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EFFECT OF FOLIAR SPRAY OF GA₃ ON VEGETATIVE GROWTH, FLOWERING AND QUALITY FLOWER YIELD OF CALENDULA (*CALENDULA OFFICINALIS* L.) CV. BONBON

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ABSTRACT

An experiment was conducted at the research farm of Raja Balwant Singh college Bichpuri, Agra during Rabi season in the year 2021-2022 to study the effect of foliar spray of GA₃ on vegetative growth, flowering and quality flower yield of Calendula (*Calendula officinalis* L.) cv. Bonbon. The experiment was laid out in Randomized Block Design with four replications which consists of five different concentrations of GA₃ i.e. 0 ppm (control), 50 ppm, 100 ppm, 150 ppm, 200 ppm, and 250 ppm. On the basis of experimental data the application of GA₃ @ 250 ppm was found to be significantly most effective on all the attributes like plant height (76.24 cm), plant spread, number of leaves per plant, number of branches per plant, days to first bud initiation, days to first flowering, no. of flowers per plant, size of flowers, weight of flower, duration of flowering, yield of flower per plant (152.12 gm) and yield of flowers per hectare (68.23 quin/hect.).

Keywords: Calendula, GA₃, ppm, plant height, plant spread, yield of flowers per hectare.

Introduction

Calendula (*Calendula officinalis* L.) is commonly known as pot marigold, Mary's gold, or poor man's saffron belongs to the family asteraceae. Its name comes from the Latin word, 'calends', which means the first day of every month, because of its long flowering period. It is one of the most commonly cultivated seasonal flowers. It is a free blooming annual with beautiful crowns, grown for garden decoration and cut flower purpose. It is an important flowering plant as well as medicinal herb indigenous to central, Eastern Europe. Calendula is a popular winter season annual which is grown widely for loose and cut flowers, owing to its good medicinal value and keeping quality. Calendula is widely cultivated in beds, baskets and boxes. Calendula is commercially propagated by seeds. The crop being an annual crop and in the nearby areas to the cities, the market can also be made available for this flower. The flowers of calendula are found in diverse colour and used in making bouquets, garland as well as vase management. Beside medicinal uses it also used for manufacturing of perfumes, cream and cosmetics GA₃ plays a very important role to enhance flowering and seed yield. Foliar application of GA₃ increase the vegetative growth such as plant height, number of branches and ultimately improve the quantity and quality of Marigold flower (Thakur *et al.*, 2019) Gibberellins has the effect of prevention of genetic dwarfism, induction of bolting and flowering by stimulating cell division and cell elongation in the sub-apical meristem. Gibberellins also

cause rapid growth of flower primordium, induces early flowering and also induces flowering in a majority of long day plants and plants in which flowering is induced by cold. There are wide spread applications of GA₃ for the promotion of growth in a variety of horticultural crops. So, in order to produce good quality flower and yield, there is an urgent need to standardize optimum dose of GA₃ for application in calendula.

Materials and Methods

The present investigation was conducted at the Agriculture Research Farm of Raja Balwant Singh College, Bichpuri, Agra India during the Rabi season 2021-22. The site is located at Agra Bharatpur road at 27.2° N latitude and 77.9° E longitude and 168 M above means sea level. The soil was sandy loam in texture, slightly alkaline in reaction (pH 8.10), low in available organic carbon, nitrogen and medium in available phosphorus and sufficient amount of available phosphorus. The experiment was conducted in Randomized Block Design with four replications, each consisting of five different concentrations of GA₃ i.e., 0 ppm (control), 50 ppm, 100 ppm, 150 ppm and 200 ppm. One month old seedlings were transplanted at the spacing of 40×40 cm. Recommended dose of fertilizers was applied at the rate of 100 kg, 75 kg and 75 kg NPK per hectare. The solutions of GA₃ were prepared by dissolving the required amount of GA₃ powder in a small quantity of ethanol and then stirring it both clockwise and anticlockwise till the powder was completely dissolved. A common hand sprayer was used for foliar spray of GA₃.

Standard package of practices was adopted and sufficient irrigation was applied to maintain optimum moisture level. Observation recorded from randomly selected three plants per plot. The data was analyzed by adopting the standard procedure Panse and Sukhatme (1985). Wherever the results were found significance, critical differences (CD) were computed at 5% level of probability to draw statistical conclusion.

