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Micronutrients Affects Vegetative Growth and Flowering Parameters of Chrysanthemum (*Chrysanthemum Morifolium*)

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ABSTRACT

The present investigation was carried out at Research cum Horticultural Farm in Indira Gandhi Krishi Vishwavidyalaya, Raipur during the year 2021-22. There were ten separate micronutrients treatments consisting of different concentrations of *viz.,* T_1 control (RDF), T_2 ($FeSO_4$@0.2%), T_3 ($FeSO_4$@0.4%), T_4 ($FeSO_4$@0.6%), T_5 ($ZnSO_4$@0.2%), T_6 ($ZnSO_4$@0.4%), T_7 (ZnSO4@0.6%), T_8 (Borax@0.2%), T_9 (Borax@ 0.4%), T_{10} (Borax @0.6%) were applied. The recommended dose of fertilizers *viz.,* 150 kg N,100 kg P_2O_5 and 80 kg K_2O/ha was given as basal dose at the time of field preparation. Observations were made on vegetative growth, flowering and yield parameters of chrysanthemum. The result indicated that the treatment T_6 [$ZnSO_4$(0.4%)] performed better in the observations recorded on growth parameters *viz.,* plant height (18.30cm and 27.88cm) at 30 and 50 DAP (days after planting) respectively, plant spread(E-W) (13.59cm and 26.80cm) at 30 and 50 DAP respectively, plant spread(N-S) (12.82cm and 26.60cm) at 30 and 50 DAP respectively. Number of primary branches per plant was 5.77. Similarly, in flowering attributes treatment T_6 [$ZnSO_4$(0.4%)] showed best result *viz.,* days taken for flower bud initiation (49.09d), days taken to flower opening(60.58d), number of flower per plant (29.05), diameter of flower(4.78cm) and weight of flower per plant (2.05g).

Key Words: Bud initiation, Chrysanthemum, Flower, Micronutrients.

INTRODUCTION

Chrysanthemum (Chrysanthemum morifolium) is native to the northern hemisphere and because of its versatility, chrysanthemums can be grown in a container, planted in a bed, used to make garlands, and also as cut-flowers for floral arrangements. Small flowered varieties are produced in India to make garlands, wreaths, veni, and religious offerings, whereas large flowered varieties are planted for display and cut flower purposes. There is an urgent need to address this significant aspect of quality flower production in chrysanthemum in India due to the popularity of chrysanthemum and its potential to capture markets. Micronutrients are vital plant nutrients that are present in tissue in minute amounts but are still necessary for the growth and development of plants. Micronutrients are essential for the growth and development of plants because they have catalytic and stimulatory effects on metabolic processes. Despite the fact that they are only needed in little amounts, they are crucial for crop growth and development. Crop enrichment with micronutrients, particularly iron and zinc, may be beneficial in inhibiting flowering in crops and helping in higher flower production. Iron is a crucial component in several oxidation-reduction reactions, such as respiration, photosynthesis, nitrates, and sulphates. The majority of them are required for the functioning of various enzyme systems. In flowers and various other crops, it has been discovered that foliar sprays of ferrous sulphate and zinc sulphate or chelates are more effective and efficient than soil treatment. Boron is well known for promoting salt absorption, protein metabolism, and cell division. Also, the root formation is associated to boron. Micronutrients play a significant role in

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determining the yield characteristics and flower production.

MATERIALS AND METHODS

The experiment was carried out during the year 2021-22 to study the effect of micronutrients on vegetative growth and floral attributes in Chrysanthemum (Chrysanthemum morifolium) cv. Savita. at premises of Horticultural Research cum Instructional Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur during the year 2021-22. The experiment was conducted in the Randomized block design with three treatment and ten replications. The field experiment comprised of ten separate micronutrients treatments consisting of different concentrations of *viz.,* T_1 control (RDF), T_2($FeSO_4$@0.2%), T_3($FeSO_4$@0.4%), T_4($FeSO_4$@0.6%), T_5 ($ZnSO_4$ @0.2%), T_6 ($ZnSO_4$@0.4%), T_7(ZnSO4@0.6%), T_8(Borax@0.2%), T_9(Borax@ 0.4%), T_{10}(Borax @0.6%). The recommended dose of fertilizer viz., 150 kg N,100 kg P_2O_5 and 80 kg K_2O/ha was given as basal dose at the time of field preparation. Observations were made on vegetative growth and flowering parameters of chrysanthemum. The data were analysed statistically.

