International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2017; 5(6): 403-407

Received: 05-09-2017
Accepted: 09-10-2017

**Mukesh Kumar Sahu**
Department of Floriculture and Landscape Architecture, COA, IGKV Raipur, Chhattisgarh, India

**T Kushram**
Department of Entomology, COA, IGKV Raipur, Chhattisgarh, India

**T Tirkey**
Department of Floriculture and Landscape Architecture, COA, IGKV Raipur, Chhattisgarh, India

**N Shukla**
Department of Floriculture and Landscape Architecture, COA, IGKV Raipur, Chhattisgarh, India

**G Sharma**
Department of Floriculture and Landscape Architecture, COA, IGKV Raipur, Chhattisgarh, India

**Correspondence**
**Mukesh Kumar Sahu**
Department of Floriculture and Landscape Architecture, COA, IGKV Raipur, Chhattisgarh, India

# Effect of Zn, Mn, Fe sprays on growth of gerbera under poly house conditions

**Mukesh Kumar Sahu, T Kushram, T Tirkey, N Shukla and G Sharma**

**Abstract**
Gerbera is one of the most imperative commercial cut flower. The growth parameters of gerbera are directly dependent on the balanced application of macro and micronutrients. In the present study, foliar application of micronutrients was done after 30, 60, 90 DAP. Foliar application of $ZnSO_4$ (0.2%) + $MnSO_4$ (0.2%) + $FeSO_4$ (0.1%), produced significantly maximum plant height (44.87 cm), Plant spread (45.20 cm), Number of leaves per plant (16.93), Length of leaf (32.14 cm) as well as Number of suckers per plant and width of leaf (13.69 cm) were significantly increased as a result of foliar application of $ZnSO_4$ (0.4%) + $MnSO_4$ (0.4%) + $FeSO_4$ (0.3%), compared to the control treatment.

**Keywords:** Foliar application, gerbera, iron, manganese and zinc

## Introduction
Gerbera belongs to family Asteraceae. This group at present comprises 45 species, native to tropical Asia and Africa. About seven species were recorded in India distributed in temperate Himalayas from Kashmir to Nepal at an altitude of 1300 to 3200 meters. Gerbera species of Indian origin are Gerbera andria, G.kunzeana, G. languinosa, G. macrophylla, G. nivea, G. ovalifolia and G. poiloselloides. The cultivated species in this genus are Gerbera asplenifolia, G. aurantica, G. kunzeana and G. viridifolia. These are stem less perennial herbs (Bhattacharjee and De, 2003) [2]. Gerbera (*Gerbera jamesonii* L.) also commonly known as Transvaal Daisy is an important cut flower grown throughout the world (Pattanashetti *et al*., 2012) [11]. Gerbera produces attractive flowers known as 'head' or capitulum. The plant is dwarf herbaceous perennial and grows in clump with solitary flower heads on a long slender stalk, which grows well above the foliage. Gerbera as a cut flower has tremendous demand in domestic and international markets. Due to globalization and income generation in different parts of the world per capita consumption of flower in most countries is increasing rapidly. In recent years, commercial production of gerbera has become a major venture in India among the commercial ornamentals.

Protected conditions provide favorable environment for the growth of the plants by protecting the crop from heavy winds, pests, diseases and other adverse climatic conditions (Khan, 1995) [7]. The market requirement for cut flowers is very specific and it can be met consistently, only when the crop is grown under protected conditions. Micronutrients are elements that are essential for plant growth but are required in much smaller amounts than those of the primary nutrients such as nitrogen, phosphorus, sulfur, and potassium. Zinc plays an important role in the production of biomass. It may be required for chlorophyll production, pollen function, fertilization. Manganese (Mn) is an essential plant mineral nutrient, playing a key role in several physiological processes, particularly photosynthesis and iron is involved in the manufacturing process of chlorophyll, and it is required for certain enzyme functions.

Different methods are used for micronutrient application such as seed priming, soil application and other methods, but foliar application is more beneficial. The advantages of foliar fertilizers were more noticeable under growing conditions restricting the incorporation of nutrients from the soil.

