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Studies on effect of foliar application of micronutrient (Fe & Zn) on growth, flowering quality and yield of tuberose (*Polianthes tuberosa* L.) CV. Prajwal

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Abstract
The investigation entitled "Studies on effect of foliar application of micronutrient (Fe & Zn) on growth, flowering quality and yield of tuberose (*Polianthes tuberosa* L.) cv. Prajwal" was conducted at Lal Baug Farm, Department of Horticulture, Junagadh Agricultural University, Junagadh (Gujarat) during March 2016 to February 2017. The experiment was laid out in Factorial Randomized Block Design (FRBD) with three replications and fifteen treatment combinations. The treatment comprised of five levels of ferrous sulphate (control *i.e.* water spray, 0.5%, 1.0%, 1.5% and 2.0%) and three levels of zinc sulphate (control *i.e.* water spray, 0.25% and 0.5%) were sprayed at 45, 60, 90 and 120 DAP. The results revealed that foliar application of $FeSO_4$ @ 2.0 % + 0.1 % C.A and $ZnSO_4$ @ 0.5 % + 0.1 % $CaCO_3$ recorded significantly maximum growth parameters in respect of plant height at 90 DAP (83.26 cm & 78.44 cm) at 120 DAP (88.66 cm & 82.95 cm), number of leaves per plant (34.25 & 33.85), fresh weight (380.12 g & 361.92 g) and dry weight (69.15 g & 63.15 g) of plant, flower quality in respect of florets diameter (4.16 cm & 4.13 cm) and vase life of spike (8.23 days & 8.10 days) and yield in respect of total number of spike per plant (4.02 & 4.00), total number of spike per net plot (48.24 & 48.00) and total number of spike per hectare (4.46 Lacs & 4.44 Lacs). However, interaction effect of zinc sulphate and iron sulphate on flower quality parameters of tuberose was found to be significant *viz.*, length of flower spike (144.53 cm), rachis length (43.33 cm &), number of florets per spike (43.07), *in-situ* longevity of spike (19.87 days).

Keywords: Ferrous sulphate, Zinc sulphate, Micronutrient, Tuberose, Prajwal

1. Introduction
Tuberose is a perennial bulbous flowering plant belonging to the genus *Polianthes* and family Amaryllidaceae. Tuberose occupies a very selective and special position to flower loving people because of its prettiness, elegance, long vase life and sweet fragrance. It has a great economic potential for cut flower trade and essential oil industry (Sadhu and Bose, 1973) [14]. Its origin is mexico. Tuberose can be available now in different delightful colors through value addition by edible dies (Dhaduk and Naik, 2003) [3]. They are source of fragrant oil used in the preparation of various high quality perfumes and cosmetics. There are four types of tuberose: "Sinle"-with one row of corolla segments, "Semi-double"- bearing with two to three rows of corolla segments and "Double"- having more than three rows of corolla segments. The "Variegated type" with golden and silver striped leaf margin is very attractive and suitable for the beautification of gardens. "Prajwal" this hybrid which bears single type flowers on tall stiff spikes is a cross between 'Shringar' x 'Mexican Single'. The hybrid was released by Indian Institute of Horticultural Research (IIHR), Bangalore. The flower buds are slightly pinkish in colour, while the flowers are white. Flowering bulbous plants require macro and micronutrients for quality growth, flowering and bulb production.
Recently, use of micronutrients essentially in fertilization of plants is gaining momentum due to their potentiality to enhance plant growth, flowering and yield. But the deficiency of micronutrients especially iron and zinc is a major problem in most of the developing countries in the world (Sharma *et al.*, 2014) [17]. The deficiency of micronutrients results in different physiological abnormalities like chlorosis, rosetting and scorching etc. (Singh *et al.*, 2012) [18]. Iron is associated with formation of chlorophyll and acts as a catalyst in several reactions in

plant metabolism. It plays a key role in photosynthesis and respiration pertaining to its property of being an oxygen carrier. Iron is also the most important element of all the micronutrients for plant tissue growth (George and Manuel 2013) [8]. Zinc participates in synthesis of auxins and hence, enhances plant growth (Sarwar *et al.*, 2012) [15]. It is also involved in carbon dioxide evolution, carbohydrate and phosphorus metabolism and synthesis of RNA. Foliar spray of iron and zinc is one of the best methods for rectifying their deficiency (Woltz, 1972) [19]. Not much work has been done on the aspect regarding effect of zinc and iron on flower quality, yield and bulb parameter particularly in tuberose. Therefore, this study was undertaken with objective to find out the response of Tuberose cv. 'Prajwal' to different doses of zinc and iron.