Results and Discussion

Analysis of variance indicated that the effect of various concentrations of GA₃ on all the given parameters was found statistically effective at 5% level of significance. Mean comparisons from Table 1 and Table 2 shows that treatment T5, containing GA₃ @ 200 ppm was found to be the best in terms of all growth and yield attributes. It is clear from table 1, that the plants sprayed with GA₃ @ 200 ppm attained maximum height (76.24cm) followed by T4 (application of 150 ppm GA₃) while untreated plants recorded lowest height. The application of higher doses of GA₃ might have increased the plant height as a consequence of hyper-elongation in stems and internodes as well. These observations and findings in the present investigation are in conformity with those reported earlier by Delvadia *et al.* (2009) in gaillardia and Shinde *et al.* (2010) in chrysanthemum. Treatments T5 (GA₃ @ 200 ppm) recorded the maximum plant spread (E-W and N-S) at peak flowering stage, while the minimum plant spread was recorded by control. GA₃ @ 200 ppm does enhance the metabolic activities of the plant and affects the both important metabolic functions, that's why may be the plant spread increases. Similar observations were reported by

Ghadage *et al.* (2010) in gaillardia. The maximum no. of leaves (241.48) were counted under the application of T5 (GA₃ 200 ppm) whereas, minimum no. of leaves per plant (203.94) was reported with the application of GA₃ 0 ppm (T1). These observations and findings are in conformity with those reported earlier by Ghadage *et al.* (2010). It is crystal clear from the data that the maximum number of branches (29.41) was counted under the application of T5 (GA₃ 200 ppm) while the minimum no. of branches per plant (19.73) was reported with the application of GA₃ 0 ppm (T1). Increase in the number of branches with GA₃, treatment may be due to the hyper elongation of internodal length and the resultant increase in nodal count on the main axis. These observations and findings are in conformity with those reported earlier by Kanwar and Khandelwal (2013) in marigold and Shinde *et al.* (2010) in chrysanthemum. It is clear from the data that the earliest bud initiation (50.97 days) and flowering (65.60 days) was recorded under the application of T5 (GA₃ 200 ppm) followed by T4 and T3, whereas maximum delay in bud initiation and flowering was observed in T1(0ppm). This may be due to the fact that gibberellin reduces juvenile period and cause early termination of juvenile phase. The enhancement in first flower bud formation and early flowering in GA₃ treatments may be due to the increase in the endogenous level of gibberellin which by virtue of its flower inducing characteristics might have also promoted the first bud formation and early flowering. Similar results have also been reported by Ramdevputra *et al.* (2009) in marigold.

Table 1: Effect of foliar spray of GA₃ on vegetative of growth and flowering of calendula

Notations	Treatment	Plant height (cm)	Plant spread (N-S) cm	Plant spread (E-W) cm	Number of leaves per plant	Number of branches per plant	Days to first bud initiation	Days to first flowering
T1	Distilled water(Control)	70.08	32.59	33.98	203.94	19.73	59.35	72.43
T2	50 ppm GA ₃	70.83	36.71	37.42	215.69	21.79	58.50	70.34
T3	100 ppm GA ₃	72.4	39.4	40.35	224.07	23.46	55.62	68.72
T4	150 ppm GA ₃	74.29	44.78	45.52	230.51	26.54	53.60	67.29
T5	200 ppm GA ₃	76.24	47.50	48.27	241.48	29.415	50.97	65.60
CD at 5%		0.271	0.166	0.259	0.153	0.168	0.152	0.118

Data presented in table 2 indicated that maximum number of flowers per plant (46.73) was registered under T5, while, the minimum number of flowers was found under treatment T1 (control). The higher number of flowers produced per plant with the application of GA₃ might be due to increased production of branches at early stage of growth and this in turn resulted in the accumulation of maximum amount of carbohydrates which were utilized for proper flower bud differentiation, development and ultimately opening into flowers. Similar results were also observed by Kumar *et al.* (2010) in African marigold and Thakur *et al.* (2019) in African marigold. The largest size of flower (5.61 cm) was recorded under the treatment T5 (GA₃ 200 ppm) whereas smallest size (4.43 cm) was observed under T1. The enlargement in flower size may caused by drawing of photosynthates to the flower as a consequence of increased sink activity. The results are in close conformity with the findings of Sharma and Joshi (2015) in China aster. Table 2