## Materials and Methods
The present experiment on the effect of foliar application of micronutrient ($ZnSO_4$, $MnSO_4$ and $FeSO_4$) on growth parameters of gerbera under protected condition was carried out at center of excellence on protected cultivation, College of Agriculture, Indira Gandhi Krishi

Vishwavidyalaya, Raipur, (C.G) during the year 2015-16. The experimental field was laid out in laid out in Completely Randomized Design with three replications. Each replication consisted of 13 treatments *viz.* ($T_1$) $ZnSO_4$ (0.2%), ($T_2$) $ZnSO_4$ (0.4%), ($T_3$) $ZnSO_4$ (0.6%), ($T_4$) $MnSO_4$ (0.2%), ($T_5$) $MnSO_4$ (0.4%), ($T_6$) $MnSO_4$ (0.6%), ($T_7$) $FeSO_4$ (0.1%), ($T_8$) FeSO4 (0.3%), ($T_9$) $FeSO_4$ (0.5%), ($T_{10}$) [$ZnSO_4$ (0.2%) + $MnSO_4$ (0.2%) + $FeSO_4$ (0.1%)], ($T_{11}$) [$ZnSO_4$ (0.4%) + $MnSO_4$ (0.4%) + FeSO4 (0.3%)], ($T_{12}$) [$ZnSO_4$ (0.6%) + $MnSO_4$ (0.6%) + $FeSO_4$ (0.5%)], ($T_{13}$) Control (water spray). The micronutrients was spray at 30, 60, 90 DAP. Observations were recorded on Plant height (cm), Plant spread (cm), Number of leaves per plant, Length of leaf (cm), Width of leaf (cm), Number of suckers per plant. Observations of the growth parameters of gerbera were recorded at 20, 40, 60, 80, 100 and 120 days after planting (DAP).

## Results and Discussion

### Plant height (cm)

Plant height was found non-significant differences during 20 and 40 DAP the range of plant height (16.56 to 18.51cm) and (23.53 to 26.95cm) respectively (Table 1). However observation on later stage at 60, 80, 100 and 120 DAP plant height showed significant differences among the different treatments.

At 60 DAP, the maximum plant height (33.30 cm) was noted with foliar application of treatment $T_{10}$ [$ZnSO_4$ (0.2%) + $MnSO_4$ (0.2%) + $FeSO_4$ (0.1%)] which was found non-significant difference with treatment $T_{11}$ (32.96 cm), $T_9$ (32.40 cm), $T_6$ (32.21cm), $T_{12}$ (32.11), $T_8$ (31.74), $T_5$ (31.64), $T_3$ (31.55), $T_1$ (31.07) and $T_2$ (31.04). At 80 DAP, the maximum plant height (36.75 cm) was noted with foliar application of treatment $T_{10}$ [$ZnSO_4$ (0.2%) + $MnSO_4$ (0.2%) + $FeSO_4$ (0.1%)] which showed *at par* with treatment $T_{11}$ (35.58 cm), $T_6$ (35.43 cm), $T_9$ (35.40 cm), $T_4$ (35.32 cm), $T_{12}$ (35.11cm), $T_8$ (34.80 cm), $T_5$ (34.85 cm) and $T_3$ (34.41).

At 100 DAP, the maximum plant height (40.60 cm) was noted with foliar application of treatment $T_{10}$ [$ZnSO_4$ (0.2%) + $MnSO_4$ (0.2%) + $FeSO_4$ (0.1%)] which was statistically similar with treatment $T_{11}$ (39.83 cm), $T_{12}$ (39.59 cm), $T_5$ (39.47 cm), $T_4$ (39.35 cm), $T_9$ (39.17 cm), $T_3$ (38.86 cm), $T_6$ (38.81 cm), $T_8$ (38.59 cm) and $T_2$ (37.53 cm). At 120 DAP, the maximum plant height (44.87 cm) was recorded with foliar application of treatment $T_{10}$ [$ZnSO_4$ (0.2%) + $MnSO_4$ (0.2%) + $FeSO_4$ (0.1%)] which showed non-significant difference with treatment $T_3$ (44.42 cm), $T_{11}$ (43.07 cm), $T_5$ (43.89 cm), $T_{11}$ (43.07 cm), $T_{12}$ (42.69 cm), $T_6$ (42.61 cm), $T_7$ (42.01 cm).

