assimilation" pathway is regarded as the primary process in plants for converting inorganic form into an organic form that is physiologically beneficial. The enzyme "Nitrate reductase" catalyses the conversion of nitrate to nitrite, which is the first step in "N assimilation" (NRase). The nitrite reductase enzyme successively converts nitrite to ammonia, which is then integrated into amino acids. Growth and yields are frequently connected with the activity of NRase in plants, which provides a good measure of the metabolic condition of plants (Srivastava, 1980). The "Nitrate reductase" activity has been regarded as a key element in enhancing the crop's "nitrogen usage efficiency" and, consequently, its capacity to produce. The data on physiological parameters as influenced by different spacing and foliar nutrition on tuberose are presented in table. 2a - 2b.It is evident from the data that the total chlorophyll content, soluble protein and Nitrate reductase activity increases significantly with increased spacing. Among the spacings S4 (45 x 20 cm) recorded the highest total chlorophyll content, soluble protein and nitrate reductase activity of 1.09 mg/g,99.82 mg/g and 49.97 NO_2 $g^{-1}h^{-1}$ followed by S1 (25 x 25 cm) with 0.85 mg/g, 87.1 mg/g and 45.20 NO_2 $g^{-1}h^{-1}$ respectively. Among the foliar nutritions F1(0.5%N+0.5%$ZnSO_4$+0.5%$FeSO_4$+0.1% Boric acid) recorded the maximum chlorophyll content, soluble protein and nitrate reductase activity of 0.98 mg/g, 89.5 mg/g and 45.48 NO_2 $g^{-1}h^{-1}$ and minimum on F3 (0.5%$ZnSO_4$+0.5% $FeSO_4$) with 0.84 mg/g, 82.03 mg/g and 44.37 NO_2 $g^{-1}h^{-1}$, respectively. The interaction effect between plant spacing and foliar nutrition showed that the treatment combination S4F1 (45 x20 cm, 0.5%N +0.5%$ZnSO_4$+0.5%$FeSO_4$+0.1%Boric acid) recorded the highest total chlorophyll content, soluble protein and nitrate reductase activity of 1.30 mg/g, 101.23 mg/g and 50.06 NO_2 $g^{-1}h^{-1}$ and the lowest on S3F3 (15 x15 cm, 0.5%$ZnSO_4$+0.5%$FeSO_4$) with 0.74 mg/g, 71.8mg/g and 41.02 NO_2 $g^{-1}h^{-1}$, respectively. As reported by Sharma and Gupta (2003) in gladiolus, wider spacing allows plants more space to absorb more nutrients from the soil and less competition between the plants for nutrients, moisture, and light may have helped in increased photosynthetic activities.

Table 2a: Effect of plant spacing and foliar nutrition on total chlorophyll content (mg/g) and soluble protein (mg/g) in tuberose

Total chlorophyll content(mg/g)					Soluble protein(mg/g)				
	F1	**F2**	**F3**	**MEAN**		**F1**	**F2**	**F3**	**MEAN**
S1	0.89	0.81	0.83	0.85	S1	94.9	87.3	79.1	87.1
S2	0.91	0.87	0.83	0.87	S2	85.5	81.39	77.5	81.46
S3	0.82	0.79	0.74	0.78	S3	76.4	74.47	71.8	74.22
S4	1.3	1.006	0.98	1.09	S4	101.23	98.52	99.72	99.82

MEAN	0.98	0.87	0.84	0.9	MEAN	89.5	85.42	82.03	85.65
	S	F	S*F			S	F	S*F	
SED	0.01	0.008	0.017		SED	0.983	0.851	1.703	
CD @5%	0.021	0.018	0.036		CD @5%	2.039	1.766	3.532	

Table 2b: Effect of plant spacing and foliar nutrition on Nitrate reductase activity NO_2 $g^{-1}h^{-1}$ in tuberose

Nitrate Reductase Activity (NO_2 $g^{-1}h^{-1}$)				
	F1	**F2**	**F3**	**MEAN**
S1	45.43	45.63	44.56	45.20
S2	44.49	43.69	43.04	43.74
S3	41.96	42.39	41.02	41.79
S4	50.06	49.76	48.89	49.57
MEAN	45.48	45.36	44.37	45.07
	S	F	S*F	
SED	0.447	0.387	0.775	
CD @5%	0.928	0.804	1.608	

The widest spacing recorded the highest amount of NRase activity. Photosynthesis and soluble protein, the relation between NRase activity and yield is linked to the specific growth phases based on their relationship, Sinha and Swaminathan (1984) considered that the NRase activity could be used as an indirect and reliable selection criterion for yield in many crop plants raised with wider spacing.

