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Effect of micro-nutrients (B, Zn and Cu) on plant growth of gerbera (*Gerbera jamesonii* L.) under polyhouse condition

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Abstract
Gerbera is one of the most important cut-flowers, successfully grown under different conditions in several areas of the world and meeting the requirements of various markets. This success is primarily due to the wide range in colour and shape of the flower. The present investigation was undertaken at Department of Horticulture, SHIATS, Allahabad, during the year 2015-2016. The experiment was laid out in simple R.B.D. with three replications and thirteen treatments separately. Studies showed that, significant effect on the number of leaves (15.60), spread of plant (53.07cm), minimum days of first flower bud emergence (77.37), minimum days of first flower harvest (87.43), flower diameter (10.83 cm), stalk length (57.67 cm), stalk diameter (8.32 mm), petal length (5.39 cm) gross return (121771.00), net return (65782.50) and Cost : Benefit ratio is (1:2.17) was observed maximum in treatment (T_{10}) with 0.5% B +0.5% Zn +0.25% Cu whereas height of plant (33.23 cm) was noted highest in (T_{11}) with 0.5% B +0.25% Zn +0.5% Cu.

Keywords: Gerbera, growth, quality, micro-nutrients

Introduction
Gerbera **(***Gerbera jamesonii* L.) is one of the most important cut flowers, successfully grown under different conditions in several areas of the world. It belongs to family Asteraceae and is commonly known as Transvaal, African or Barbeton Daisy. It is native of Tropical Asia and Africa. Gerbera produces attractive flowers known as 'head' or capitulum. The plants are stem-less perennial herbs. Leaves are radial, petiolate, lanceolate, deeply lobed, sometimes leathery, narrower at the base and wider at the tip and arranged in a rosette fashion at the base. Flower heads are solitary in a wide range of colours i.e. yellow, orange, cream, white, pink, brick red, scarlet, terracotta, salmon peach, maroon and various other intermediate shades. Based on the flower heads they are grouped into single, semi-double and double. Double cultivars have attractive bicoloured flowers. Flower stalks are long, thin and leafless. In addition to NPK, micronutrients have a great bearing influencing the yield attributes and flower production. Micronutrients are involved in all metabolic and cellular functions. The nutrient elements which are required comparatively in small quantities are called as micro or minor nutrients or trace elements (Ganesh and Khanna 2013) [2]. Micronutrients are essentially as important as macronutrients to have better growth, yield and quality in plants.

Materials and Methods
A field experiment was carried out at Experimental field, Department of Horticulture, Sam Higginbottom Institute of Agricultural Technology & Sciences (formerly Known as Allahabad Agriculture Institute Deemed to be University, AAI-DU) during Rabi season of 2015-2016.

Planting material
The investigation was carried out on Gerbera. The cultivar of Gerbera used for the study was "Marinilla". The planting material was obtained from IIHR-Bangalore.

Source of Micro-nutrients.
Boron Borax (11.34%B)
Zinc Zinc sulphate (40% Zn)
Copper Copper sulphate (25% Cu)

The experimental design was a complete randomized block with thirteen treatments of the following as inadequate levels of Boron (B) Zinc (Zn) and Copper (Cu) like doses of fertilizers: T0= Control, T1= 0.25%B +0.5%Zn, T2=0.25%B +0.5%Cu, T3=0.25%Zn + 0.5%Cu, T4= 0.5%B + 0.25%Zn, T5=0.5%B +0.25%Cu, T6 =0.5%Zn +0.25%Cu, T7=0.25%B +0.25%Zn + 0.5%Cu, T8=0.25%B +0.5%Zn +0.25%Cu, T9=0.5%B +0.25%Zn +0.25%Cu, T10=0.5%B + 0.5%Zn+0.25%Cu, T11=0.5%B +0.25%Zn +0.5% Cu and T12=0.25%B +0.5%Zn +0.5%Cu. The first micro-nutrients were applied immediately 20 Days after transplanting and 2nd =50 DAT, 3rd =80 DAT, 4th =110 DAT 5th =140 DAT. Data on growth and development characters were taken duly. Data were statistically analyzed using computer MSTATC program.

Results and Discussion

The present investigations, observations on various plant characteristics were recorded to evaluate the "Effect of micro-nutrients on plant growth of Gerbera (*Gerbera jamesonii* L.) cv. marinilla under Polyhouse condition". The tabulated data were statistically analyzed with a view to find out the significant effect of different factors which are present in the appendix. The results of the experiment are presented in this chapter.

The maximum plant height (33.23 cm) was recorded in T_{11} followed by T_{12} (32.43) Table no. 1. The plant height was found to be minimum (26.60 cm) in T_0 control (No-treatments). These findings were in conformity with the Misra (2001) [8] in Gerbera. The maximum number of leaves (15.60) was recorded in T_{10} followed by T_7 (15.47). The number of leaves was found to be minimum (10.87) in T_0 control (no treatments). This agrees with reports for Gerbera (Nath and Biswas 2002) [9] The maximum plant spread (53.07 cm) was recorded in T_{10} followed by T_{12}. The plant spread was found to be minimum (45.35 cm) in (T_0) control (Table 1). These findings were in conformity with the findings of Jadhav *et al*., (2005) [5]

The minimum number of days (77.37) for first flower bud emergence was recorded in T_{10} followed by T_8 (77.67). The number of days for first flower bud emergence was found to be maximum (81.13) in T_0 control (no-treatments). This finding was similar results were obtained Joshi *et al*., (2003). The minimum number of days (87.43) for first flower harvest was recorded in T_{10} followed by T_9 (87.60) The number of days for first flower harvest was found to be maximum (91.50) in T_0 control (no-treatments). Plant receiving micro-nutrient resulted in early flower production. Similar results were obtained Ahmad *et al.* (2010) [1]. The maximum stalk length (57.67 cm) was recorded in T_{10} and followed by T_7 (56.43 cm). The stalk length (47.60 cm) was found to be minimum in (T_0) control (No-treatment). This also reported by Halder *et al.* (2007) [4]. The maximum stalk diameter (8.32 mm) was recorded in T_{10} followed by T_7 (8.28 mm). The stalk diameter (7.13 mm) was found to be minimum in T_0 control (no-treatment). The maximum flower diameter was recorded in T_{10} (10.83cm), followed by T_{11} (10.55cm). The flower diameter (9.23cm) was found to be minimum in T_0 control (no-treatments). The maximum petal length (5.39 cm) was recorded in T_{10} and followed by T_{11} (5.26 cm). The petal length (4.39 cm) was found to be minimum in T_0 control (No-treatment).

