

Original Research Article

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Effect of Micronutrients on Growth and Flowering of Gerbera (*Gerbera jamesonii*) Var. Rosaline

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ABSTRACT

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The present experiment was conducted to study the effect of different micronutrients for improving the quality as well as yield of *Gerbera jamesonii* Var. Rosaline considering both vegetative growth and flowering parameters under protected condition. The experiment was carried out at horticulture research station, BCKV, Nadia, West Bengal, during the year 2017-2018. Experimental field was laid out in completely randomized design consisting of thirteen treatments each including three replicates. Foliar spray of four micronutrients viz., Fe, Mg, Zn and B at three levels (0.4%, 0.6% and 0.8%) were applied. The observations showed that ferrous sulphate at a concentration of 0.6% recorded the maximum plant height (42.0 cm), the highest no. of flowers/plant (14.7) with the maximum flower diameter (12.5cm), whereas the best result in terms of no. of leaves (41.0), no. of suckers (8.0), plant spread (78.0cm) and flower stalk length (71.7cm) was recorded in magnesium sulphate. Vase life of the cut flower was found maximum in plant treated with 0.6% magnesium sulphate. No significant difference was found in all treatments regarding flower stalk diameter. Application of Ferrous sulphate, Magnesium sulphate and Zinc sulphate were found to significantly increase the growth and flowering of plant. However, application of Boric acid in all levels was found to be less effective.

Introduction

Gerbera (*Gerbera jamesonii*) belongs to the family compositae, which is commonly known as Transvaal Daisy, Barberton Daisy or African daisy. It is an important commercial flower grown throughout the world in a wide range of climatic conditions. It produces attractive flowers known as 'head' or capitulum in wide range of colors including

yellow, orange, cream, white, pink, brick- red, scarlet, salmon, maroon, terracotta and various other intermediate shades.

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.

It ranks fifth in the international cut flower market. 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. It is a popular cut flower in Holland, Germany and USA (Choudhary and Prasad, 2000; Sujatha *et al.*, 2002). Gerbera are broadly and commonly used as cut flowers for flowery array, interior decoration and gifts for particular occasion, wedding ceremony bouquet. Micronutrients play vital roles in the growth and development of plants, due to their stimulatory and catalytic effects on metabolic processes and ultimately on flower yield and quality (Khosa *et al.*, 2011). Micronutrients are to be necessarily taken up by the plants from soil or supplemented through foliar application for good growth and yield of crops and maximizing the efficient use of applied N, P and K. Due to unbalanced use of micronutrient, the plant growth, development and quality of flower are directly affected. Therefore the balanced nutrient application is necessary for healthy plant growth and production of quality flower. In the absence of micronutrients, the plants are known to suffer from physiological disorders which eventually lead to imbalanced growth and low yield of flower. The advantages of foliar fertilizers were more noticeable under growing conditions restricting the incorporation of nutrients from the soil. So, the present experiment was carried out to investigate the comparative effect of different micronutrients and find out the most appropriate dose to get best quality products.

Materials and Methods

The experiment was carried out to monitor the effect of micronutrients on growth and flowering of *Gerbera jamesonii* Var. Rosaline

at horticulture research station, BCKV, Nadia, West Bengal, during the year 2017-2018 under protected condition. Tissue cultured plants of commercial variety Rosaline was planted in the early September.

Standard package of practices was followed for growing the crop with regular nutrient application through fertigation. Four micronutrients viz., Fe, Mg, Zn and B at three levels (0.4%, 0.6% and 0.8%) were applied in replicated plots.

The experimental field was laid out in completely randomized design comprising of thirteen treatments like T₁: Ferrous sulphate @ 0.4%, T₂: Ferrous sulphate @ 0.6%, T₃: Ferrous sulphate @ 0.8%, T₄: Magnesium sulphate @ 0.4%, T₅: Magnesium sulphate @ 0.6%, T₆: Magnesium sulphate @ 0.8%, T₇: Zinc sulphate @ 0.4%, T₈: Zinc sulphate @ 0.6%, T₉: Zinc sulphate @ 0.8%, T₁₀: Boric acid @ 0.4%, T₁₁: Boric acid @ 0.6%, T₁₂: Boric acid @ 0.8%, T₁₃: Only water spray, of each having three replicates and the data was investigated statistically by performing analysis of variance regarding all parameters and interpreted at 5% probability level to compare the difference among treatment means.