The increased plant height with application of micronutrients might be due to its role in synthesis of tryptophan which is a precursor of auxin (IAA) and it is essential in nitrogen metabolism which stimulates growth. Similarly iron acts as an important catalyst in the enzymatic reactions of the metabolism and would have helped in larger biosynthesis of photo assimilates thereby enhancing growth of the plants. Similar results were also reported by Muthumanickam *et al.* (1999) [9], Jadhav (2004) [5] in gerbera, Balakrishnan (2005) [3] in Marigold, Rao (2005) [12] in Gladiolus and Pal. *et al.* (2016) [10] in Gerbera.

### Plant Spread (cm)

The data pertaining to plant spread (cm) recorded at different stages of crop growth is presented in table 2. Plant spread showed non-significant differences during 20 and 40 DAP, the range of plant spread was noted 16.89 to 18.51cm and 23.29 to 26.95cm, respectively. However at 60, 80, 100 and 120 DAP, the plant spread was significantly influenced by foliar application of different micronutrients and their combination.

At 60 DAP the maximum plant spread (33.79 cm) was observed in treatment $T_{10}$ [($ZnSO_4$ (0.2%) + $MnSO_4$ (0.2%) + $FeSO_4$ (0.1%)] which was *at par* with treatment $T_{12}$ (32.78 cm), $T_8$ (32.74 cm), $T_{11}$ (32.63 cm), $T_9$ (32.41 cm), $T_5$ (31.64 cm), $T_4$ (31.25 cm), $T_3$ (32.22 cm), $T_6$ (30.88 cm) and $T_1$ (30.73cm). At 80 DAP the maximum plant spread (38.09 cm) was noted in treatment $T_{10}$ [($ZnSO_4$ (0.2%) + $MnSO_4$ (0.2%) + $FeSO_4$ (0.1%)] which was found *at par* with treatment $T_4$ (36.32 cm), $T_{11}$ (36.25 cm), $T_6$ (35.43 cm) and $T_9$ (35.07 cm).

At 100 DAP the maximum plant spread (40.93 cm) was observed with treatment $T_{10}$ [($ZnSO_4$ (0.2%) + $MnSO_4$ (0.2%) + $FeSO_4$ (0.1%)] which was *at par* with treatment $T_{11}$ (40.49 cm), $T_4$ (40.02 cm), $T_6$ (38.81cm), $T_8$ (38.56 cm), $T_3$ (38.53 cm) and $T_9$ (38.17cm). At 120 DAP the maximum plant spread (45.20 cm) was recorded in treatment $T_{10}$ [($ZnSO_4$ (0.2%) + $MnSO_4$ (0.2%) + $FeSO_4$ (0.1%)] which was statistically similar with treatment $T_{12}$ (45.07 cm), $T_4$ (44.23 cm), $T_3$ (44.09 cm), $T_6$ (42.27 cm), $T_5$ (42.01 cm), $T_2$ (41.50 cm) and $T_8$ (41.30 cm).

The plant sprayed significantly influenced with application of micronutrient ferrous sulphate is an essential components of several dehydrogenase, proteinase, peptidase and promotes growth hormones and closely associated with plant growth, all these factors contributed to cell multiplication, cell division and cell differentiation resulting in increased photosynthesis and translocation of food material which enhanced the plant spread and is also encouraged due to the $ZnSO_4$ could be attributed to improved root system of plants resulting in absorption of more water and nutrients and its utilization. Moreover, micronutrients activate several enzymes (catalase, carbonic dehydrogenize, tryptophane synthates etc.) and involved various physiological activities. Similar results were also obtained by Kakade *et al.* (2009) [6] in China aster, Balakrishnan (2005) [3] in marigold and Ahmad *et al.* (2010) [1] in Rose.

### Number of leaves per plant

At 20 and 40 DAP, the results showed non-significant differences among different treatments of micronutrient the range of number of leaves 4.93 to 6.07 and 7.07 to 8.40 per plant, respectively (Table 3). At 60 DAP the maximum number of leaves per plant (11.20) was recorded with application of treatment $T_{11}$ [$ZnSO_4$ (0.4%) + $MnSO_4$ (0.4%) + $FeSO_4$ (0.3%)] which was exhibited significantly differ with most of the treatments except $T_{10}$ (10.80) and $T_3$ (9.93). The minimum number of leaves per plant (8.53) was noted with the treatment $T_{13}$ (control). At 80 DAP the highest number of leaves per plant (13.33) was found with foliar application of treatment $T_{10}$ [$ZnSO_4$ (0.2%) + $MnSO_4$ (0.2%) + $FeSO_4$ (0.1%)], which was *at par* with $T_{11}$ (12.40).