On the basis of experiment, It is concluded that treatment (T_{10}) 0.5% B + 0.5% Zn + 0.25% Cu is the best treatment regarding studied parameters like number of leaves, plant spread, gross return, net return and Cost : Benefit ratio is (1:3.02). whereas treatment (T_{11}) 0.5% B + 0.25% Zn + 0.5% Cu performed best in plant height. However, since this is based on one- season experiment, further trials may be needed to substantiate the results.

Table 1: Effect of Micro nutrients (B, Zn and Cu) on Plant Growth of Gerbera (*Gerbera jamesonii* L.) cv. Marinilla

Treatment No.	Plant height (cm)					No of leaves					Plant spread (cm)				
	30 DAT	60 DAT	90 DAT	120 DAT	150 DAT	30 DAT	60 DAT	90 DAT	120 DAT	150 DAT	30 DAT	60 DAT	90 DAT	120 DAT	150 DAT
T0	13.35	15.00	18.80	24.80	26.60	4.07	5.03	6.60	8.23	10.87	23.90	30.33	35.20	41.53	45.35
T1	15.89	16.60	20.80	27.23	30.59	5.00	5.30	7.93	9.67	12.93	25.53	31.40	37.87	42.67	48.62
T2	15.85	17.77	21.90	27.23	30.40	5.40	5.20	7.67	9.00	11.93	26.10	34.73	38.57	42.47	48.37
T3	16.37	17.10	22.07	27.23	30.08	5.53	6.27	7.80	9.47	11.87	29.03	33.03	38.83	43.90	46.20
T4	16.63	18.11	22.70	28.30	31.89	4.93	6.23	8.13	9.40	13.80	31.83	34.30	39.07	41.93	48.27
T5	15.40	15.98	22.63	26.53	30.30	5.17	6.00	7.73	9.93	13.40	28.70	33.67	39.60	42.37	49.70
T6	15.79	16.83	21.97	26.50	31.53	5.53	6.13	7.80	8.73	12.33	26.93	34.90	40.27	43.30	48.53
T7	16.50	18.87	23.67	28.00	31.67	5.60	6.03	7.87	10.07	15.47	29.87	36.03	40.27	46.50	50.13
T8	16.26	19.33	23.47	28.33	31.13	6.13	6.60	8.07	9.07	12.33	29.83	34.60	40.10	42.80	49.60
T9	15.95	18.80	23.20	26.70	30.38	5.33	6.07	8.33	9.00	13.13	27.73	32.90	38.10	42.47	47.70
T10	15.85	19.90	24.47	28.67	32.20	5.27	7.23	8.41	11.27	15.60	28.03	38.33	41.57	47.80	53.07
T11	16.51	19.30	23.87	28.23	33.23	5.47	6.33	8.00	10.20	15.07	28.07	35.60	39.33	43.17	49.60
T12	16.70	19.65	23.90	30.13	32.43	5.57	22.71	8.41	10.13	14.67	28.77	37.50	41.27	46.30	50.80
F- test	NS	S	S	S	S	S	S	S	S	S	S	S	S	S	S
S. Ed. (±)	0.86947	1.14615	1.0538	0.90627	1.30459	0.36599	0.4669	0.33005	0.52885	1.05598	1.30612	1.43652	1.3022	1.50766	1.54014
C. D. at 5%	1.7945	2.36553	2.175	1.87044	2.69255	0.75536	0.9637	0.6812	1.0915	2.17944	2.69569	2.96482	2.6876	3.11166	3.1787

Table 2: Effect of Micro nutrients (B, Zn and Cu) on Plant Growth of Gerbera (*Gerbera jamesonii* L.) cv. Marinilla

Treatment No.	First bud emergence	Flower Dimter (cm)	Stalk Length (cm)	Stalk Dimeter (cm)	First flower harvest	Petal Length (cm)
T0	81.13	9.23	47.60	7.13	91.50	4.39
T1	78.93	10.32	54.00	7.41	89.40	4.88
T2	78.40	9.33	50.13	7.09	89.44	4.78
T3	79.60	9.97	54.67	7.35	88.30	4.70
T4	78.93	9.70	55.27	7.29	89.40	4.86
T5	80.33	9.99	51.40	7.22	88.87	4.69
T6	79.80	9.55	49.73	7.75	89.37	4.41
T7	79.73	10.36	56.43	8.28	87.87	4.94
T8	77.67	9.95	54.60	7.32	90.13	4.47
T9	78.60	9.55	54.73	7.80	87.60	4.77
T10	77.37	10.83	57.67	8.32	87.43	5.39
T11	78.80	10.55	55.37	7.29	88.10	5.26
T12	78.50	10.48	56.07	8.14	88.18	4.73
F- test	S	S	S	S	S	S
S. Ed. (±)	0.804324	0.395767	1.819078	0.330768	0.852451	0.216871
C. D. at 5%	1.660043	0.816822	3.754393	0.682673	1.759372	0.4476

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