Conclusion

Different plant spacing and foliar nutrition spray significantly affected growth and physiological parameters in tuberose. A rise in plant spacing and judicious supply of nutrients increased plant height, number of leaves per plant, number of tillers per plant, leaf area, total chlorophyll, soluble protein and Nitrate Reductase activity. From these results it can be concluded that tuberose e planted at a wider spacing of 45 x 20 cm with a foliar nutrition spray (0.5%N +0.5%$ZnSO_4$+0.5%$FeSO_4$+0.1%Boric acid resulted in improved growth characteristics.

Reference

1. Ali-Khan A, Ibadullah Jan, Junaid Khan, Haneef Raza, Jawad Ahmad, Ahmad J. The effect of bulb size and plant spacing on the growth and flowering of tuberose. Am Eurasian J Agric Environ Sci. 2016;16(4):694-697.
2. Karuppaiah P. Effect of zinc and boron on growth, yield and quality of tuberose (*Polianthes tuberosa* L.) cv. Prajwal. Horticulture International Journal. 2019;3:10. 15406/hij.2019.03.00104.
3. Khalaj, Mohammad, Edrisi, Behzad. Effect of plant spacing and nitrogen levels on quantity and quality characteristics of tuberose (*Polianthes tuberosa* L.) under field experiment. 2012;2:244-255.
4. Lowery OH, Brought NTR, Farr LA, Randall RJ. Protein measurement with folin phenol reagent. J Biol. Chem. 1957;193:265-275.
5. Malam VR, Singh SP, Ahlawat TR, Mathukia RK, Giriraj Jat. Effect of spacing and crop duration on growth, flowering and bulb production in tuberose (*Polianthes tuberosa* L.) cv. Double. Journal of Horticultural Sciences. 2010;5(2):134-137.
6. Malam VR, Singh SP, Ahlawat TR, Mathukia RK. Effect of spacing and crop duration on growth and flowering in tuberose (*Polianthes tuberosa* Linn.) cv. double. Progressive Agriculture. 2010;10(3):131-133.
7. Mudassir, Sana, Riaz Ahmad, Muhammad Akbar Anjum. Foliar Application of Micronutrients Enhances Growth, Flowering, Minerals Absorption and Postharvest Life of Tuberose (*Polianthes tuberosa* L.) in Calcareous Soil. J Hortic. Sci. Technol. 2021;4:41-47.
8. Niu, Junhao, Liu, Chang Huang, Mingli Liu, Kezhong Yan, Dongyun. Effects of Foliar Fertilization: a Review of Current Status and Future Perspectives. Journal of Soil Science and Plant Nutrition. 2020;21:1-15.
9. Panse VG, Sukhatme PV. Statistical Methods for Agricultural Workers. ICAR, New Delhi, 1995, pp.359
10. Roth-Bejerano N, Lips H. Hormonal regulation of nitrate reductase activity in leaves. New Phytol. 1970;69:165-169.
11. Sanjib S, Talukdar MC, Sharma S, Misra RL, Sanyat M. Effect of time, spacing and depth of planting on gladiolus. Floriculture Research Trend in India. 2002;7:243-245.
12. Sharma JR, Gupta RB. Effect of corm size and spacing on growth, flowering and corm production in gladiolus. J Orn. Hort. 2003;6(4):352-356.
13. Sinha SK, Nicholas JD. Nitrate reductase in Paleg, L.G. and D. Aspinall (Eds.). The physiology and biochemistry of drought resistance in plants. Academic press, Australia, 1981, pp. 145-168.
14. Sinha SK, Swaminathan MS. New parameters and selection criteria in plant breeding. In Vose, P.B. and S.G. Blixt (eds). Crop breeding, a contemporary basis. Pergamon press, oxford, 1984, pp. 1-31.
15. Sudhagar R, Karthikeyan I, Kamalakannan S, Kumar S, Venkatesan S. Effect of spacing and zinc application on growth parameters of tuberose (*Polianthes tuberosa* L.) cv. Single. Plant Archives. 2019;19(2):3620-3622.
16. Srivastava HS. Regulation of nitrate reductase activity in higher plants. Phytochem. 1980;19:725-733.
17. Tanvi D Patel, Dr. RR Viradia, Tejashwini CR, Hetvi V Patel, Unnati R Patel. Studies on effect of foliar application of micronutrient (Fe &Zn) on growth, flowering quality and yield of tuberose (*Polianthes tuberosa* L.) CV, Prajwal. Int J Chem Stud. 2017;5(6):93-97.
18. Yadav BS, Gupta AK, Sukhbir Singh. Studies on the effect of nitrogen, plant spacing and biofertilizers on growth parameters in tuberose cv. Double. Haryana J Hort. Sci. 2005;34(1-2):78-80.
19. Yadav BS, Ahlawat VP, Sehrawat SK. Effect of nitrogen and zinc on growth and spike production of tuberose. Haryana J Hort. Sci. 2003;32(3&4):216-218.
20. www.indiastat.com