Materials and Methods

The experiment was carried out the Lal Baug Farm, Department of Horticulture, Junagadh Agricultural University, Junagadh (Gujarat) during March 2016 to February 2017. Healthy and disease free bulbs of tuberose were planted at a spacing of 30 cm × 30 cm in individual plot size of 1.5 × 1.8 m^2. Pre-harvest treatments of zinc sulphate and iron sulphate were given, individually and in different combinations. The experiment was laid out in Factorial Randomized Block Design (FRBD) with three replications and fifteen treatment combinations. The treatment comprised of five levels of ferrous sulphate viz., FeSO4 @ 0.0% (F1) (water spray), FeSO4 @ 0.5% + 0.1 % C.A (F2), FeSO4 @ 1.0 % + 0.1 % C.A (F3), FeSO4 @ 1.5 % + 0.1 % C.A (F4), FeSO4 @ 2.0 % + 0.1 % C.A (F5) and three levels of zinc sulphate *viz.*, ZnSO4 @ 0.0 % (Z1) (water spray), ZnSO4 @ 0.25 % + 0.1 % CaCO3 (Z2) and ZnSO4 @ 0.5 % + 0.1 % CaCO3 (Z3) were sprayed at 45, 60, 90 and 120 DAP. All the cultural operations like weeding; plant protection, etc. were practiced when required. Various growth parameters like plant height, number of leaves per plant, fresh and dry weight of plant, flower quality parameters such as length of flower spike, rachis length, floret diameter, number of florets per spike, *in-situ* longevity of spike and vase life of spike and yield parameters such as total number of spike per plant, total number of spike per net plot and total number of spike per hectare were recorded from the treated plants and statistically analyzed.

Results and Discussion

Growth Parameters

Data revealed in Table-1 clearly indicated that foliar spray of zinc sulphate and iron sulphate was effective in influencing various growth parameters such as plant height, number of leaves per plant, fresh and dry weight of plant. Significantly maximum plant height (90 & 120 days after planting), number of leaves per plant, fresh and dry weight of plant in tuberose were recorded with the application of FeSO4 @ 2.0 % (83.26 cm & 88.66 cm, 34.25, 380.12 g, and 69.15 g respectively). Similarly, ZnSO4 @ 0.5 % + 0.1 % CaCO3 significantly the maximum height (90 & 120 days after planting), number of leaves per plant, fresh and dry weight of plant (78.44 cm & 82.95 cm, 33.85, 361.92 g, and 63.15 g respectively) as compared to other treatments. Treatment combination of FeSO4 1.5 % + 0.1 % C.A + ZnSO4 @ 0.5 % + 0.1 % CaCO3 resulted non-significant. This might be due to iron applied with proper concentration acts as a important catalyst in the enzymatic reaction of metabolism. This ultimately would have helped in larger biosynthesis of photoassymilates, thereby enhanced vegetative growth of plant. Similarly, zinc applied at optimum concentration is closely involved in metabolism of RNA and ribosomal content in plant cell, which leads to stimulation of carbohydrates, proteins and DNA formation. It also helps in synthesis of tryptophan which acts as a growth promoting substance. The results could paint in the same direction of Kumar *et al*. (2001a) [10] in tuberose, Balakrishnan (2005) and Jat *et al*. (2007) [9] in marigold and Lahije (2012) [11] and Memon *et al.*, (2013) [13] in gladiolus.