Results and Discussion

Comprehensive study in terms of both vegetative growth and flowering parameters of *Gerbera* Var. Rosaline was followed in this experiment to find out the effect of different micronutrients for improving the quality and yield of the plant. Observations were recorded by means of plant height, no. of leaves/plant, no. of suckers/plant, plant spread, no. of flowers/plant, flower diameter, stalk length, stalk diameter, vase life and the result displayed here in Table 1 and Table 2. Significant differences were noticed among the treatments for all the characters studied.

Vegetative growth

The effect of vegetative growth influenced by application of different micronutrients on gerbera Var. 'Rosalin' in terms of plant height, number of leaves, number of suckers and plant spread is reflected in Table-1. The maximum plant height was observed in plant treated with T₂: Ferrous sulphate @ 0.6%, (42.0cm) which was at par with T₁: Ferrous sulphate @ 0.4% (41.3cm), T₃: Ferrous sulphate @ 0.8% (40.0cm), T₅: Magnesium sulphate @ 0.6% (39.7cm) and T₈: Zinc sulphate @ 0.6% (39.0cm), whereas minimum plant height was recorded in control (26.7cm) over other treatments. So, ferrous sulphate of 0.6% brought the gerbera plants increase up to 57.3% more plant height over control. It is indicating that increase level of ferrous sulphate from 0.4% to 0.6% improved plant height, but higher dose declined the plant height and same magnitude was observed in all most all the micronutrients.

Regarding leaves production as shown in Table 1, response was received the best from those plants treated with T₄: Magnesium sulphate @ 0.4% and T₅: Magnesium sulphate @ 0.6% influencing the production of maximum number of leaves (41.0) which was at par with the application of T₇: Zinc sulphate @ 0.4% (40.3), T₂: Ferrous sulphate @ 0.6% (39.3) and T₁: Ferrous sulphate @ 0.4% (39.0). Leaf production was recorded the least in control (18.3). The remaining dose of both magnesium sulphate and ferrous sulphate also showed a significant increase in number of leaves (38.0) but number of leaves was not so remarkably increased due to application of other two doses of zinc sulphate. So, initial two doses of magnesium sulphate i.e. 0.4% and 0.6% showed a significant increase in leaf production up to 124.04% over control. Further increase in doses expressed reverse effect. The increase level of ferrous sulphate from 0.4% to 0.6%

enhanced leaf production, but higher dose declined the number of leaves production rate. Increasing dose of zinc sulphate had a negative impact regarding leaf production.

Sucker production was greatly influenced by different level of micronutrients as revealed in Table 1. The plants treated with different doses of magnesium sulphate, ferrous sulphate and zinc sulphate, resulted a remarkable increase in number of sucker development per plant over control. Plants treated with T₆: 0.8% magnesium sulphate produced the highest number of suckers (8.0) and it was found to be at par with T₇: Zinc sulphate @ 0.4% (7.3 number of suckers), T₂: Ferrous sulphate @ 0.6% & T₃: Ferrous sulphate @ 0.8% (6.6 number of suckers) and T₁: Ferrous sulphate @ 0.4% (6.0 number of suckers). The minimum number of suckers was developed in control (3.6). Thus the result indicates that magnesium sulphate @ 0.8% augmented the sucker production by 122.2% over control. It was also highlighted that increasing doses of both magnesium sulphate as well as ferrous sulphate triggered the increase in sucker production. The effect was recorded just opposite in case of zinc sulphate.

Plant spread or canopy spread of the plant is considered as an important vegetative growth parameter over which a remarkable influence of different doses of micronutrients was noticed in this investigation. The findings regarding plant spread is exhibited here in Table 1. The maximum plant spread was assessed in plant treated with T₄: Magnesium sulphate @ 0.4% (78.0cm) which was at par with T₅: Magnesium sulphate @ 0.6% (75.0cm) and followed by T₆: Magnesium sulphate @ 0.8% (71.7cm), T₂: Ferrous sulphate @ 0.6% (71.0cm) T₁: Ferrous sulphate @ 0.4% (70.3cm) and T₃: Ferrous sulphate @ 0.8% (69.0cm), whereas plant spread was recorded the least in control

(47.3cm) over other treatments. So, magnesium sulphate of 0.4% brought the gerbera plants increase up to 64.9% more plant spread over control. It is stipulated that the lowest dose of magnesium sulphate displayed the best result and increase level from 0.4% to 0.6% and 0.8%, showed a significant decline in the plant spread. Same magnitude was observed in boric acid treated plants. However magnitude differed in ferrous sulphate treated plants where increase level from 0.4% to 0.6% boost the plant spread, but higher dose reduced the plant spread and same magnitude was observed in zinc sulphate.

