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STUDIES ON FLOWER PRODUCTION IN ANNUAL CHRYSANTHEMUM IN RESPONSE TO IRON AND ZINC

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Abstract

A field experiment was conducted to study the flower production of annual chrysanthemum in response to iron and zinc and to find out their suitable concentrations for higher production of better quality flowers during *rabi* season of the year 2015-16 at Horticulture Section, College of Agriculture, Nagpur with nine treatments in Randomized Block Design with three replications. The treatments comprised of different levels of zinc sulphate and ferrous sulphate *viz*., $\mathbf{T_1}$ (control), $\mathbf{T_2}$ (0.5% $FeSO_4$), $\mathbf{T_3}$ (1% $FeSO_4$), $\mathbf{T_4}$ (0.5% $ZnSO_4$), $\mathbf{T_5}$ (1% $ZnSO_4$), $\mathbf{T_6}$ (0.5% $FeSO_4$ + 0.5% $ZnSO_4$), $\mathbf{T_7}$ (0.5% $FeSO_4$ + 1% $ZnSO_4$), $\mathbf{T_8}$ (1% $FeSO_4$ + 0.5% $ZnSO_4$), $\mathbf{T_9}$ (1% $FeSO_4$ + 1% $ZnSO_4$). The spraying of different solutions was done at 30th and 45th day after transplanting. The results revealed that, foliar application of 0.5% $FeSO_4$ + 0.5% $ZnSO_4$ recorded significantly maximum vegetative growth in respect of branches plant^{-1}, yield in respect of flower yield plant^{-1} and flower yield plot^{-1} and quality in respect of weight of fully opened flower, stalk length of flower and longevity of intact flower and also noted earliest first flower bud initiation, opening of flower and first harvesting of flowers as compared to other treatments.

K*ey words*: Annual chrysanthemum, zinc, iron, quality, yield

Introduction

Annual chrysanthemum (*Chrysanthemum coronarium*) is one of the most important flower crops grown in India, though it is originated in South Europe. It is a winter annual crop and belongs to the family *Asteraceae*. It is also known as ‘Crown Daisy’ or ‘Garland chrysanthemum’. Because of variation in size, shape and colour of flowers, the annual chrysanthemum is popular among the people. These flowers have constant demand during the days of festivals, functions, in the place of worshiping and decoration throughout the year. The climate of Maharashtra is most suitable to grow this crop with less efforts and expenditure.

There is an ample scope to enhance the productivity of annual chrysanthemum by adopting proper crop management techniques. In order to meet the ever increasing demand ofproduction of quality flowers, to increase productivity and to overcome the physiological disorders, application of major and micronutrients are inevitable. Now-a-days, micronutrients especially zinc (zinc sulphate) and iron (ferrous sulphate) are gradually gaining momentum among the flower growers because of their beneficial nutritional support and to ensure better harvest and returns. Keeping this in view, the present study was undertaken to investigate the effect of foliar application of zinc and iron on growth, yield and quality of annual chrysanthemum.

Materials and Methods

The present study was undertaken during 2015-16 at Horticulture Section, College of Agriculture, Nagpur. The experiment was laid out in Randomized Block Design with nine treatments *viz*. $\mathbf{T_1}$ (control), $\mathbf{T_2}$ (0.5% $FeSO_4$), $\mathbf{T_3}$ (1% $FeSO_4$), $\mathbf{T_4}$ (0.5% $ZnSO_4$), $\mathbf{T_5}$ (1% $ZnSO_4$), $\mathbf{T_6}$ (0.5% $FeSO_4$ + 0.5% $ZnSO_4$), $\mathbf{T_7}$ (0.5% $FeSO_4$ + 1% $ZnSO_4$), $\mathbf{T_8}$ (1% $FeSO_4$ + 0.5% $ZnSO_4$), $\mathbf{T_9}$ (1% $FeSO_4$ + 1% $ZnSO_4$) and replicated thrice.

The experimental plot was brought to fine tilth by ploughing, clod crushing and harrowing. At the time of land preparation, well rotted FYM @ 15 t ha^{-1} was mixed uniformly in the soil before last harrowing. The field was then laid out with flat beds of the dimension 1.80 × 2.40 m. Uniform and healthy seedlings of annual chrysanthemum were transplanted in the prepared plots at the spacing of 45×30 cm.

