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Effect of micro nutrients on plant growth and flower yield of calendula (*Calendula officinalis* L.) var. Bon Bon

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Abstract

The present experiment was conducted to determine the “Effect of micro-nutrients on plant growth and flower yield of Calendula (*Calendula officinalis* L.) cv. bon bon” in the department of horticulture, Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj, (U.P.), India. During the winter season 2019. Twelve different micro-nutrients (Boron, Zinc and Iron) ratios were taken as treatments and are applied as foliar spray at an interval of fifteen days for instance in treatment T₁ (0.1% Boron) 1g of boron is mixed with 1000 ml of water and sprayed on the plants. The 12 treatments included in the trail viz., T₀ (Control), T₁ (0.1% Boron), T₂ (0.2% Boron), T₃ (0.3% Boron), T₄ (0.2% Zinc), T₅ (0.4% Zinc), T₆ (0.6% Zinc), T₇ (0.8% Zinc), T₈ (0.2% Iron), T₉ (0.4% Iron), T₁₀ (0.6% Iron), T₁₁ (0.8% Iron) were tested in three replications. The results revealed that micro-nutrient treatment which had significant response on plant height (cm), plant spread (cm²), number of leaves per plant, number of branches per plant, Number of days required for first flower bud emergence from planting (days), flower diameter (cm), fresh weight of flower (g), flower yield per plant, flowers yield per plot (kg), flower yield per hectare (t). T₁₁(0.8% Iron) was found to be best treatment in terms of plant height (34.07cm), plant spread (40.20 cm²), number of leaves (102.20), number of branches per plant (28.60), flower diameter (5.04 cm), weight of single flower(5.83 g), flower yield per plant (203.57 g), flower yield per plot (3.25kg), flower yield per hectare (20.35 t) and T₃ (0.3% Boron) has recorded maximum performance in the following mentioned parameters as follows minimum number of days required for first bud emergence (37.59 days), maximum number of flower (35.47). The next succeeded performance shown just as much as T₁₁ (0.8% Iron) and recorded as follows in treatment T₃ (0.3% Boron) plant height (33.57cm), plant spread (38.05 cm²), number of branches per plant (27.27), number of leaves (100.20), flower diameter (4.93 cm), weight of single flower (5.64 g), flower yield per plant (200.04 g), flower yield per plot (3.20 kg), flower yield per hectare (20.00 t) and T₁₁ (0.8% Iron) has second maximum reading in the following parameter number of flower (34.93) and minimum number of days required for first bud emergence was found second highest in T₇ (0.8% Zinc).

Keywords: Calendula, zinc, boron, iron, plant growth, flower yield

Introduction

Calendula (*Calendula officinalis* L.) is one of the most commonly cultivated seasonal flowers. Calendula is a winter season annual, which is grown extensively in beds, baskets and boxes. It is also known as English marigold or pot marigold. The word “Calendula” has been derived from Latin word. Kalwndae, meaning first day of the month. It is gaining popularity as a cut flower. It gives a beautiful effect with red salvia, phlox and snapdragons and appeals the people who enjoy various colours. It grows well in diverse climatic conditions, however, there is lack of authentic information on its Agro-technology.

Calendula (*Calendula officinalis* L.) belong to the family Asteraceae. Its original home is in South Europe. Calendula was also used for its medicinal properties. It is cultivated commonly in North America, Balkans, Eastern Europe, Germany and India. (Kirtikar and Basu, 2000).

Calendula has long flowering period. Bearing large yellow or orange flowers with many petals, this herb is also grown as a common garden plant. It stems and leaves are covered with hairs. This hardy annual prefers well drained, light and sandy soil and grows to a height. 21 - 65 cm. The yield of flowers depends on different attributes which are closely associated with nutrient uptake by the plant. Plants have nutritional requirements just like humans in order to grow, develop and complete their life cycle. The supply of nutrients to the plants should be balanced, ensuring not to over or under-fertilize. Nutrients are classified according to their importance to plants and are categorized as primary (N, P, K), secondary (Ca, mg, S, Cl, Na), and micro-nutrients (Fe, Zn, Mn, Cu, Mo, B, Co).

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Material and Methods

The experiment was conducted in randomized block design (RBD) with 12 treatments with 3 replications. Seedlings were planted in the bed field of department of horticulture, Sam Higginbottom, University of Agriculture, Technology and Sciences, Prayagraj during November 2019 to March 2020. Total number of treatments were 12 viz. T₀ (Control), T₁ (0.1% Boron), T₂ (0.2% Boron), T₃ (0.3% Boron), T₄ (0.2% Zinc), T₅ (0.4% Zinc), T₆ (0.6% Zinc), T₇ (0.8% Zinc), T₈ (0.2% Iron), T₉ (0.4% Iron), T₁₀ (0.6% Iron), T₁₁ (0.8% Iron).