Flowering behavior and vase life

In this experiment, flower quality was evaluated in terms of total number of flowers per plant, flower diameter, stalk length, stalk diameter and vase life as well. Data collected on the parameters of flower quality were subjected to statistical analysis at 5% probability level of significance and the results represented in table 2.

The maximum number of flowers per plant (Fig. 1) was inscribed in plant treated with T₂: Ferrous sulphate @ 0.6%, (14.7 flowers per plant) which was at par with T₃: Ferrous sulphate @ 0.8% (13.3 flowers per plant), T₁: Ferrous sulphate @ 0.4% (12.7 flowers per plant), T₅: Magnesium sulphate @ 0.6% (12.7 flowers per plant) and followed by other two doses of magnesium sulphate and all doses of zinc sulphate, Whereas, the minimum number of flowers per plant was recorded in control (5.3 flowers per plant) over other treatments. T₁₁: Boric acid @ 0.6% and T₁₂: Boric acid @ 0.8% was at par with control. So, ferrous sulphate of 0.6% enriched the gerbera plants with up to 177.3% more number of flowers per plant over control. It is indicating that increase level of ferrous sulphate from 0.4% to 0.6% improved plants by increasing

number of flowers, but higher dose declined the flower production and same magnitude was observed in all most all the micronutrients.

Data represented in Table 2 shows that the highest flower diameter (12.5cm) was observed in the plant treated with T₂: Ferrous sulphate @ 0.6% which was recorded to be at par with T₁: Ferrous sulphate @ 0.4% (12.4cm) and T₃: Ferrous sulphate @ 0.8% (12.4cm), T₄: Magnesium sulphate @ 0.4% (12.4cm) and followed by T₅: Magnesium sulphate @ 0.6% (12.4cm), whereas flower diameter was recorded the least in control (9.2cm) over other treatments.

The application of boric acid showed no significant difference in enhancing flower diameter and was at par with control. Thus the result indicates that ferrous sulphate @0.6% elevated the flower diameter by 35.9% over control. It is implicated that increase level of ferrous sulphate from 0.4% to 0.6% improve plant by increasing flower diameter, but higher dose reduced the flower diameter. However, the result shows a little or no change with the increased level of magnesium sulphate from 0.4% to 0.6% but higher dose reduced the flower diameter and same amplitude noticed in zinc sulphate.

Regarding stalk length and stalk diameter, micronutrients evolved a notable influence in increasing the length as well as diameter of flower stalk over control. The longest stalk length (71.7cm) was recorded in T₅: Magnesium sulphate @ 0.6% which was at par with T₄: Magnesium sulphate @ 0.4% (70.0cm). The result depicts that all treatments of ferrous sulphate i.e. T₂: Ferrous sulphate @ 0.6% (61.7cm), T₃: Ferrous sulphate @ 0.8% (61.7cm) and T₁: Ferrous sulphate @ 0.4% (58.7cm) was at par. Stalk length was recorded the minimum in control (41.0cm).

The plants treated with different doses of zinc sulphate, were effective to enhance the stalk length and the values were at par with T₆: Magnesium sulphate @ 0.8%. The recorded data reflects that almost all the micronutrients had a remarkable influence in increasing stalk length over control. So, application of 0.6% magnesium sulphate enlarged the stalk by 74.8% more than control. The observation indicates that increasing level of magnesium sulphate from 0.4% to 0.6% improved the stalk length but higher dose had adverse effect. Same magnitude was followed in zinc sulphate but for ferrous sulphate increase in stalk length was noticed even at the maximum level.