At 100 DAP the maximum number of leaves per plant (14.86) was found with foliar application of treatment $T_{10}$ [$ZnSO_4$ (0.2%) + $MnSO_4$ (0.2%) + $FeSO_4$ (0.1%)] which was *at par* with $T_{11}$ (14.73), At 120 DAP the highest number of leaves per plant (16.93) was observed with foliar application of treatment $T_{10}$ [$ZnSO_4$ (0.2%) + $MnSO_4$ (0.2%) + $FeSO_4$ (0.1%)] which was *at par* with $T_{11}$ (16.60).

The $MnSO_4$ is an enzyme activator and essential for carbohydrate and nitrogen metabolism. It also helps in the assimilation of carbon dioxide in photosynthesis and is also involve in uptake of Iron. Due to better plant growth by the

application of $MnSO_4$ also resulted in significant increase in number of leaves with optimum dose of $ZnSO_4$ and $FeSO_4$. The results are conformity with findings of Khan (2000) [8] in Dahlia cv. Swami Lokeshwaranad, Ahmad *et al.* (2010) [1] in Rose and Jadhav (2004) [5] in gerbera.

**Length of leaf (cm)**

Length of leaf showed non-significant differences during the initial growth stage (20 and 40 DAP) the range of length of leaf (6.02 to 7.35 cm) and (13.32 to 16.00 cm) respectively.

At 60 DAP, the maximum length of leaf (23.87 cm) was recorded with treatment $T_{10}$ [$ZnSO_4$ (0.2%) + $MnSO_4$ (0.2%) + $FeSO_4$ (0.1%)], which was significantly greater than the treatment $T_1$ (19.63 cm), $T_4$ (19.92 cm), $T_3$ (20.54 cm) and $T_2$ (20.82 cm). At 80 DAP, the maximum length of leaf (29.72 cm) was recorded with foliar application of treatment $T_{10}$ [$ZnSO_4$ (0.2%) + $MnSO_4$ (0.2%) + $FeSO_4$ (0.1%)], which was significantly greater than the treatment $T_7$ (25.75 cm) and $T_{13}$ (23.75 cm) At 100 DAP, the maximum length of leaf (31.64 cm) was noted with foliar application of treatment $T_{10}$ [$ZnSO_4$ (0.2%) + $MnSO_4$ (0.2%) + $FeSO_4$ (0.1%)], which was significantly differed with treatment $T_2$ (29.10 cm), $T_7$ (27.65 cm), $T_9$ (29.18 cm) and $T_{13}$ (26.70 cm). At 120 DAP, the maximum length of leaf (32.14 cm) was recorded with foliar application of treatment $T_{10}$ [$ZnSO_4$ (0.2%) + $MnSO_4$ (0.2%) + $FeSO_4$ (0.1%)], which was noted non-significant differ with treatment $T_{12}$ (31.76 cm), $T_4$ (30.81 cm), $T_6$ (30.59 cm) and $T_3$ (29.98 cm) and significantly differ with rest of the treatments. The minimum length of leaf (28.15 cm) was observed with treatment $T_{13}$.

The result indicated that the foliar application of zinc and ferrous sulphate might be stimulating metabolic activity with stimulating effect on cell wall loosing, increased cell elongation along with cell enlargement and cell differentiation resulting in increased photosynthesis and translocation of food material which might be enhanced the leaves length. Similar results were also obtained by Bashir *et al.* (2013) [4] and Pal. *et al.* (2016) [10] in Gerbera.

**Width of leaf (cm)**

As the data indicated that width of leaf was significant not influenced by foliar application of different micronutrients at initial stage of plant growth (20 and 40 DAP), the range of width of leaf 3.82 to 4.53 cm and 4.65 to 5.59 cm respectively.