Solutions of zinc sulphate and ferrous sulphate each of 0 % (water spray), 0.5 % and 1 % were prepared by dissolving respective amount of zinc sulphate and ferrous sulphate, respectively in distilled water. Then the prepared solution was sprayed twice at 30th and 45th day after transplanting of seedlings as per the treatment. The various observations on growth in respect of branches plant^{-1}, flowering in respect of days for first flower bud initiation, fully opened flower and first harvesting, yield *i.e.* flower yield plant^{-1} and plot^{-1} and quality parameters in respect of weight of fully opened flower, stalk length of flower and longevity of intact flower in marigold were recorded at appropriate stages and data analysed statistically as per the method suggested by Panse and Sukhatme (1967).

Results and Discussion

The data from table 1 revealed that, effect of foliar application of zinc and iron on all growth, flowering, yield and quality parameters was found significant.

Growth

Significantly maximum number of branches plant-1 in annual chrysanthemum was counted with the treatment **T_6** *i.e.* 0.5 % $FeSO_4$ + 0.5 % $ZnSO_4$ (29.00) which was statistically at par with the treatments **T_4** (26.00) and **T_2** (24.99), whereas, the control treatment **T_1** recorded minimum number of branches plant^{-1} (18.99).

An increased number of branches plant^{-1} with foliar spray of 0.5 % zinc sulphate and 0.5 % ferrous sulphate might be due to the fact that, zinc applied at optimum concentration is closely involved in metabolism of RNA and ribosomal content in plant cell which leads to stimulation of carbohydrates, proteins and DNA formation. It also helps in synthesis of tryptophan which acts as a growth promoting substance. Similarly, iron applied with proper concentration acts as an important catalyst in the enzymatic reaction of metabolism. This ultimately would have helped in larger biosynthesis of photoassymilates, thereby enhanced vegetative growth of plant. The results could paint in the same direction of Karuppaiah (2014) in chrysanthemum and Chopde *et al.* (2015) in gladiolus.

Flowering

The data presented in table 1 indicated that, the treatment **T_6** *i.e.* 0.5 % $FeSO_4$+0.5 % $ZnSO_4$ took significantly minimum days for first flower bud initiation, fully opened flower and first harvesting (38.00, 13.43 and 63.38 days, respectively), however, the control treatment **T_1** took maximum days for first flower bud initiation (50.39 days), fully opened flower (18.87 days) and first harvesting (77.92 days).

Table 1: Effect of foliar application of zinc and iron on flower production of Annual chrysanthemum

Treatments	Branches plant^{-1}	Days to first flower bud initiation (days)	Days to fully opened Flower (days)	Days to first harvesting (days)	Flower yield plant^{-1} (g)	Flower yield plot^{-1} (kg)	Weight of fully opened flower (g)	Stalk length of flower (cm)	Longevity of intact flower (days)
T_1 – Control	18.99	50.39	18.87	77.92	341.83	13.67	1.99	11.90	10.81
T_2 - 0.5 % $FeSO_4$	24.99	40.99	15.55	67.25	405.66	16.23	2.25	15.56	12.97
T_3 – 1 % $FeSO_4$	21.99	42.00	15.65	72.45	367.64	14.71	2.06	13.57	12.03
T_4 - 0.5 % $ZnSO_4$	26.00	39.99	14.73	65.40	408.83	16.35	2.26	15.65	13.26
T_5 – 1 % $ZnSO_4$	22.99	42.72	16.07	66.80	396.20	15.85	2.24	13.74	12.35
T_6 - 0.5 % $FeSO_4$ + 0.5 % $ZnSO_4$	29.00	38.00	13.43	63.38	458.73	18.35	2.47	16.39	13.87
T_7 - 0.5 % $FeSO_4$ + 1 % $ZnSO_4$	23.99	42.99	17.29	76.86	383.62	15.34	2.17	14.30	12.92
T_8 – 1 % $FeSO_4$ + 0.5 % $ZnSO_4$	20.99	42.00	17.40	73.30	378.64	15.15	2.16	14.00	12.36
T_9 – 1 % $FeSO_4$ + 1 % $ZnSO_4$	21.99	44.66	17.59	69.53	371.01	14.84	2.14	15.30	12.27
SE (m) ±	1.51	1.94	0.93	2.72	18.64	0.74	0.08	0.84	0.52
CD at 5%	4.56	5.84	2.82	8.20	56.12	2.24	0.24	2.53	1.58