Regarding stalk diameter as reflected in Table 2, there was a significant change where all the treatments showed superior result over control. The maximum stalk diameter (0.44cm) was recorded from the plants treated with T₂: Ferrous sulphate @ 0.6% which was at par with T₄: Magnesium sulphate @ 0.4% (0.42cm), T₆: Magnesium sulphate @ 0.8% (0.41cm), T₇: Zinc sulphate @ 0.4% (0.41cm), T₈: Zinc sulphate @ 0.6% (0.41cm), T₉: Zinc sulphate @ 0.8% (0.41cm), and T₁₀: Boric acid @ 0.6% (0.41cm). Both of the rest two doses of ferrous sulphate as well as 0.6% magnesium sulphate produced stalk diameter of 0.37cm. Thus the result showed that 0.6% ferrous sulphate broaden the stalk by 41.9% over control. Increase level of ferrous sulphate from 0.4% to 0.6% specified to enhance flower stalk diameter, but higher dose restricted the growth and same magnitude was observed in all most all the micronutrients.

Vase life of the cut flower was also considerably influenced by micronutrients as mentioned in Table 2. The maximum vase life (7.8days) was observed in the flower treated with T₅: Magnesium sulphate @ 0.6%, whereas the minimum vase life was recorded

in control (6.3days) which was at par with boric acid at all level. Here, the percent increase in vase life of flowers was noted to be 23.8% by the application of 0.6% magnesium sulphate over control. The findings depicts that medium dose of magnesium sulphate was superior over other two doses. However, in case of all other micronutrients, plants responded better on the lowest dose over others.

In this investigation, micronutrients have shown a remarkable response to increase plant height and spread. It might be due to active effect of micronutrients on synthesis of different growth hormones like auxins and enhancing the uptake of nitrogen which improves metabolism to stimulate growth of the plants. All the factors are involved in cell division, cell multiplication and cell differentiation resulting in increased photosynthesis and translocation of food material thus enhancing the plant spread.

A significant difference regarding plant height and plant spread has been found among different treatments and all the values recorded superior over control. Application of Ferrous sulphate, Magnesium sulphate and Zinc sulphate has been found to significantly increase the plant height and plant spread than control. Although there was a significant increase in plant height and plant spread due to effect of zinc sulphate spray, Boric acid in all levels was found to be less effective in enhancing plant height as well as plant spread. The observations are in line with the findings of Muthumanickam *et al.*, (1999), Anuprite *et al.*, (2005) where the effect of micronutrient was determined to be essential for growth having stimulatory and catalytic effect in physiological and metabolic process in Gerbera. Pal *et al.*, (2016) conducted an experiment in gerbera and reported that micronutrients notably influenced the vegetative growth of plants. Similar results

were also reported by Jadhav (2004), Sahu *et al.*, (2016) in Gerbera. Nearby similar observations were recorded by Rao (2005), Juhari *et al.*, (2005) in Gladiolus. Near about similar results were also obtained by Balakrishnan (2005) in marigold, Ahmad *et al.*, (2010) in Rose and Kakade *et al.*, (2009) in china aster. Micronutrient plays a vital role in activation of enzymes as well as metabolism of carbohydrates and nitrogen.

It is also involved in assimilation of carbon dioxide in photosynthesis and also helps in uptake of iron. 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. Application of micronutrient might be resulted to better plant growth along with significant increase in number of leaves per plant. This experiment reflects that application of magnesium, iron and zinc had a significant effect to increase the number of leaves per plant and all treatments were superior over control. The result shows that application of Fe and zinc though had a positive effect in influencing the number of leave, Boric acid again was found less effective than other treatments. The result achieved is in line with the findings of Sahu *et al.*, (2016) and Jadhav (2004) in Gerbera, Khan (2000) in Dahlia cv. Swami Lokeshwaranand, Ahmad *et al.*, (2010) in Rose. Micronutrients like ZnSO₄, FeSO₄ and MgSO₄ are considered as essential components of several enzymes such as dehydrogenase, proteinase, peptidase etc. each of which plays active role to promote growth, enhancement of hormones, all these factors contribute to cell multiplication, cell division and cell differentiation resulting in increased photosynthesis and translocation of food material which enhanced the number of suckers. The plants treated with different levels of magnesium sulphate, ferrous

sulphate and zinc sulphate, resulted a remarkable increase in number of sucker development per plant. Application of boric acid in all levels had a little effect on enhancing the number of suckers per plant. The above result is supported by Pal *et al.*, (2016) in Gerbera. The finding is also near about similar with the report of Sahu *et al.*, (2017) in gerbera.