RESULTS AND DISCUSSION

Plant Height

At 30 DAP the maximum plant height (18.30cm) was recorded with the application of treatment by T_6 which was found statistically at par with treatment T_{10} and T_4. However, the minimum plant height was recorded with the application of treatment T_2 (15.01cm). At 50 days after planting maximum plant height (27.88cm) was obtained with treatment with the application of treatment T_6 which was found statistically at par treatment T_{10} and T_4. However, the minimum plant height (20.80cm) was recorded with the application of treatment T_1 (control). This increase in plant height with application of zinc sulphate application may be due to the zinc ability to synthesize tryptophan, a precursor of indoleacetic acid (auxin), which allows the plant to maintain apical dominance and promote growth. Furthermore, the greatest efficacy of the best treatments can also be attributed to the proper combination and time of application. Saini *et al* (2015), Karuppaiah (2014), and Neha Chopde (2016) all came to similar conclusions in chrysanthemum and Kumar *et al* (2003) in carnation.

Plant spread

Maximum plant spread at 30 days after planting was observed with the application of treatment T_6 (13.59cm), which was statistically at par with treatmentT_3, T_4, T_5, T_7, T_9 andT_{10}.Whereas, minimum plant spread was observed with the application of treatment T_1 (10.45cm). At 50 days after planting maximum plant spread (26.8cm) was observed with the application of treatment T_6. which was statistically at par with treatment T_{10} and T_3.Whereas, minimum plant spread (20.36cm) was observed with the application of treatment T_1. The $ZnSO_4$ enhanced plant spread could be attributed to the improvement of the plant root system, leading to the absorption and utilization of coefficient water and nutrient**.** Moreover, micronutrients activate several enzymes (catalase, peroxidase, alcohol, dehydrogenase, carbonic dehydrogenize, tryptophane synthates etc.) and involved themselves in chlorophyll synthesis and various physiological activities of the plant that maybe enhances to plant spread and development. Result can be conformity with the observation of Saini *et al* (2015) and Vanlalruati *et al* (2019) in chrysanthemum.

Plant Spread (N-S)

Significantly maximum plant spread at 30 days after planting was recorded with the application of treatment T_6 (12.82cm), which was statistically at par with T_3, T_4, T_7, T_9 and T_{10}. Whereas, minimum plant spread (7.52cm) was recorded with the application of treatment T_1. At 50 days after planting maximum plant spread was recorded under treatment T_6 (26.60cm), which was statistically at par with treatment T_3, T_4, T_7, T_9 and T_{10}. Whereas, minimum plant spread was recorded with the application of treatment T_2 and T_8 (17.60cm). Plant Spread were greatly affected by the application of $ZnSO_4$, promoting cell proliferation, cell division, and cell differentiation, resulting in increased photosynthesis and transfer of food substances, improved plant growth. The root system is also improved, resulting in absorption of micronutrients, leading to more water and more nutrients and their utilization. Kakade *et al* (2009) and Ashita Joseph *et al* (2019) also reported similar result in china aster.

Number of primary branches per plant

At 30 days after planting application of treatment T_6 (5.77) showed the highest number of primary branches per plant, which was statistically at par with T_3, T_4, T_7 and T_{10}. However, less number of primary branches per plant (3.46) was observed with the application of treatment T_2. Increased the number of primary branches per plant with application of micronutrients such as $ZnSO_4$, which is essential components of several dehydrogenases, proteinases and peptidases, promote hormonal growth and are closely related to plant growth. The result can be conformality with result reported by Karuppaiah (2014) in Gerbera and Similar results was also obtained by Thirumalmurugan *et al* (2021) in African marigold.

Flowering Parameters

Days taken to First Bud Appearance

Significantly, the earliest first bud (49.09 d) was recorded with treatment T_6, which was statistically at par with treatment T_3, T_4, T_7, T_9 and T_{10}. The most delayed bud appearance (57.73 d) was recorded with application of treatment T_1. Micronutrients like $ZnSO_4$ favour to storage of more carbohydrates

Table1. Effect of Micronutrients on Vegetative growth in Chrysanthemum cv. Savita

Treatment	Plant Height		Plant spread (E-W)		Plant spread (N-S)		Number of primary branches per plant
	30DAP	50DAP	30 DAP	50 DAP	30 DAP	50 DAP	30 DAP
T1	15.57	20.80	10.45	20.36	7.52	19.46	3.63
T2	15.01	24.92	11.56	22.81	9.75	17.60	3.46
T3	16.96	25.19	13.22	25.20	11.94	24.80	5.60
T4	17.67	26.59	12.74	24.34	11.73	22.80	4.97
T5	16.81	25.37	11.90	21.53	8.83	22.63	3.72
T6	18.30	27.88	13.59	26.80	12.82	26.60	5.77
T7	17.04	23.90	12.83	22.39	11.26	24.21	4.80
T8	15.91	24.53	10.66	20.55	9.86	17.60	3.95
T9	17.33	24.18	12.00	24.28	11.48	25.11	4.42
T10	17.93	26.72	11.98	25.36	10.69	24.36	5.00
SEm ±	0.22	0.44	0.60	0.54	0.84	1.22	0.41
CD @ 5%	0.67	1.32	1.78	1.62	2.50	3.63	1.22

[T_1 control (RDF), T_2($FeSO_4$@0.2%), T_3($FeSO_4$@0.4%), T_4($FeSO_4$@0.6%), T_5 ($ZnSO_4$ @0.2%), T_6 ($ZnSO_4$@0.4%), T_7(ZnSO4@0.6%), T_8(Borax@0.2%), T_9(Borax@ 0.4%), T_{10}(Borax @0.6%)]

Table2. Effect of Micronutrients on flowering parameters in Chrysanthemum cv. Savita.