Table 1: Effect of iron and zinc on growth of tuberose (*Polianthes tuberosa* L.) CV. 'Prajwal'

Treatments	Plant height (cm)			Number of leaves per plant	Fresh weight of the plant (g)	Dry weight of the plant (g)
	60 DAP	90 DAP	120 DAP			
Level of $FeSO_4$ (Fe)						
F_1- $FeSO_4$ @ 0.0 %	50.11	70.19	75.11	32.69	299.26	55.24
F_2- $FeSO_4$ @ 0.5 % + 0.1 % C.A	53.59	73.69	77.76	32.82	334.82	59.16
F_3- $FeSO_4$ @ 0.1 % + 0.1 % C.A	58.41	78.31	82.27	33.04	361.92	66.10
F_4- $FeSO_4$ @ 1.5 % + 0.1 % C.A	61.88	81.19	86.38	33.19	367.14	67.47
F_5- $FeSO_4$ @ 2.0 % + 0.1 % C.A	63.95	83.26	88.66	34.25	380.12	69.15
S.Em.±	0.84	1.43	1.39	0.09	6.56	1.17
C.D. at 5 %	NS	4.20	4.08	0.29	19.24	3.45
Level of $ZnSO_4$ (Zn)						
Z_1- $ZnSO_4$ @ 0.0	53.60	73.88	77.72	32.96	320.92	57.30
Z_2- $ZnSO_4$ @ 0.25 % + 0.1 % $CaCO_3$	55.83	75.21	80.47	33.80	339.51	60.37
Z_3- $ZnSO_4$ @ 0.5 % + 0.1 % $CaCO_3$	58.06	78.44	82.95	33.85	361.92	63.15
S.Em.±	0.73	1.24	1.21	0.07	5.68	1.01
C.D. at 5 %	NS	3.64	3.54	0.24	16.68	2.98
Interaction (Fe X Zn)	NS	NS	NS	NS	NS	NS
CV %	11.12	10.98	7.82	9.44	5.81	5.99

Flowering Quality Parameters

Data revealed in Table 2 to 6 clearly indicated that foliar spray of combination of zinc sulphate and iron sulphate was effective in influencing various flower quality parameters such as length of flower spike, rachis length, florets diameter, number of florets per spike, *in-situ* longevity of spike and vase life of spike. Significantly maximum florets diameter and vase life of spike in tuberose were recorded with the application of FeSO4 @ 2.0 % + 0.1 % C.A (4.16 cm and 8.23 days, respectively). Similarly, ZnSO4 @ 0.5 % + 0.1 % CaCO3 significantly the maximum florets diameter and vase life of spike (4.13 cm and 8.01 days, respectively) as compared to other treatments. Treatment combination of FeSO4 1.5 % + 0.1 % C.A + ZnSO4 @ 0.5 % + 0.1 % CaCO3 resulted into maximum length of flower spike (144.53 cm), rachis length (43.33 cm), number of florets per spike

(43.07) and *in-situ* longevity of spike (19.87 days).This might be due to FeSO4 and ZnSO4 enhanced growth and development of plant. Zinc favours the storage of more carbohydrates through photosynthesis and iron involves in synthesis of plant hormones and also plays an important role in chlorophyll synthesis, photosynthesis and respiration. This may be the attributing factor for the positive effectiveness of optimum dose of zinc and iron on reducing juvenile phase of the plant. Similar results are also obtained by Ganesh *et al.* (2013) [5] in tuberose, Fahad *et al.* (2014) [4] in gladiolus and Balkrishnan *et al*. (2007) [1] in African marigold.

Table 2: Effect of iron and zinc on floret diameter (cm) and vase life of spike (days) of tuberose (*Polianthes tuberosa* L.) cv. 'Prajwal'