Zinc, iron and magnesium play an important role by involving in photosynthesis, break down of IAA, auxin and protein synthesis increase the flower yield through foliar application of micronutrients. The result illustrated that different doses of ferrous sulphate and magnesium sulphate greatly influence yield and quality of the flowers in all respect. Zinc sulphate also improvised the quality remarkably. However, application of boric acid had a negligible effect, in fact, it had adverse effect at all level like leaf yellowing. The observation recorded was supported by the findings of Sahu *et al.*, (2017) who had studied the effect of micronutrients on Gerbera and reported ferrous sulphate to be the best micronutrient for growth and flowering of the plant.

Near about similar results were obtained by jadhav *et al.*, (2005). Application of micronutrients also had a significantly positive effect in stalk length and stalk diameter. The results are in agreement with Nahed (2007) who conducted experiment on blue sage to enhance the length of peduncle and length of main inflorescence by the spray of zinc and tyrosine. The result of the present investigation was in line with the findings of Sahu *et al.*, (2016). The observation recorded was also supported by Basir *et al.*, (2013) in Gerbera. Mostafa (1996) studied the effect of B, Mn and Mg on the growth of carnation which resulted with increased flower diameter (Fig. 2 and 3).

Table.1 Effect of different micro-nutrients on vegetative growth of gerbera Var. Rosaline

Treatments	Plant height (cm)	No. of leaves/plant	No. of sucker/plant	Plant spread (cm)
T ₁ : Ferrous sulphate @ 0.4%	41.3	39.0	6.3	70.3
T ₂ : Ferrous sulphate @ 0.6%,	42.0	39.3	6.6	71.0
T ₃ : Ferrous sulphate @ 0.8%	40.0	38.0	6.6	69.0
T ₄ : Magnesium sulphate @ 0.4%	38.7	41.0	5.6	78.0
T ₅ : Magnesium sulphate @ 0.6%	39.7	41.0	6.0	75.0
T ₆ : Magnesium sulphate @ 0.8%	36.0	38.0	8.0	71.7
T ₇ : Zinc sulphate @ 0.4%	37.7	40.3	7.3	68.0
T ₈ : Zinc sulphate @ 0.6%	39.0	34.0	5.6	68.3
T ₉ : Zinc sulphate @ 0.8%	32.7	27.3	5.3	65.7
T ₁₀ : Boric acid @ 0.4%	34.0	31.7	4.6	64.7
T ₁₁ : Boric acid @ 0.6%	35.0	29.7	5.0	61.3
T ₁₂ : Boric acid @ 0.8%	32.7	30.7	4.3	56.0
T ₁₃ : Control(Only water spray)	26.7	18.3	3.6	47.3
Mean	36.6	34.49	6.17	66.64
SEm (±)	1.55	1.43	0.627	2.73
CD (P=0.05)	3.07	2.87	1.83	5.49
CV (%)	5.19	5.07	18.74	5.02

Table.2 Effect of different micro-nutrients on flowering behavior and vase life of gerbera Var. Rosaline

Treatments	No. of flowers / plant	Flower diameter (cm)	Stalk length (cm)	Stalk diameter (cm)	Vase life(Days)
T ₁ : Ferrous sulphate @ 0.4%	12.7	12.4	58.7	0.37	7.7
T ₂ : Ferrous sulphate @ 0.6%,	14.7	12.5	61.7	0.44	7.7
T ₃ : Ferrous sulphate @ 0.8%	13.3	12.4	61.7	0.37	7.4
T ₄ : Magnesium sulphate @ 0.4%	10.7	12.4	70.0	0.42	7.7
T ₅ : Magnesium sulphate @ 0.6%	12.7	12.4	71.7	0.37	7.8
T ₆ : Magnesium sulphate @ 0.8%	11.0	11.9	55.3	0.41	7.7
T ₇ : Zinc sulphate @ 0.4%	10.7	11.6	55.7	0.41	7.7
T ₈ : Zinc sulphate @ 0.6%	12.0	11.6	54.7	0.41	7.5
T ₉ : Zinc sulphate @ 0.8%	10.7	10.9	50.3	0.41	7.2
T ₁₀ : Boric acid @ 0.4%	7.3	10.7	43.7	0.36	6.7
T ₁₁ : Boric acid @ 0.6%	6.0	10.8	47.3	0.42	6.5
T ₁₂ : Boric acid @ 0.8%	5.7	10.8	45.0	0.35	6.5
T ₁₃ : Control(Only water spray)	5.3	9.2	41.0	0.31	6.3
Mean	10.21	11.52	55.13	0.38	7.25
SEm (±)	0.91	0.18	3.29	0.01	0.31
CD (P=0.05)	1.82	0.36	6.62	0.05	0.62
CV (%)	10.87	1.90	7.32	7.87	5.21

