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EFFECT OF FOLIAR APPLICATION OF MICRONUTRIENTS ON GROWTH AND FLOWERING OF ROSE CV. TOP SECRET UNDER POLYHOUSE CONDITION

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ABSTRACT
An experiment was carried out to study the effect of foliar application of micronutrients on growth and flowering of rose cv. Top Secret under polyhouse condition at green house complex, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari during the year 2013-2014. The experiment was laid out with eighteen treatment combinations with spraying of $ZnSO_4$ (0, 0.2 and 0.4 %) and $FeSO_4$ (0, 0.2 and 0.4 %) at 15 and 30 days interval. The results indicated that the vegetative growth in term of plant height (60.00 cm), number of leaves per stalk (6.78) and leaf area (44.53 cm^2) were found significantly superior in foliar application of 0.4 % $FeSO_4$ followed by 0.4 % $ZnSO_4$. The flowering attributes like days taken to flower bud initiation (17.60 days) and days taken to opening of flower bud (19.46 days) was found minimum in foliar application of 0.2 % $ZnSO_4$. Foliar spray of 0.4 % $ZnSO_4$ increased the flower quality parameters like stalk length (56.23 cm), stalk girth (8.88 mm), length of bud (36.2 mm), diameter of flower (9.11 cm), fresh weight of flower stalk (15.81 g), number of petals per flower (34.5), weight of petals per flower (8.66 g) and vase life (9.47 days). The production of flower respectively, number of flower per plant (30.1 and 30.2) and number of flower per square meter (165.7 and 166.5) increased with the foliar spray of 0.4 % $ZnSO_4$ and 0.4 % $FeSO_4$.

INTRODUCTION

Rose is one of the most beautiful creations of nature and is universally acclaimed as "Queen of flowers". It belongs to the family '*Rosaceae*' and genus *Rosa*. Successful production of good quality cut roses, micronutrients plays a vital role for production of quality flowers, increase the yield by involving in oxidation reduction process, photosynthesis and energy transfer. Foliar application of micronutrient was increased physiological activity and productive process in rose (Bhattacharjee, 1993). Zinc is an important for the formation and activity of chlorophyll and in the functioning of several enzymes and the growth hormone auxin. Plant needs iron (F_2) to produce chlorophyll and to activate several enzymes including those involved in the oxidation/ reduction processes of photosynthesis and respiration. Various experiments have been conducted earlier on foliar spray of micro-nutrients in different flower crops (e.g. in rose, Younis *et al*., 2013), in fruit crops (e.g. in mango, Gurjar *et al*., 2015) and vegetables (e.g. in okra, Dalal and Nandkar, 2010) and shown significant response to improve yield of different crops. Thus, present study was conducted to study the effect of micronutrients on growth and production of rose by foliar application.

MATERIALS AND METHODS

The present investigation was carried out at the Greenhouse Complex, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari- 396 450, Gujarat, during the year 2013-2014. The bed size of bottom width 100 cm, top width 90 cm, height 45 cm, path 50 cm and spacing 30 x 30 cm. The experiment was laid out in Randomized Block Design with Factorial Concept (FRBD) with eighteen treatments combinations *viz*. T_1- $S_1Z_0F_0$, T_2- $S_1Z_0F_1$, T_3- $S_1Z_0F_2$, T_4- $S_1Z_1F_0$, T_5- $S_1Z_1F_1$, T_6- $S_1Z_1F_2$, T_7- $S_1Z_2F_0$, T_8- $S_1Z_2F_1$, T_9- $S_1Z_2F_2$, T_{10}- $S_2Z_0F_0$, T_{11}- $S_2Z_0F_1$, T_{12}- $S_2Z_0F_2$, T_{13}- $S_2Z_1F_0$, T_{14}- $S_2Z_1F_1$, T_{15}- $S_2Z_1F_2$, T_{16}- $S_2Z_2F_0$, T_{17}- $S_2Z_2F_1$ and T_{18}- $S_2Z_2F_2$ involving two levels of micronutrients ($ZnSO_4$ 0.2 and 0.4 % and $FeSO_4$ 0.2 and 0.4 %) and its spray interval (S_1 and S2)along with control. The treatments were replicated thrice.