Treatments	Floret diameter (cm)	Vase life of spike (Days)
Level of $FeSO_4$ (Fe)		
F_1- $FeSO_4$ @ 0.0 %	3.25	6.00
F_2- $FeSO_4$ @ 0.5 % + 0.1 % C.A	3.64	6.61
F_3- $FeSO_4$ @ 0.1 % + 0.1 % C.A	3.93	6.89
F_4- $FeSO_4$ @ 1.5 % + 0.1 % C.A	4.08	8.05
F_5- $FeSO_4$ @ 2.0 % + 0.1 % C.A	4.16	8.23
S.Em.±	0.12	0.02
C.D. at 5 %	0.40	0.60
Level of $ZnSO_4$ (Zn)		
Z_1- $ZnSO_4$ @ 0.0	3.53	6.93
Z_2- $ZnSO_4$ @ 0.25 % + 0.1 % $CaCO_3$	3.67	7.38
Z_3- $ZnSO_4$ @ 0.5 % + 0.1 % $CaCO_3$	4.13	8.01
S.Em.±	0.16	0.17
C.D. at 5 %	0.46	0.52
Interaction (Fe X Zn)	NS	NS
CV %	11.93	11.81

Table 3: Effect of iron and zinc on length of flower spike (cm) of tuberose (*Polianthes tuberosa* L.) cv. 'Prajwal'

Zn / Fe	**Z_1- $ZnSO_4$ @ 0.0 %**	**Z_2- $ZnSO_4$ @ 0.25 % + 0.1 % $CaCO_3$**	**Z_3- $ZnSO_4$ @ 0.5 % + 0.1 % $CaCO_3$**
F_1-$FeSO_4$ @ 0.0 %	128.61	130.80	136.63
F_2-$FeSO_4$ @ 0.5 % + 0.1 % C.A	130.07	133.33	137.00
F_3-$FeSO_4$ @ 0.1 % + 0.1 % C.A	133.93	136.13	137.33
F_4-$FeSO_4$ @ 1.5 % + 0.1 % C.A	136.93	137.33	144.53
F_5-$FeSO_4$ @ 2.0 % + 0.1 % C.A	141.53	140.93	138.20
S.Em.±	1.66	C.D. (P=0.05)	4.88

Table 4: Effect of iron and zinc on rachis length (cm) of tuberose (*Polianthes tuberosa* L.) cv. 'Prajwal'

Zn / Fe	**Z_1- $ZnSO_4$ @ 0.0 %**	**Z_2- $ZnSO_4$ @ 0.25 % + 0.1 % $CaCO_3$**	**Z_3- $ZnSO_4$ @ 0.5 % + 0.1 % $CaCO_3$**
F_1-$FeSO_4$ @ 0.0 %	27.60	29.78	35.61
F_2-$FeSO_4$ @ 0.5 % + 0.1 % C.A	29.05	32.31	36.0
F_3-$FeSO_4$ @ 0.1 % + 0.1 % C.A	34.90	35.10	36.31
F_4-$FeSO_4$ @ 1.5 % + 0.1 % C.A	35.89	36.30	43.33
F_5-$FeSO_4$ @ 2.0 % + 0.1 % C.A	40.52	39.91	37.93
S.Em.±	1.65	C.D. (P=0.05)	4.89

Table 5: Effect of iron and zinc on number of florets per spike of tuberose (*Polianthes tuberosa* L.) cv. 'Prajwal'

Zn / Fe	**Z_1- $ZnSO_4$ @ 0.0 %**	**Z_2- $ZnSO_4$ @ 0.25 % + 0.1 % $CaCO_3$**	**Z_3- $ZnSO_4$ @ 0.5 % + 0.1 % $CaCO_3$**
F_1-$FeSO_4$ @ 0.0 %	29.00	33.40	35.68
F_2-$FeSO_4$ @ 0.5 % + 0.1 % C.A	29.07	35.67	36.87
F_3-$FeSO_4$ @ 0.1 % + 0.1 % C.A	37.00	34.13	40.34
F_4-$FeSO_4$ @ 1.5 % + 0.1 % C.A	38.40	40.60	43.07
F_5-$FeSO_4$ @ 2.0 % + 0.1 % C.A	42.60	40.73	40.93
S.Em.±	1.63	C.D. (P=0.05)	4.77

Table 6: Effect of iron and zinc on *In-situ* longevity of spike (days) of tuberose (*Polianthes tuberosa* L.) cv. 'Prajwal'