At 60 DAP, the maximum width of leaf (8.63 cm) was recorded with foliar application of treatment $T_{10}$ [$ZnSO_4$ (0.2%) + $MnSO_4$ (0.2%) + $FeSO_4$ (0.1%)], which was *at par* with treatment $T_{12}$ (7.74 cm), $T_{11}$ (7.60 cm), $T_3$ (7.51 cm), $T_9$ (7.50 cm), $T_4$ (7.48 cm) and $T_8$ (7.48 cm) where as it was showed significantly differ with rest of the other treatments. The minimum width of leaf (6.31 cm) was observed with treatment $T_{13}$. At 80 DAP, the maximum width of leaf (10.43cm) was recorded with foliar application of treatment $T_{11}$ [$ZnSO_4$ (0.4%) + $MnSO_4$ (0.4%) + $FeSO_4$ (0.3%)], which was found to be statistically similar with $T_4$ (10.23 cm), $T_{10}$ (10.18cm), $T_{12}$ (10.07 cm), $T_1$ (9.80 cm), $T_3$ (9.68 cm), $T_6$ (9.56 cm) and $T_9$ (9.27).

At 100 DAP, the maximum width of leaf (12.77 cm) was recorded with foliar application of treatment $T_{11}$ [$ZnSO_4$ (0.4%) + $MnSO_4$ (0.4%) + $FeSO_4$ (0.3%)], which was found to be statistically similar with $T_{10}$ (11.65 cm), and $T_{12}$ (11.25 cm). At 120 DAP, the maximum width of leaf (13.69 cm) was recorded with foliar application of treatment $T_{11}$ [$ZnSO_4$ (0.4%) + $MnSO_4$ (0.4%) + $FeSO_4$ (0.3%)], which was *at par* with $T_{10}$ (12.34 cm).

Micronutrients *viz* zinc, ferrous and manganese sulphate are the essential component of several growth parameters like, dehydrogenase, proteinase, peptidase and growth hormones and closely associated with growth, of the plants, all these factors contributed to cell multiplication, cell division and cell differentiation resulting in increased photosynthesis and translocation of food material which might be enhanced the width of leaf. Similar results were also obtained by Bashir *et al.* (2013) [4] and Pal. *et al.* (2016) [10] in Gerbera.

**Number of suckers per plant**

Number of suckers was showed non-significant difference at 60, 80 and 100 days after planting. However at 120 DAP, the maximum number of suckers was recorded in treatment $T_{10}$ [$ZnSO_4$ (0.2%) + $MnSO_4$ (0.2%) + $FeSO_4$ (0.1%)], which was found to be significantly superior over all the other treatment except treatment recorded $T_{11}$ (1.36), $T_5$ (1.34), $T_6$ (1.31), $T_9$ (1.31) and $T_7$ (1.30) which was exhibited significantly differ with treatments $T_{10}$. The minimum number of suckers (1.09) was observed with treatment $T_{13}$.

Increased the number of sucker might be due to micronutrients like $ZnSO_4$, $FeSO_4$ and $MnSO_4$ is essential component of several dehydrogenase, proteinase, peptidase and promotes growth of hormones and closely associated with growth, all these factors contributed to cell multiplication, cell division and cell differentiation resulting in increased photosynthesis and translocation of food material which enhanced the number of suckers The above result was confirmed by Pal. *et al.* (2016) [10] in Gerbera.

**Table 1:** Effect of foliar application of micronutrients on plant height (cm).

| Treatment | 20 DAP | 40 DAP | 60 DAP | 80 DAP | 100 DAP | 120 DAP |
|---|---|---|---|---|---|---|
| $T_1$ | 17.39 | 26.95 | 31.07 | 33.55 | 37.01 | 40.68 |
| $T_2$ | 18.21 | 23.69 | 31.04 | 34.08 | 37.53 | 40.83 |
| $T_3$ | 17.66 | 24.70 | 31.55 | 34.41 | 38.86 | 44.42 |
| $T_4$ | 17.71 | 25.45 | 30.92 | 35.32 | 39.35 | 43.89 |
| $T_5$ | 17.13 | 26.47 | 31.64 | 34.58 | 39.47 | 42.01 |
| $T_6$ | 18.51 | 26.55 | 32.21 | 35.43 | 38.81 | 42.61 |
| $T_7$ | 17.22 | 24.55 | 30.07 | 32.97 | 36.23 | 39.75 |
| $T_8$ | 17.82 | 25.19 | 31.74 | 34.80 | 38.56 | 41.63 |
| $T_9$ | 18.27 | 24.65 | 32.41 | 35.41 | 39.17 | 40.52 |
| $T_{10}$ | 17.76 | 25.36 | 33.30 | 36.75 | 40.60 | 44.87 |
| $T_{11}$ | 17.89 | 24.37 | 32.96 | 35.59 | 39.83 | 43.07 |
| $T_{12}$ | 16.56 | 23.53 | 32.11 | 35.11 | 39.59 | 42.69 |
| $T_{13}$ | 17.62 | 24.95 | 28.57 | 31.67 | 34.49 | 37.32 |
| S. Em± | - | - | 0.80 | 0.81 | 1.09 | 1.40 |
| CD at 5% | NS | NS | 2.34 | 2.36 | 3.19 | 4.08 |