The budded plants of rose cv. Top Secret were used for planting in raised beds under polyhouse conditions. The micronutrients were applied as per proposed treatments at 15 and 30 days interval regularly throught foliar spary. Data regarding different growth parameters as plant height (cm), stalk length (cm) and leaf area (cm^2) were taken by measuring tap and digital leaf area meter respectively. Length of bud (mm) and flower diameter (cm) were measured by digital vanier caliper. Fresh weight of flower stalk (g) was taken by digital weighing balance and at the end vase life of flower was counted in days.

Statistical analysis

The experimental data pertaining to all the characters studied

were subjected to statistical analysis of variance technique as described by Panse and Sukhatme (1967). The method of analysis of variance for factorial randomized block design (FRBD) was used. The test of significance among treatments was worked out by 'F' test. The critical difference at five per cent level of probability was worked out wherever the treatment effect were significant to compare mean of two treatments.

RESULTS AND DISCUSSION

Effect of spray interval on growth, flowering and flower production

A perusal of data regarding plant height, number of leaves per stalk, leaf area, days taken to flower bud initiation and opening of flower bud, flower stalk length, stalk girth, length of bud, diameter of flower, fresh weight of flower stlak, number of petals per flower, weight of petals per flower, vase life, number of flower per plant and number of flower per square meter as influenced by spray interval was found non significant.

Effect of $ZnSO_4$ on growth, flowering and flower production

It is evident from the data revealed that application of zinc sulphate at different concentration (0, 0.2 and 0.4 %) show better results on growth, flowering ang leaf nutrient content in rose. Plant height (59.80 cm), number of leaves per stalk (6.58) and leaf area (44.28 cm^2) were found significantly maximum in plants treated with 0.4 % $ZnSO_4$ (Z_2). Maximum plant height due to higher concentration of zinc might be its role in synthesis of proteins. Micronutrients involving in leaves and shoots of plants by oxidation – reduction process and photosynthesis process (Jagtap *et al.,* 2012) in rose. Khosa *et al.,* 2011, reported that due to spraying of micronutrient solution the food prepared by leaves and maximum leaf area provides more food to body of the plant to kept gerbera plant health.

The improvement of flowering attributes were observed by foliar application of 0.4 % $ZnSO_4$ (Z_2) recorded minimum days taken to flower bud initiation (17.60 days) and opening of flower bud (19.46 days). Foliar application of micro nutrients minimized the days for number of flower bud initiation and opening of flower bud in gerbera (Khosa *et al.,* 2011). Flowering quality parameters like flower stalk length (56.23 cm), stalk girth (8.88 mm), length of bud (36.2 mm), diameter of flower (9.11 cm) and fresh weight of flower stalk (15.81 g) was found significantly maximum in 0.4 % $ZnSO_4$ (Z_2). A good amount of leaves coupled with conducive root environment which would have led to proper nutrient uptake in the substrates may resulted in grater accumulation of food matter leading to increase in flower quality (Younis *et al.,* 2013) in rose. Significantly maximum number of petals per flower (34.5), weight of petals per flower (8.66 g) and vase life (9.47 days) was found in plants treated with 0.4 % $ZnSO_4$ (Z_2). Khoshgoftarmanesh *et*

Table 1: Effect of foliar application of micronutrients and their combination on vegetative growth parameters and flowering attributes in rose cv. Top Secret under polyhouse condition

