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Effect of Foliar Application of Micronutrients on Growth and Flower Production of Gerbera Under Protected Condition

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The experiment on Effect of foliar application of micronutrients on growth and flower production of Gerbera under protected condition was carried out during the year 2015-16. The experiment was laid out in Completely Randomized Design (CRD) with three replications comprising thirteen levels of micronutrients. Growth, flowering, yield and quality attributes influenced by different levels of micronutrients, *viz* Plant height, number of leaves per plant, plant spread, stalk length, stalk thickness, flower diameter, number of flower per plant, vase life significantly highest when the micronutrients was applied at level of [($ZnSO_4$ (0.2%) + $MnSO_4$ (0.2%) + $FeSO_4$ (0.1%)].

Keywords: Gerbera, zinc, manganese, iron, protected condition, foliar application.

Gerbera (*Gerbera jamesonii*) belongs to the family compositae. This flower is native to South African and Asiatic regions. The genus Gerbera consists of about 40 species comprising half-hardy and perennial flowering plants. In India, they are distributed in the temperate Himalayas from Kashmir to Nepal at altitudes of 1300 to 3200 meters.

Gerbera is one of the most imperative commercial cut flower. It ranks fourth in the international cut flower market and a popular cut flower in Holland, Germany and USA (Choudhary and Prasad, 2000 and Sujatha *et al.*, 2002). It is an important commercial flower grown throughout the world in a wide range of climatic conditions. Gerbera are broadly and commonly used as cut flowers for flowery array, interior decoration and gifts for particular occasion, wedding ceremony bouquet. The daisy like flowers are in wide range of colours including yellow, orange, cream, white, pink, brick-red, scarlet, salmon, maroon, terracotta and various other intermediate shades.

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The plant growth and development as well as flower quality significantly influenced by climatic factors as well as nutrient management. Due to unbalanced use of macro and micro nutrient, 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.

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. In the absence of these micronutrients, the plants are known to suffer from physiological disorders which eventually lead to imbalanced growth, flower quality and low yield.

Foliar application of nutrients is gaining more importance in fertilization of various field and floricultural crops, in many countries. The advantages of foliar fertilizers were more obvious under growing conditions restricting the absorption of nutrients from the soil. Foliar fertilization technique may also be a good alternative to the conventional soil application to avoid the loss of fertilizers by leaching and thereby, minimizing the ground water pollution. Foliar nutrition is recommended by several investigators as an alternative fertilization method to improve the growth and flowering of gerbera.

MATERIALS AND METHODS

The present study was carried out under protected condition at the center of excellence on protected cultivation, Department of Floriculture and Landscape Architecture, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur, (C.G) during the year 2015-16. The experiment was laid out in Completely Randomized Design (CRD), with spacing of 25 cm (Row to row) X 25 cm (Plant to plant). With thirteen treatment combinations, and three replication. The micronutrients are applied at 30 days interval after planting.

RESULTS AND DISCUSSION

The maximum plant height (44.87cm) was recorded with foliar application of treatment T_{10} [$ZnSO_4$ (0.2%) + $MnSO_4$ (0.2%) + $FeSO_4$ (0.1%)] which was showed significant difference with treatment T_1 (40.68 cm), T_9 (40.52 cm), T_7 (39.75 cm) and T_{13} (37.32 cm) however it was found non - significant differences with rest of the treatments. The minimum plant height (37.32 cm) was observed with treatment T_{13}.

The increased plant height with application of micronutrients might be due to its

Treatment details

Treatment	Micronutrients
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	$FeSO_4$ (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%) + MnSO4 (0.4%) + FeSO4 (0.3%)
T_{12}	$ZnSO_4$ (0.6%) + $MnSO_4$ (0.6%) + $FeSO_4$ (0.5%)
T_{13}	Control (water spray)

Table 1. Effect of foliar application of micronutrients on growth and yield and quality of Gerbera under protected condition