**Table 2:** Effect of foliar application of micronutrients on plant spread (cm)

| Treatment | 20 DAP | 40 DAP | 60 DAP | 80 DAP | 100 DAP | 120 DAP |
|---|---|---|---|---|---|---|
| $T_1$ | 18.18 | 26.95 | 30.73 | 33.89 | 36.67 | 40.35 |
| $T_2$ | 17.36 | 23.69 | 29.04 | 32.75 | 37.19 | 41.50 |
| $T_3$ | 17.66 | 24.70 | 31.22 | 34.07 | 38.53 | 44.09 |
| $T_4$ | 17.71 | 25.45 | 31.25 | 36.32 | 40.02 | 44.23 |
| $T_5$ | 17.13 | 26.47 | 31.64 | 34.58 | 39.13 | 42.01 |
| $T_6$ | 18.51 | 26.55 | 30.88 | 35.43 | 38.81 | 42.27 |
| $T_7$ | 17.22 | 24.55 | 30.07 | 32.31 | 35.89 | 39.75 |
| $T_8$ | 17.82 | 25.19 | 32.74 | 34.80 | 38.56 | 41.30 |
| $T_9$ | 18.27 | 24.65 | 32.41 | 35.07 | 38.17 | 39.52 |
| $T_{10}$ | 17.52 | 25.81 | 33.79 | 38.09 | 40.93 | 45.20 |
| $T_{11}$ | 16.89 | 23.70 | 32.63 | 36.25 | 40.49 | 45.07 |
| $T_{12}$ | 17.56 | 25.19 | 32.78 | 34.29 | 36.59 | 37.02 |
| $T_{13}$ | 17.62 | 23.28 | 26.91 | 31.00 | 34.16 | 36.65 |
| S. Em± | - | - | 1.19 | 1.06 | 1.27 | 1.49 |
| CD at 5% | NS | NS | 3.47 | 3.08 | 3.70 | 4.33 |

**Table 3:** Effect of foliar application of micronutrients on number of leaves per plant

| Treatment | 20 DAP | 40 DAP | 60 DAP | 80 DAP | 100 DAP | 120 DAP |
|---|---|---|---|---|---|---|
| $T_1$ | 5.67 | 7.67 | 9.67 | 10.53 | 11.60 | 12.93 |
| $T_2$ | 4.93 | 7.07 | 9.27 | 10.60 | 11.73 | 12.73 |
| $T_3$ | 5.67 | 7.33 | 9.93 | 11.47 | 12.20 | 13.13 |
| $T_4$ | 5.53 | 7.27 | 8.93 | 10.27 | 12.07 | 13.47 |
| $T_5$ | 5.87 | 8.00 | 9.60 | 10.93 | 12.47 | 14.47 |
| $T_6$ | 5.20 | 7.47 | 9.13 | 10.73 | 12.33 | 13.87 |
| $T_7$ | 5.72 | 7.67 | 9.40 | 10.87 | 12.40 | 13.87 |
| $T_8$ | 5.33 | 7.67 | 8.87 | 10.43 | 11.80 | 12.93 |
| $T_9$ | 5.67 | 7.73 | 9.73 | 10.60 | 11.53 | 13.73 |
| $T_{10}$ | 5.80 | 7.60 | 10.80 | 13.33 | 14.86 | 16.93 |
| $T_{11}$ | 6.07 | 8.40 | 11.20 | 12.40 | 14.73 | 16.60 |
| $T_{12}$ | 5.47 | 7.53 | 9.60 | 10.73 | 11.67 | 13.00 |
| $T_{13}$ | 5.33 | 7.47 | 8.53 | 10.20 | 10.93 | 12.27 |
| S. Em± | - | - | 0.44 | 0.64 | 0.70 | 0.74 |
| CD at 5% | NS | NS | 1.27 | 1.85 | 2.05 | 2.17 |