Treatment	Days taken to First Bud Appearance	Total number of Days to flower Opening	Number of Flowers per Plant	Diameter of flower(cm)	Weight of the Flower
T1	57.73	68.23	14.33	4.35	1.43
T2	56.71	66.02	16.65	4.46	1.52
T3	51.55	63.53	25.02	4.81	1.96
T4	50.91	63.82	22.60	4.68	1.74
T5	54.31	66.20	17.08	4.43	1.65
T6	49.09	60.58	29.05	4.78	2.05
T7	52.55	61.32	22.37	4.63	1.88
T8	55.33	66.22	18.33	4.43	1.57
T9	50.73	61.84	23.88	4.68	1.97
T10	51.73	63.93	25.11	4.71	1.66
SEm ±	1.52	1.55	1.86	0.10	0.13
CD @ 5%	4.51	4.61	5.52	0.30	0.38

[T_1 control (RDF), T_2($FeSO_4$@0.2%), T_3($FeSO_4$@0.4%), T_4($FeSO_4$@0.6%), T_5 ($ZnSO_4$ @0.2%), T_6 ($ZnSO_4$@0.4%), T_7(ZnSO4@0.6%), T_8(Borax@0.2%), T_9(Borax@ 0.4%), T_{10}(Borax @0.6%)]

through photosynthesis, which may lead to early bud initiation. Similar result was obtained by Saini *et al* (2015) in chrysanthemum and Patokar *et al* (2017) in African marigold.

Days to flower Opening

Among all the treatments, the earliest flower opening was obtained in treatment T_6 (60.58 d), which was statistically at par with treatment T_3, T_4, T_7, T_9 and T_{10}. While the treatment T_1(68.23 d) shows the longest days to flower opening. Micronutrients like zinc promote the storage of more carbohydrates through photosynthesis, which may be lead to earlier flower opening. Similar results are also achieved by Thirumalmurugan and Gupta and Kumar (2015) in African marigold.

Number of Flowers per Plant

The maximum number of flowers per plant (29.05) was obtained in treatment T_6, which was statistically at par with T_3, T_9 and T_{10}.However it was showed significant difference with remaining other treatments. While the treatment T_1 had only 14.33 flowers per plant. The increasing number of flowers per plant could be as a result of the zinc application relieving chlorosis in the plants and producing healthy, green leaves, which in turn led to increased assimilate synthesis and partitioning of floral growth, which may ultimately improve flower yield. Similar results was also reported by Joseph *et al* (2019) in China Aster and Chopde *et al* (2016) in chrysanthemum.

Diameter of Flower

The maximum flower diameter (4.78cm) was recorded with the application of treatment T_6. which was statistically at par with treatment T_3, T_4, T_9 and T_{10}. Whereas, the minimum flowers diameter (4.35cm) was recorded in treatment T_1. The greater size of the flower diameter may be due to increased production of the food material, which subsequently increases in size of ray florets leads to increasing cell size which may be increase the diameter of flower. Similar finding was achieved by Vanlalruati *et al* (2019) in chrysanthemum and Karuppaiah (2019) in tuberose.

Weight of the Flower per plant

The maximum flower weight (2.05g) per plant was recorded with application of treatment T_6, which was statistically at par with treatment T_3, T_4, T_7 and T_9. However, it was showed significant difference with remaining other treatments. While, the minimum flower weight (1.43g) per plant was recorded with application of treatment T_1. Increases the weight of flowers may be due to the association of zinc which regulates semi-permeability of cell walls, mobilize more water to the flowers and also increase iron synthesis which might be responsible for increased flower size and weight. These finding can be in conformality with the result reported by Vanlalruati *et al* (2019) in chrysanthemum Balakrishnan *et al* (2007) in African marigold.

CONCLUSION

Foliar application of treatment T_6 [$ZnSO_4$(0.4%)] performed better in the observations on growth parameters *viz.,* plant height, plant spread (E-W) and (N-S) and number of primary branches per plant. Similarly flower characters *viz.,* days taken for flower bud initiation, days taken for complete flower opening, diameter of flower and weight of flower per plant with the application of treatment T_6[$ZnSO_4$ (0.4%)].

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