Treatments	Plant height (cm)	Number of leaves per stalk	Leaf area (cm^2)	Days taken to flower bud initiation	Days taken to opening of flower bud	Stalk length (cm)	Stalk girth (mm)
S- Interval of spray							
S_1- At 15 days interval	58.20	6.31	43.23	18.03	19.84	54.44	8.27
S_2- At 30 days interval	59.50	6.53	43.96	18.67	20.63	55.03	8.40
S.Em. ±	0.49	0.07	0.30	0.14	0.14	0.32	0.06
C.D. at 5 %	NS	NS	NS	NS	NS	NS	NS
Different concentration of Zinc (Zn)							
Z_0- 0 % $ZnSO_4$	57.60	6.23	42.39	19.27	21.11	53.41	7.77
Z_1- 0.2 % $ZnSO_4$	59.20	6.46	44.11	18.18	20.14	54.56	8.35
Z_2- 0.4 % $ZnSO_4$	59.80	6.58	44.28	17.60	19.46	56.23	8.88
S.Em. ±	0.60	0.09	0.37	0.18	0.17	0.39	0.08
C.D. at 5 %	1.72	0.28	1.00	0.52	0.50	1.14	0.23
Different concentration of Iron (Fe)							
F_0- 0 % $FeSO_4$	57.50	6.05	42.37	19.28	21.18	53.30	8.00
F_1- 0.2 % $FeSO_4$	59.10	6.45	43.87	18.05	19.85	54.90	8.30
F_2- 0.4 % $FeSO_4$	60.00	6.78	44.53	17.72	19.68	56.01	8.71
S.Em. ±	0.60	0.09	0.37	0.18	0.17	0.39	0.08
C.D. at 5 %	1.72	0.28	1.00	0.52	0.50	1.14	0.23
Interaction Effect of S x Z							
S.Em. ±	0.85	0.13	0.53	0.25	0.25	0.56	0.11
C.D. at 5 %	NS	NS	NS	NS	NS	NS	NS
Interaction Effect of S x F							
S.Em. ±	0.85	0.13	0.53	0.25	0.25	0.56	0.11
C.D. at 5 %	NS	NS	NS	NS	NS	NS	NS
Interaction Effect of Z x F							
S.Em. ±	1.04	0.16	0.65	0.31	0.30	0.68	0.14
C.D. at 5 %	NS	NS	NS	NS	NS	1.97	0.40
Interaction effect (S x Z x F)							
S.Em. ±	1.47	0.23	0.92	0.44	0.43	0.97	0.20
C.D. at 5 %	NS	NS	NS	NS	NS	NS	NS
CV %	4.33	6.44	3.68	4.23	3.71	3.07	4.18

Table 2: Effect of foliar application of micronutrients and their combination on flower quality and production of flower in rose cv. Top Secret under polyhouse condition

Treatment	Length of bud (mm)	Diameter of flower (cm)	Fresh weight of flower stalk (g)	Number of petals per flower	Weight of petals per flower (g)	Vase life (days)	Number of flower per plant	Number of flower per square meter
S- Interval of spray								
S_1- At 15 days interval	35.1	8.62	14.94	33.0	8.47	8.38	29.0	159.7
S_2- At 30 days interval	36.0	8.82	15.40	33.3	8.59	8.71	29.7	163.4
S.Em.±	0.18	0.09	0.16	0.26	0.04	0.11	0.32	1.75
C.D. at 5 %	NS	NS	NS	NS	NS	NS	NS	NS
Z- $ZnSO_4$ and its interval								
Z_0- 0 % $ZnSO_4$	34.9	8.10	14.72	31.2	8.38	7.54	28.0	154.3
Z_1- 0.2 % $ZnSO_4$	35.8	8.97	15.31	33.9	8.59	8.62	29.9	164.4
Z_2- 0.4 % $ZnSO_4$	36.2	9.11	15.81	34.5	8.66	9.47	30.1	165.7
S.Em.±	0.22	0.11	0.20	0.32	0.05	0.14	0.39	2.15
C.D. at 5 %	0.65	0.31	0.57	0.93	0.15	0.41	1.12	6.19
F- $FeSO_4$ and its interval								
F_0- 0 % $FeSO_4$	34.8	8.36	14.56	31.9	8.45	7.84	27.9	153.5
F_1- 0.2 % $FeSO_4$	35.7	8.86	15.14	33.0	8.48	8.61	29.9	164.7
F_2- 0.4 % $FeSO_4$	36.0	8.96	15.48	34.3	8.61	9.18	30.2	166.5
S.Em.±	0.22	0.11	0.20	0.32	0.05	0.14	0.39	2.15
C.D. at 5 %	0.65	0.31	0.57	0.93	0.15	0.41	1.12	6.19
Interaction Effect of S x Z								
S.Em.±	0.32	0.15	0.28	0.45	0.07	0.20	0.55	3.04
C.D. at 5 %	NS	NS	NS	NS	NS	NS	NS	NS
Interaction Effect of S x F								
S.Em.±	0.32	0.15	0.28	0.45	0.07	0.20	0.55	3.04
C.D. at 5 %	NS	NS	NS	NS	NS	NS	NS	NS
Interaction Effect of Z x F								
S.Em.±	0.39	0.19	0.34	0.56	0.09	0.24	0.68	3.73
C.D. at 5 %	1.13	0.55	NS	1.61	0.26	0.71	1.95	10.7
Interaction effect (S x Z x F)								
S.Em.±	0.56	0.27	0.49	0.79	0.112	0.38	0.96	5.27
C.D. at 5 %	NS	NS	NS	NS	NS	NS	NS	NS
CV %	2.72	5.37	5.60	4.14	2.61	7.08	5.67	5.65