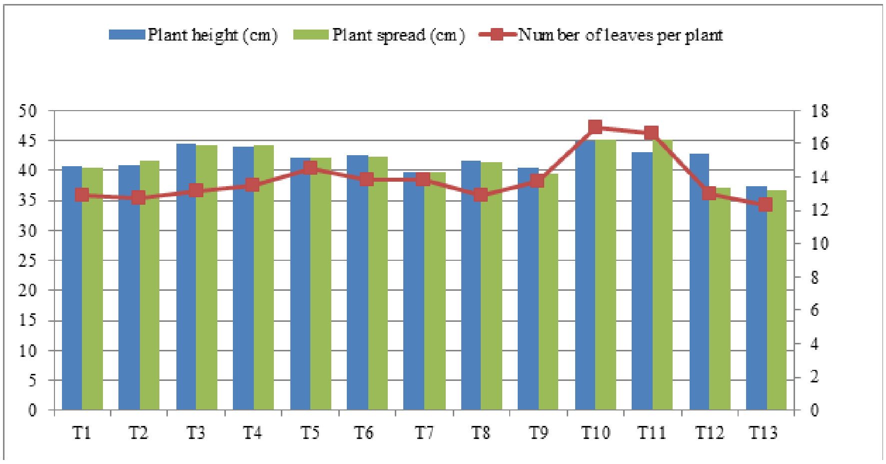
Treatment	Plant height after 120days (cm)	No. of leaves per plant after 120days	Plant spread after 120 days (cm)	Stalk length (cm)	Stalk thickness (mm)	Flower diameter (cm)	No. of cut flower per plant	Vase life days
T_1	40.68	12.93	40.35	63.20	6.69	9.77	5.07	5.33
T_2	40.83	12.73	41.50	64.11	6.68	9.94	5.40	5.67
T_3	44.42	13.13	44.09	65.97	6.89	10.09	5.33	5.33
T_4	43.89	13.47	44.23	64.95	6.49	9.89	5.47	5.33
T_5	42.01	14.47	42.01	66.79	6.62	9.74	5.87	6.00
T_6	42.61	13.87	42.27	63.36	6.76	9.69	5.47	5.33
T_7	39.75	13.87	39.75	63.30	6.60	10.07	5.47	5.33
T_8	41.63	12.93	41.30	67.80	6.50	9.84	5.60	5.67
T_9	40.52	13.73	39.52	67.92	6.54	9.69	5.60	6.00
T_{10}	44.87	16.93	45.20	69.59	7.16	11.09	6.27	6.67
T_{11}	43.07	16.60	45.07	68.22	6.97	10.53	6.07	6.33
T_{12}	42.69	13.00	37.02	66.81	6.94	10.13	5.33	5.67
T_{13}	37.32	12.27	36.65	60.69	6.06	9.11	4.07	4.67
S. Em±	1.40	0.74	1.49	1.72	0.18	0.30	0.28	0.34
CDat 5%	4.08	2.17	4.33	5.01	0.54	0.88	0.82	1.00

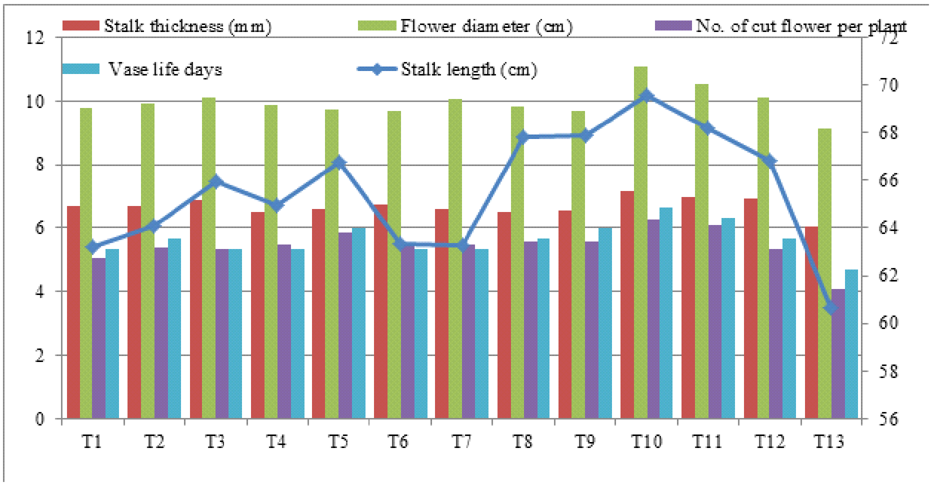
role in synthesis of tryptophan which is a precursor of auxin (IAA) and it is essential in nitrogen metabolism which stimulates growth of the plants similarly iron acts as an important catalyst in the enzymatic reactions of the metabolism and would have helped in larger biosynthesis of photo assimilates thereby enhancing growth of the plants., Juhari *et al*. (2005), in gladiolus.