Zn / Fe	**Z_1- $ZnSO_4$ @ 0.0 %**	**Z_2- $ZnSO_4$ @ 0.25 % + 0.1 % $CaCO_3$**	**Z_3- $ZnSO_4$ @ 0.5 % + 0.1 % $CaCO_3$**
F_1-$FeSO_4$ @ 0.0 %	11.00	12.80	14.13
F_2-$FeSO_4$ @ 0.5 % + 0.1 % C.A	11.69	14.05	16.80
F_3-$FeSO_4$ @ 0.1 % + 0.1 % C.A	14.08	17.78	18.80
F_4-$FeSO_4$ @ 1.5 % + 0.1 % C.A	16.92	17.47	19.87
F_5-$FeSO_4$ @ 2.0 % + 0.1 % C.A	18.34	18.82	17.20
S.Em.±	0.85	C.D. (P=0.05)	2.50

Yield Parameters

The yield parameters *viz.* total number of spike per plant, total number of spike per net plot and total number of spike per hectare were recorded significantly maximum with the application of $FeSO_4$ @ 2.0 % + 0.1 % C.A (4.02, 48.24 and 4.46, respectively) and $ZnSO_4$ @ 0.5 % + 0.1 % $CaCO_3$ (4.00, 48.00 and 4.44, respectively) (Table 6). Whereas, 0 % each of zinc and iron *i.e.* water spray (control treatment) noted minimum yield in terms of total number of spike per plant, total number of spike per net plot and total number of spike per hectare. This might be due to the fact that, zinc activates several enzymes *viz.* catalyase, tryptophan synthate etc. and involves itself in chlorophyll synthesis and various physiological activities by which plant growth and development are encouraged, due to which the flower yield might have been increased. The findings are in agreement with the results obtained by Jat *et al.* (2007) [9] in African marigold, Sharma *et al.* (2013) [16] in gladiolus and Ganga *et al.* (2009) in orchid. Similarly, iron enhanced the flowering parameters, relived the plant from chlorosis and produced healthy green leaves which resulted in higher assimilate synthesis and partitioning of flower growth which may in turn have increased the flower production and ultimately yield. Similar results were also reported by Balkrishnan *et al.* (2007) [1] in marigold and Ganga *et al.* (2008) in chrysanthemum, Barman and Pal (1993) and Munikrishnappa *et al*. (2002).

Table 7: Effect of iron and zinc on yield of tuberose (*Polianthes tuberosa* L.) cv. 'Prajwal'

Treatments	Total number of spike per plant	Total number of spike per net plot	Number of spike per hectare (Lakh No.)
Level of $FeSO_4$ (Fe)			
F_1- $FeSO_4$ @ 0.0 %	3.00	36.00	3.33
F_2- $FeSO_4$ @ 0.5 % + 0.1 % C.A	3.50	42.00	3.88
F_3- $FeSO_4$ @ 0.1 % + 0.1 % C.A	3.74	44.88	4.15
F_4- $FeSO_4$ @ 1.5 % + 0.1 % C.A	3.90	46.80	4.33
F_5- $FeSO_4$ @ 2.0 % + 0.1 % C.A	4.02	48.24	4.46
S.Em.±	0.09	1.10	0.10
C.D. at 5 %	0.26	3.06	0.29
Level of $ZnSO_4$ (Zn)			
Z_1- $ZnSO_4$ @ 0.0	3.11	37.32	3.45
Z_2- $ZnSO_4$ @ 0.25 % + 0.1 % $CaCO_3$	3.60	43.20	4.00
Z_3- $ZnSO_4$ @ 0.5 % + 0.1 % $CaCO_3$	4.00	48.00	4.44
S.Em.±	0.16	1.90	0.17
C.D. at 5 %	0.45	5.35	0.50
Interaction (Fe X Zn)	NS	NS	NS
CV %	11.26	10.11	10.31