al., 2008, also showed that genotypic difference and enough micro-nutrient contribution were two solution factors in successful development of rose. Micronutrient application is key factor which play a dominant role in successful production of best quality cut roses and increased vase life of flower. Maximum number of flower per plant (30.1) and number of flower per square meter (165.7) was found in foliar application of 0.4 % $ZnSO_4$ (Z_2).

Effect of $FeSO_4$ on growth, flowering and flower production

Application of micronutrients has remarkable effect on the growth and fowering parameters in rose. The plants treated with 0.4 % $FeSO_4$ (F_2) was found significantly maximum plant height (60.00 cm), number of leaves per stalk (6.78) and leaf area (44.53 cm^2). Iron plays a vital role in production of vegetative growth and ultimately encourages the plant height in rose (Jagtap *et al.,* 2012). Khosa *et al.,* 2011, reported that due to spraying of micronutrient solution the food prepared by leaves and maximum leaf area provides more food to body of the plant to kept gerbera plant health. These results are in accordance with those reported by Bashir *et al*. (2013) in gerbera and Munikrishnappa *et al*. (2002) in tuberose.

It is evident from the data revealed that minimum days taken to flower bud initiation (17.72 days) and opening of flower bud (19.68 days) was recorded in foliar application of 0.4 % $FeSO_4$ (F_2). Flowering parameters like flower stalk length (56.01 cm), stalk girth (8.71 mm), length of bud (36.0 mm), diameter of flower (8.96 cm), fresh weight of flower stalk (15.48 g) was recorded significantly maximum in plants treated with 0.4 % $FeSO_4$ (F_2). Bhattacharjee, 1993 in rose reported that micronutrient plays an important role involving in photosynthesis; break down of IAA, auxin and protein synthesis. Bud length and fresh weight of flower stalk was maximum in fertilization, raise in the length of pollen tubes, cell division, growth, development and process of respiration in plants (Khosa *et al*., 2011) in gerbera. The data revealed that significantly maximum number of petals per flower (34.3), weight of petals per flower (8.61 g) and vase life (9.18 days) was found in same treatment. Vase life was considerably maximum in proper application of micronutrients supported the flowers in the vase for the extended vase life in orchid (Ganga *et al*., 2009). Significantly maximum number of flower per plant (30.2) and number of flower per square meter (166.5) was found in plant treated with 0.4 % $FeSO_4$ (F_2).

Interaction effect of S x Z, S x F, Z x F and S x Z x F

The data showed that interaction effect of different micronutrients was found non significant different growth parameters and days taken to flower bud initiation and opening of flower bud was found non significant as influenced by interaction effect of micronutrients. The data pertaining to flower stalk length, stalk girth, bud length, diameter of flower, number

of petals per flower, weight of petals per flower, vase life of flower, number of flower per plant nd number of flower per square meter was found non significant with respect to interaction effect of micronutrients.

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