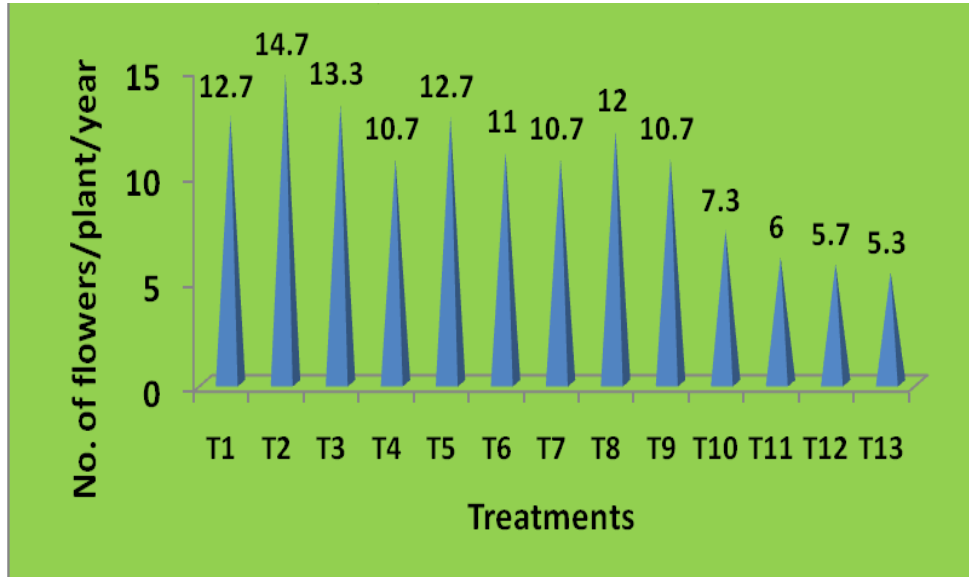


Fig.1 Effect of different micro-nutrients on flower production of Gerbera Var. Rosalin

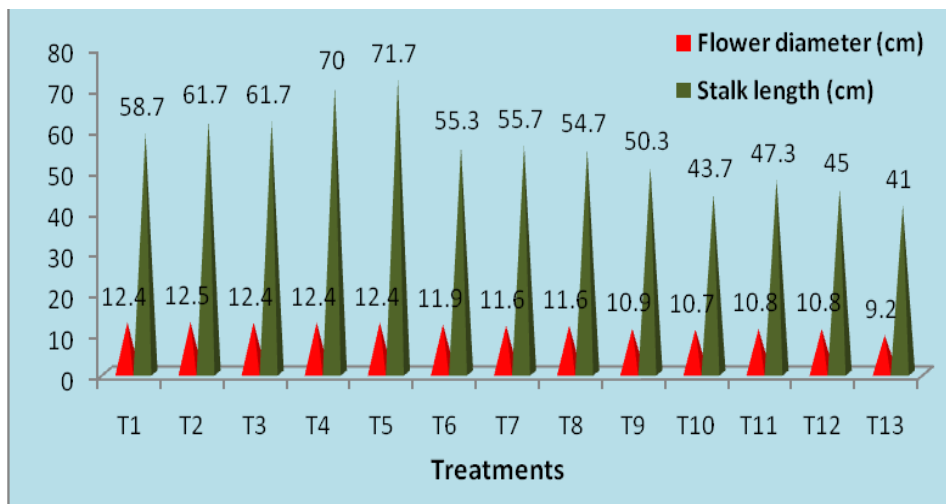


Fig.2 Effect of different micro-nutrients on flower diameter and stalk length of gerbera Var. Rosaline

From the present investigation it can be concluded that ferrous sulphate @ 0.6% is the superior to increase plant height and magnesium sulphate found to be the best to elevate the vegetative growth of gerbera in terms of plant spread, total number of suckers per plant, number of leaves per plant. Regarding the aquirement of higher yield with better quality cut flowers, effect of ferrous sulphate @ 0.6% is the supreme in maximizing number of flower production per

plant with greater diameter and acceptable stalk length as well as the longest vase life. Magnesium sulphate @ 0.6% proves to be the best in response to improve flower stalk length and diameter. So, magnesium sulphate and ferrous sulphate at a dose of 0.6% can be recommended for gerbera cultivation, moreover application of magnesium sulphate would respond better in vegetative growth stage and during flowering ferrous sulphate application would be more preferable.