Climatic conditions in experimental site

The area of Prayagraj district comes under subtropical belt in the South East of Uttar Pradesh, which experiences extremely hot summer and fairly cold winter. The maximum temperature of the location reaches up to 46°C-48°C and seldom falls as low as 4°C-5°C. The relative humidity range between 20 to 94%. The average rainfall in this area is around 103.4mm annually with maximum concentration during July to September with few showers and drizzles in winter also.

Results and Discussion

The present study entitled "effect of micronutrients on plant growth and yield of *Calendula officinalis* L) cultivar bon bon under Prayagraj agro-climatic conditions was carried out under open condition at research farm of Department of Horticulture, Naini Agriculture Institute, Sam Higginbottom University of Agriculture, technology and Sciences, Prayagraj UP during the Year 2019-2020. The experiment was laid out in randomized block design with 12 treatments and three replications. And different levels of micronutrients were studied in the investigation. The study revealed that all the characters were significantly affected by the different levels of micronutrients.

The results of present investigation are summarized below:-

A. Growth parameters

The treatment T₁₁ (0.8% Iron) has recorded maximum performance in all the parameters as follows plant height (34.07 cm), plant spread (40.20 cm²), number of leaves

(102.20), number of branches per plant (28.60). The second performance was by T₃ (0.3% Boron) which shows as much performance as T₁₁ (0.8% Iron) and recorded as follows plant height (33.57 cm), plant spread (38.05 cm²), number of branches (27.27), number of leaves (100.20). The minimum number of reading observed in T₀ (Control) as plant height (29.09 cm), plant spread (32.98 cm²), number of branches (88.80), number of leaves (88.80).

B. Floral parameter

The treatment T₁₁ (0.8% Iron) has recorded maximum performance in all the parameters as follows flower diameter (4.93cm), weight of single flower (5.83g) and T₃ (0.35 Boron) has maximum record in minimum number of days required for first flower bud emergence from planting (37.53 days). The second performance was by T₃ (0.3% Boron) which shows performance as T₁₁ (0.8% Iron) and recorded as follows flower diameter (4.93 cm), weight of single flower (5.64 g) as well as T₇ (0.8% Zinc) was recorded second in performance of minimum number of days required for flower bud emergence from planting (38.80 days). The minimum number of reading observed in T₀ (Control) flower diameter (4.04 cm), weight of single flower (7.78 g) and number of days required for first bud emergence was maximum (46.13 days).

C. Yield parameter

The treatment T₁₁ (0.8% Iron) has recorded maximum performance in all the parameters as follows flower yield per plant (203.57 g), flower yield per plot (3.25 kg), flower yield per hectare (20.35 t) and T₃ (0.3% Boron) has maximum record number of flower (35.47). The second performance was by T₃ (0.3% Boron) which shows performance as T₁₁ (0.8% Iron) and recorded as follows flower yield per plant (200.04 g), flower yield per plot (3.20 kg), flower yield per hectare (20.00 t) as well as T₁₁ (0.8% Iron) was recorded second in performance of number of flower (34.93). The minimum number of reading observed in T₀ (Control) flower yield per plant (139.60 g), flower yield per plot (2.23 kg), flower yield per hectare (13.96 t), number of flower (29.27).

Table 1: Effect of different micro-nutrients on plant growth and flower yield of *Calendula* cv. Bon bon

Treatment symbol	Treatment name	Plant height (cm)	Plant spread (cm ²)	No. of branches/plant	No. of leaves per plant	Minimum no. of days required for first bud emergence	Flower diameter (cm)	Weight of single flower (g)	Maximum no. of flower	Flower yield per plant(g)	Flower yield per plot (kg)	Flower yield per hectare (t)
T ₀	Control	29.09	32.98	19.73	88.80	46.13	4.04	4.78	29.27	139.6	2.23	13.96
T ₁	0.1% Boron	30.29	33.74	21.20	91.40	43.87	4.13	5.16	30.33	156.66	2.50	15.66
T ₂	0.2% Boron	31.68	35.19	24.93	99.20	40.87	4.4	5.29	32.80	173.32	2.77	17.33
T ₃	0.3% Boron	33.57	38.05	27.27	100.20	37.53	4.93	5.64	35.47	200.04	3.20	20.00
T ₄	0.2% Zinc	30.00	34.06	22.35	91.95	43.56	4.02	5.56	31.26	163.00	2.42	16.00
T ₅	0.4% Zinc	30.47	34.74	23.13	92.53	43.13	4.24	5.64	31.47	163.31	2.61	16.33
T ₆	0.6% Zinc	31.93	35.96	24.87	99.07	41.80	4.44	5.19	33.67	178.25	2.85	17.82
T ₇	0.8% Zinc	32.17	37.33	26.73	100.07	38.80	4.85	5.59	34.80	194.41	3.11	19.44
T ₈	0.2% Iron	31.05	35.00	23.06	97.01	42.87	4.05	5.06	31.00	163.05	2.52	16.20
T ₉	0.4% Iron	31.21	35.13	23.20	97.47	42.60	4.35	5.20	31.53	164.05	2.62	16.40
T ₁₀	0.6% Iron	31.88	36.68	25.07	99.07	41.32	4.77	5.25	32.87	172.44	2.76	17.24
T ₁₁	0.8% Iron	34.07	40.20	28.60	102.20	40.27	5.04	5.83	34.93	203.57	3.25	20.35
S.Ed(±)		0.61	0.48	0.46	1.07	0.44	0.16	0.22	0.46	7.53	0.12	0.75
C.D@5%		1.27	1.02	0.96	2.24	0.93	0.33	0.47	0.97	15.83	0.26	1.58
Result		S	S	S	S	S	S	S	S	S	S	S