shows that the highest weight of flowers (3.68 gm) was recorded under the treatment T5 (GA₃ 200 ppm) followed by t4 and T3 however, lowest weight (2.86gm) was observed under T1. Increase in fresh weight of flowers GA₃ is may be attributed to the increased flower size and accumulation of more food materials. These observations and findings are in conformity with finding of Kanwar and Khandelwal (2013) in marigold. Highest duration of flowering (84.63) was observed with the application of GA₃ 200 ppm (T5) followed by T4 and T3 which by significantly effective to each other. Whereas, minimum duration of flowering (74.52 days) was noticed with no application of GA₃ (T1). The more duration of flowering with the application of higher doses of GA₃ could be as a consequence of better growth and flowering of plants which resulted in production of maximum number of flowers per plant. The results of present study are also in agreement with the earlier findings of Thakur *et al.* (2019) in African marigold. It is clear from the data in table 2 that

amongst of all the treatments, T5 recorded significantly maximum yield of flower per plant (152.12 gm) and per hectare (68.23Q) also. This was significantly followed by T4, T3, T2 and T1 respectively. Whereas, minimum yield per plant (84.55g) and per hectare (52.44Q) respectively was noticed with no application of GA₃ (T1). GA₃ treated plants remained active physiologically to build food, which in turn,

gave the better plant growth and a greater number of flowers, leading to higher yield. The second reason could be the growth promoting enzymes synthesizing nucleic acid in plants accelerates the food assimilation and increase in number of flower and yield. Same findings were accordance to Badge *et al.* (2014) and Patil *et al.* (2016) in marigold.

Table 2 : Effect of GA₃ on flowers yield and quality of calendula.

Notations	Treatment	No. of flowers per plant	Size of flowers (cm)	Weight of flower (g)	Duration of flowering (days)	Yield of flower per plant (g)	Yield of flowers per hectare (qha ⁻¹)
T1	Distilled water (Control)	39.14	4.43	2.86	74.52	84.55	52.44
T2	50 ppm GA ₃	41.12	4.87	3.09	78.5	93.38	55.59
T3	100 ppm GA ₃	41.89	5.06	3.35	79.39	109.18	59.51
T4	150 ppm GA ₃	44.59	5.28	3.55	82.04	124.54	64.34
T5	200 ppm GA ₃	46.73	5.61	3.68	84.63	152.12	68.23
CD at 5%		0.259	0.048	0.015	0.136	0.283	0.472

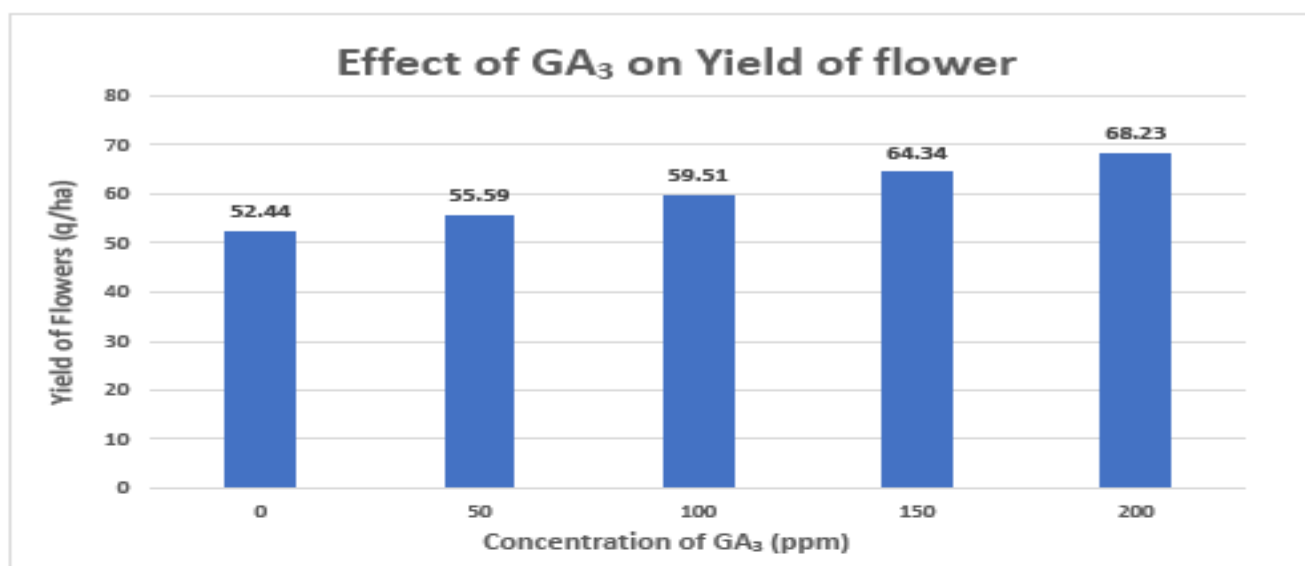


Fig. 1 : Effect of GA₃ on yield of flower

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