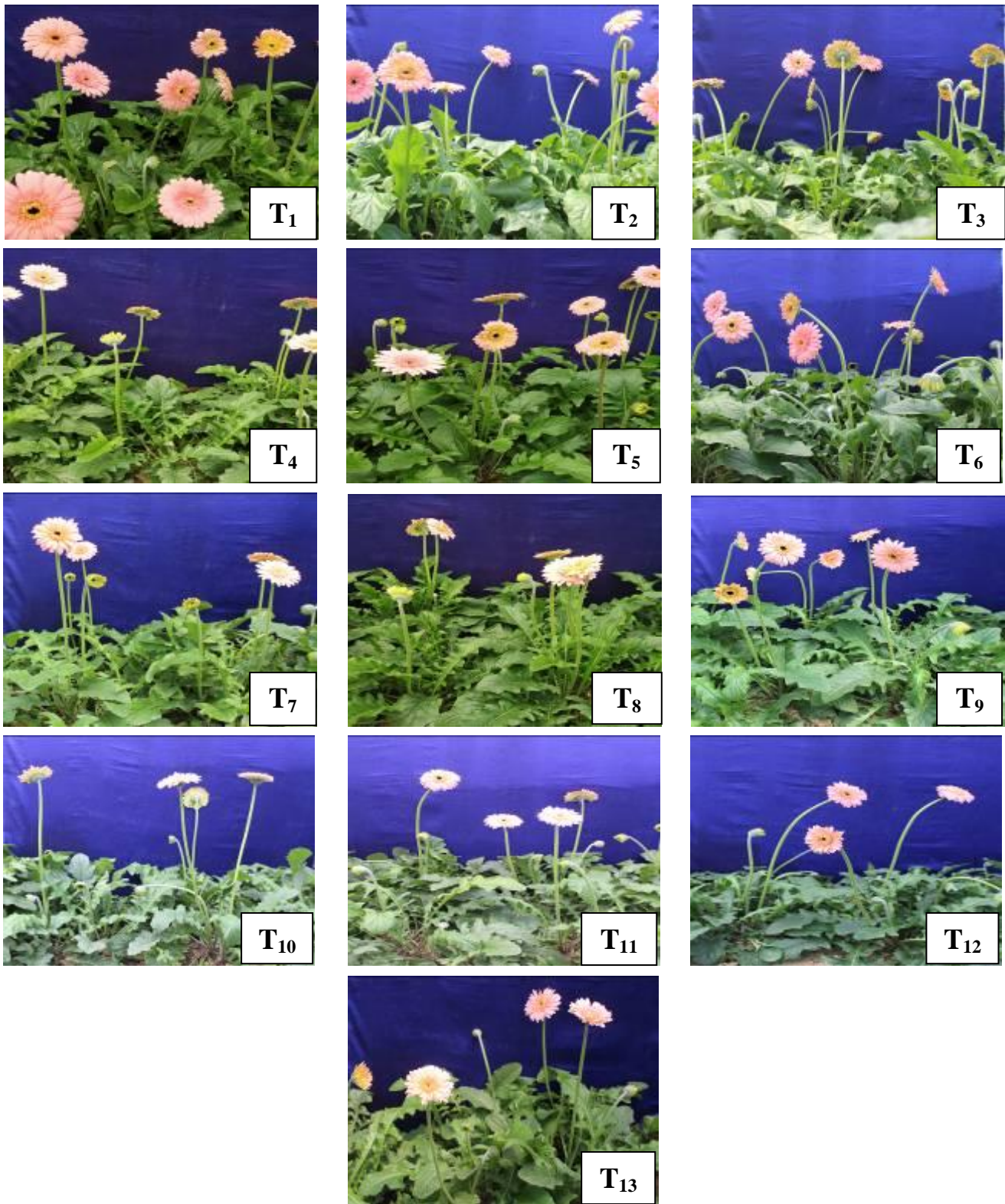


Fig.3 (T₁- T₁₃) Effect of micronutrients on vegetative growth and flowering of Gerbera (*Gerbera jamesonii*) Var. Rosaline

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