References

1. Balakrishnan VM, Jawaharlal T, Senthil Kumar, Ganga M. Response of micronutrients on flowering, yield and xanthophylls content in African marigold. J. Ornam. Hort., 2007; 10(3):153-156.
2. Barman D, Pal P. A note on effect of micronutrients on growth and yield of tuberose CV. 'Single'. J. Hort. 1993; 6(1):69-70.
3. Dhaduk BK, Naik DB. Effect of edible dyes on flower colouring of tuberose (*polianthes tuberosa* L.) cv. 'singal Local' paper presented at Kerala Agriculture University, Vellanikara, Trichur in National Symposium on recent Advances in Indian Floriculture. 2003; (12-14):101.
4. Fahad S, Ahmad M, Kh Akbar AM, Hussain S. The Effect of Micronutrients (B, Zn and Fe) Foliar Application on the Growth, Flowering and Corm Production of Gladiolus (*Gladiolus grandiflorus* L.). J. Agr. Sci. Tech 2014; 16:1671-1682.
5. Ganesh S, Soorianatha Sundaram K, Kannan M. Studies on effect of plant growth regulators and micronutrients on growth, floral characters and yield of tuberose (*Polianthes tuberosa* L.) CV. 'Prajwal'. Asian J Hort. 2013; 8(2):696-700.
6. Ganga M, Jagadeeswari V, Padmadevi K, Jawaharlal M. Response of chrysanthemum cv. CO.1 to the application of micronutrients. J Orna. Hort. 2008; 11(3):220-223.
7. Ganga M, Padmadevi K, Jegadeeswari V, Jawaharlal M. Performance of *Dendrobium* cv. Sonia 17 as influenced by micronutrients. J Ornam. Horti. 2009; 12(1):39-43.
8. George P, Maneul J. Low cost tissue culture technology for the regeneration of some economically important plants for developing countries. International Journal of Agriculture, Environment and Biotechnology. 2013; 6:703-711.
9. Jat RN, Khandelwal SK, Gupta KN. Effect of foliar application of urea and zinc sulphate on growth and flowering parameters in African marigold. J Orna. Hort. 2007; 10(4):271-273.
10. Kumar M, Chatopadhyay TK, Das DK, Mondal SK. Effect of zinc, copper and iron fertilization on tuberose (*Polianthes tuberosa* Linn.) cv. 'Single'. J. Interacademicia. 2001a; 5(2):180-185.
11. Lahijie MF. Application of micronutrients FeSO4 and ZnSO4 on growth and development of gladiolus variety Oscar. International J. Agric. Crop Sci. 2012; 4(1):781-720.
12. Memon SA, Baloch AR, Baloch MA, Buriro M. Effect of zinc sulphate and iron sulphate on the growth and flower production of gladiolus (*gladiolus hortulanus*). J. Agri. Tech. 2013; 9(6):1621-1630.
13. Munikrishnappa PM, Gowda MC, Farooqui AA, Reddy YAN. Fertigation studied in tuberose cv. 'Single'. Indian J Hort. 2002; 59(1):106-110.
14. Sadhu MK, Bose TK. Tuberose for most artistic garland. Indian Hort. 1973; 18(3):17-20.
15. Sarwar M, Jilani G, Rafique E, Akhtar ME, Chaudhry AN. Impact of integrated nutrient management on yield and nutrient uptake by maize under rainfed conditions. Pakistan Journal of Nutrients. 2012; 11:27-33.
16. Sharma J, Gupta AK, Chandan Kumar, Guatam RKS. Influence of zinc, calcium and boron on vegetative and flowering parameters of gladiolus *cv.* Aldebran. *The Bioscan.* 2013; 8(4):1153-1158.

17. Sharma P, Imran Sharma P, Chugh V, Dhaliwal HS, Singh D. Morphological, cytological and biochemical characterization of wheat Aegilops longissima derivatives BC1F6 and BC2F4 with high grain micronutrient. International Journal of Agriculture, Environment and Biotechnology. 2014; 7(2):191-204.
18. Singh JP, Kumar K, Katiyar PN. Effect of zinc, iron and copper on yield parameters of gladiolus. Hort Flora Res. Spect. 2012a; 1(1):64-68.
19. Woltz SS. The World of Gladiolus. NAGC, U.S.A. 1972, 143-149.