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 followed by treatment T_{11} (16.60) and treatment T_{10} was observed significantly different with rest of the other treatments. The minimum number of leaves per plant (12.27) was noted with the treatment $T_{13.}$

The micronutrient $MnSO_4$ 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 $MnSO_4$ might be resulted in significant increase in number of leaves per plant. The results are conformity with findings of Khan (2000) in Dahlia cv. Swami Lokeshwaranad, Ahmad *et al.* (2010) in Rose.

The maximum plant spread (45.20 cm) was recorded in T_{10} [($ZnSO_4$ (0.2%) + $MnSO_4$ (0.2%) + $FeSO_4$ (0.1%)] which was statistically similar with T_{11} (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). However it was significantly difference with rest





of the treatments. The minimum plant spread (36.65 cm) was recorded in T_{13} (control).

Micronutrients 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 ZnSO4 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. It might be enhanced to plant sprayed. Similar results were also obtained by Kakade et al. (2009) in china aster, Balakrishnan (2005) in marigold and Ahmad *et al.* (2010) in Rose

The maximum stalk length (69.59 cm) was obtained in treatment T_{10} [$ZnSO_4$ (0.2%) + $MnSO_4$ (0.2%) + $FeSO_4$ (0.1%)] which was statically similar with T_{11} (68.22 cm), T_9 (67.92 cm), T_8 (67.80cm), T_{12} (66.81 cm), T_5 (66.79 cm), T_3 (65.97 cm) and T_4 (64.95 cm). Whereas it was showed significantly impact with rest of the treatments. However the minimum stalk length (59.34 cm) was obtained in T_{13} where on water spray was applied.

The maximum stalk thickness (7.16 mm) was obtained in treatment T_{10} [$ZnSO_4$ (0.2%) + $MnSO_4$ (0.2%) + $FeSO_4$ (0.1%)] which was statically similar with T_{11} (6.97 mm), T_3 (6.89 mm), T_6 (6.76 mm), T_{12} (6.94 mm), T_1 (6.69 cm), T_2 (6.68 mm) and T_5 (6.62 mm). Although it was significantly difference to rest of the treatments. The minimum stalk thickness (6.06 mm) obtained in T_{13}.

The treatment effects were found to varied significantly for flower diameter the maximum flower diameter (11.09 cm) was recorded with the application of treatment T_{10} [$ZnSO_4$ (0.2%) + $MnSO_4$ (0.2%) + $FeSO_4$ (0.1%)] followed by treatment T_{11} [$ZnSO_4$ (0.4%) + $MnSO_4$ (0.4%) + $FeSO_4$ (0.3%)] and treatment T_{10} was showed significantly varied with rest of the other treatments. The minimum flower diameter (9.11 cm) was recorded in T_{13}.

The greater size of the flower diameter may be due to the association of zinc in regulating semi permeability of cell walls, thus mobilizing more water into flowers and also increase the synthesis of iron which promotes cell size in turns increase the flower size and weight of the flowers. Similar results also reported by Nag and Biswas (2003).

In case of number of flower per plant, the maximum number flower (6.27) per plant was noted in treatment T_{10} [($ZnSO_4$ (0.2%) + $MnSO_4$ (0.2%) + $FeSO_4$ (0.1%)] statistically similar with treatment T_{11} (6.07) and treatment T_{10} was showed significantly superior than the rest of the treatments. The minimum number flower (4.07) was obtained in treatment T_{13}.

Zinc, iron and manganese 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. Similar results were obtained by jadhav *et al*. (2005).

In case of vase life the longest vase life (6.67 days) reported with Treatment T_{10} [($ZnSO_4$ (0.2%) + $MnSO_4$ (0.2%) + $FeSO_4$ (0.1%)] which was followed by treatment T_{11} (6.33 days), T_9 (6.00 days), T_5 (6.00 days), T_2 (5.67 days), T_8 (5.67 days) and T_{12} (5.67 days).

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