**Table 4:** Effect of foliar application of micronutrients on length of leaf (cm).

| Treatment | 20 DAP | 40 DAP | 60 DAP | 80 DAP | 100 DAP | 120 DAP |
|---|---|---|---|---|---|---|
| $T_1$ | 6.92 | 14.05 | 19.63 | 28.09 | 29.84 | 28.87 |
| $T_2$ | 6.70 | 14.45 | 20.82 | 27.10 | 29.10 | 29.47 |
| $T_3$ | 6.63 | 14.17 | 20.54 | 28.15 | 29.75 | 29.98 |
| $T_4$ | 6.89 | 13.14 | 19.92 | 28.86 | 30.15 | 30.81 |
| $T_5$ | 6.74 | 13.70 | 22.45 | 27.80 | 29.48 | 29.44 |
| $T_6$ | 7.08 | 14.38 | 23.23 | 28.11 | 30.59 | 30.59 |
| $T_7$ | 6.60 | 12.76 | 21.11 | 25.75 | 27.65 | 28.17 |
| $T_8$ | 7.35 | 14.13 | 23.35 | 28.35 | 30.25 | 29.77 |
| $T_9$ | 6.53 | 14.53 | 23.19 | 27.60 | 29.18 | 29.47 |
| $T_{10}$ | 7.04 | 16.00 | 23.87 | 29.72 | 31.64 | 32.14 |
| $T_{11}$ | 6.87 | 13.32 | 22.87 | 28.26 | 30.26 | 28.64 |
| $T_{12}$ | 7.10 | 14.75 | 23.81 | 28.87 | 31.14 | 31.76 |
| $T_{13}$ | 6.02 | 13.45 | 18.99 | 23.75 | 26.70 | 28.15 |
| S. Em± | - | - | 1.04 | 0.95 | 0.76 | 0.81 |
| CD at 5% | NS | NS | 3.04 | 2.78 | 2.22 | 2.35 |

**Table 5:** Effect of foliar application of micronutrients on width of leaf (cm).

| Treatment | 20 DAP | 40 DAP | 60 DAP | 80 DAP | 100 DAP | 120 DAP |
|---|---|---|---|---|---|---|
| $T_1$ | 4.23 | 5.31 | 6.54 | 9.80 | 10.47 | 11.68 |
| $T_2$ | 3.82 | 4.81 | 6.67 | 9.17 | 10.19 | 11.11 |
| $T_3$ | 4.02 | 5.25 | 7.51 | 9.67 | 10.22 | 11.19 |
| $T_4$ | 3.92 | 5.22 | 7.48 | 10.23 | 10.78 | 11.91 |
| $T_5$ | 4.02 | 5.07 | 7.06 | 9.49 | 10.42 | 11.71 |
| $T_6$ | 3.99 | 5.18 | 7.41 | 9.55 | 10.75 | 11.62 |
| $T_7$ | 3.91 | 4.70 | 6.88 | 9.04 | 10.41 | 11.58 |
| $T_8$ | 4.09 | 5.16 | 7.48 | 8.26 | 10.24 | 10.92 |
| $T_9$ | 4.53 | 5.59 | 7.50 | 9.26 | 10.40 | 11.64 |
| $T_{10}$ | 4.21 | 5.17 | 8.63 | 10.18 | 11.65 | 12.34 |

| | | | | | | |
|---|---|---|---|---|---|---|
| $T_{11}$ | 4.01 | 5.28 | 7.60 | 10.43 | 12.76 | 13.69 |
| $T_{12}$ | 4.07 | 5.13 | 7.74 | 10.07 | 11.25 | 11.60 |
| $T_{13}$ | 3.83 | 4.65 | 6.31 | 9.02 | 9.89 | 10.63 |
| S. Em± | - | - | 0.41 | 0.42 | 0.45 | 0.48 |
| CD at 5% | NS | NS | 1.20 | 1.21 | 1.32 | 1.42 |