An early flowering with 0.5 % each of zinc sulphate and ferrous sulphate might be due to enhanced growth and development of plant. Zinc favours the storage of more carbohydrates through photosynthesis and iron involves in synthesis of plant hormones and also plays an important role in chlorophyll synthesis, photosynthesis and respiration. This may be the attributing factor for the positive effectiveness of optimum dose of zinc and iron on reducing juvenile phase of the plant. The results are in close conformity with the findings of Chopde *et al*. (2015) in gladiolus and Gupta and Kumar (2015) in African marigold.

Yield

The treatment of foliar application of 0.5 % $FeSO_4$ + 0.5 % $ZnSO_4$ (**T_6**) recorded significantly highest flower yield plant^{-1} (458.73 g) and plot^{-1} (18.35 kg) and it was found at par with the treatments **T_4** *i.e.* 0.5 % $ZnSO_4$ (408.83 g and 16.35 kg , respectively) and **T_2** *i.e.* 0.5 % $FeSO_4$ (405.66 g and 16.23 kg, respectively). Whereas, significantly minimum flower yield plant^{-1} (341.83 g) and plot^{-1} (13.67 kg) was recorded with the treatment **T_1** (control). This might be due to the fact that, zinc activates several enzymes *viz*. catalyase, tryptophan synthate etc. and involves itself in chlorophyll synthesis and various physiological activities by which plant growth and development are encouraged, due to which the flower yield might have been increased. Similarly, iron applied through 0.5 % ferrous sulphate enhanced the flowering parameters, relived the plant from chlorosis and produced healthy green leaves which resulted in higher assimilate synthesis and partitioning of flower growth which may in turn have increased the flower production and ultimately yield. Similar results were also reported by Lahijie (2012) in gladiolus.

Quality

Significantly maximum weight of fully opened flower was noted with the treatment **T_6** *i.e.* 0.5 % $FeSO_4$ + 0.5 % $ZnSO_4$ (2.47 g) which was statistically at par with the treatments **T_4** *i.e.* 0.5 % $ZnSO_4$ (2.26 g), **T_2** *i.e.* 0.5 % $FeSO_4$ (2.25 g) and **T_5** *i.e.* 1 % $ZnSO_4$ (2.24 g), whereas, it was found minimum with the control treatment (1.99 g). Similarly, stalk length of annual chrysanthemum flower was registered significantly maximum (16.39 cm) with the treatment **T_6** *i.e.* 0.5 % $FeSO_4$ + 0.5 % $ZnSO_4$ which was statistically at par with the treatments **T_4** (15.65 cm), **T_2** (15.56 cm), **T_9** (15.30 cm), **T_7** (14.30 cm) and **T_8** (14.00 cm), whereas, the control treatment **T_1** noted minimum stalk length of flower (11.90 cm). The longevity of intact flower was found significantly maximum with the treatment **T_6** (13.87 days) which was at par with the treatments T_4 (13.26 days), **T_2** (12.97 days), **T_7** (12.92 days), **T_8** (12.36 days) and **T_5** (12.35 days), however, minimum longevity of intact flower was recorded with the treatment **T_1** (10.81 days).

Better quality flowers of annual chrysanthemum were produced due to application of 0.5% zinc sulphate and 0.5% ferrous sulphate which might be due to enhanced vegetative growth resulted into production of more food material which in turn might have been utilized for better development of flowers of annual chrysanthemum. The results are in close conformity with the findings of Balkrishnan *et al.* (2007) in African marigold and Lahijie (2012) in gladiolus.

Thus, it can be inferred from the present investigation that, foliar application of 0.5 % each of zinc sulphate and ferrous sulphate increased vegetative growth and flower yield, enhanced flowering and improved flower quality in annual chrysanthemum.

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