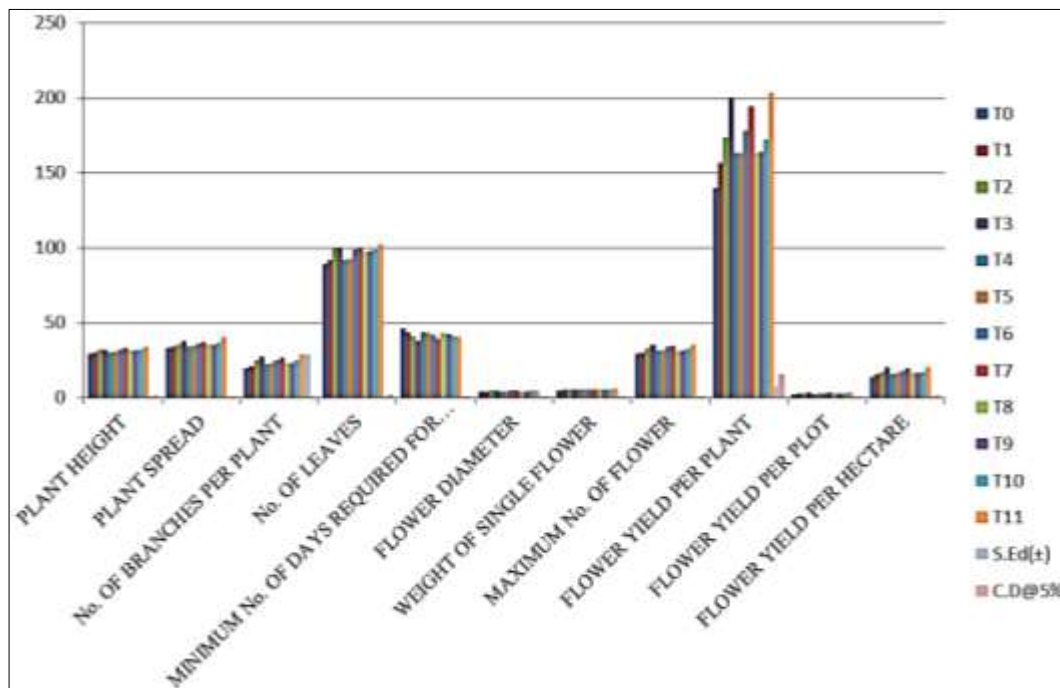


Fig 1: Graphical representation of table 1

Conclusion

On the basis of present investigation the T₁₁ (0.8% Iron) showed maximum performance in plant height (34.07 cm), plant spread (40.20 cm²), number of leaves (102.20), number of branches per plant (28.60), flower diameter (5.04 cm), weight of single flower (5.83 g), flower yield per plant (203.57 g), flower yield per plot (3.25 kg), flower yield per hectare (20.35 t) and T₃ (0.3% Boron) has recorded maximum performance in the following mentioned parameters as follows minimum number of days required for first bud emergence (37.59 days), maximum number of flower (35.47). The next succeeded performance shown just as much as T₁₁ (0.8% Iron) and recorded as follows in treatment T₃ (0.3% Boron) plant height (33.57 cm), plant spread (38.05 cm²), number of branches per plant (27.27), number of leaves (100.20), flower diameter (4.93 cm), weight of single flower (5.64 g), flower yield per plant (200.04 g), flower yield per plot (3.20 kg), flower yield per hectare (20.00 t) and T₁₁ (0.8% Iron) has second maximum reading in the following parameter number of flower (34.93) and minimum number of days required for first bud emergence was found second highest in T₇ (0.8% Zinc).

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