**Table 6:** Effect of foliar application of micronutrients on number of suckers per plant

| Treatment | 60 DAP | 80 DAP | 100 DAP | 120 DAP |
|---|---|---|---|---|
| $T_1$ | 1.06 | 1.06 | 1.25 | 1.21 |
| $T_2$ | 1.06 | 1.06 | 1.06 | 1.18 |
| $T_3$ | 1.03 | 1.07 | 1.17 | 1.25 |
| $T_4$ | 1.00 | 1.06 | 1.09 | 1.18 |
| $T_5$ | 1.08 | 1.08 | 1.17 | 1.34 |
| $T_6$ | 1.03 | 1.25 | 1.25 | 1.31 |
| $T_7$ | 1.08 | 1.13 | 1.17 | 1.30 |
| $T_8$ | 1.03 | 1.09 | 1.25 | 1.26 |
| $T_9$ | 1.06 | 1.09 | 1.18 | 1.31 |
| $T_{10}$ | 1.06 | 1.25 | 1.20 | 1.46 |
| $T_{11}$ | 1.06 | 1.25 | 1.21 | 1.36 |
| $T_{12}$ | 1.06 | 1.09 | 1.09 | 1.20 |
| $T_{13}$ | 1.03 | 1.06 | 1.06 | 1.09 |
| S. Em± | - | - | - | 0.06 |
| CD at 5% | NS | NS | NS | 0.18 |

## Conclusion

From the present experiment, it can be concluded that $ZnSO_4$ (0.2%) + $MnSO_4$ (0.2%) + $FeSO_4$ (0.1%) was found to be best for plant height, plant spread, Number of leaves per plant, Length of leaf, number of suckers per plant, and $ZnSO_4$ (0.4%) + $MnSO_4$ (0.4%) + $FeSO_4$ (0.3%) was found to be best for width of leaf.

## References


1. Ahmad I, Khan MA, Qasim M, Ahmad R, Randhawa MA. Growth, yield and quality of Rosa hybrida L. as influenced by various micronutrients. Pak. J of Agric. Sci. 2010; 47:1:5-12.
2. Bhattacharjee SK, DE LC. advanced commercial floriculture. Avishkar Publication, Jaipur. 2003, 299-308.
3. Balakrishnan V. Effect of micronutrients on flower yield and xanthophylls content of African marigold (*Tagetus erecta* L.). M.Sc, Thesis submitted to Tamil Nadu Agricultural University, Coimbatore, 2005.
4. Bashir AB, Ahmad W, Ahmad KS, Shafi J, Muhammad AS, Muhammad A *et al*. Efficacy of foliar application of micro nutrients on growth and flowering of *Gerbera jamesonii* L. Uni. J of Agri. Res. 2013; 1(4):145-149.
5. Jadhav AH, Dalal SR, Shinde RD, Deshmukh RP. Effect of micronutrients on growth and flower production of Gerbera under polyhouse conditions. Adv. in Plant Sci. 2005; 18(2):755-758.
6. Kakade DK, Rajput SG, Joshi KL. Effect of foliar application of Fe and Zn on growth, flowering and Yield of China aster (Callistepus chinensis L. Nees). Asian J Hort. 2009; 4(1):138-140.
7. Khan MM. Relevance of green house A report from training on construction and management of low cost greenhouse, 1995, 1-8.
8. Khan FU. Effect of micronutrients on Dahlia. J. Orna. Hort. 2000; 3(2):122-123.
9. Muthumanicka D, Rajmani K, Jawaharlal M. Effect of micronutrients on flower production in Gerbera. J. Orna Hort. 1999; 2(2):131-132.
10. Pal S, Barad AV, Singh AK, Khadda BS, Kumar D. Effect of foliar application of Fe and Zn on growth, flowering and yield of gerbera (*Gerbera jamesonii*) under protected condition. Indian J Agri. Sci. 2016; (86)3:394-398.
11. Pattanashetti CN, Athani SI, Harish DK, Imamsaheb SJ. Economics of gerbera (Gerbera jamesonii) cultivation under protected conditions. Plant Archives. 2012; 12(1):91-94.
12. Rao KSP. Influence of iron nutrition on growth, flowering and corm yield in gladiolus. J Orn Hort. 2005; 8(4):293-295.