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Effectualness of Biostimulants on Annual Chrysanthemum (*Chrysanthemum coronarium* L.) Flowering, Quality and Yield

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ABSTRACT: Bio stimulants are the organic materials that promote the plant growth when applied in minute quantities and are also referred as metabolic enhancers. They have been emerged as a supplement to mineral fertilizers and hold a promise to improve the yield as well as quality of the crop. Keeping in view, the need and importance of biostimulants, an experiment was carried out at the Experimental block of Floriculture and Landscape Architecture, College of Horticulture, Mudigere, Keladi Shivappa Nayaka University of Agricultural and Horticultural Sciences, Iruvakki, Shivamogga in the year 2022- 2023, to investigate the impact of biostimulants on the flowering, quality, and yield of annual chrysanthemum (*Chrysanthemum coronarium* L.), with ten treatments *viz.*, T_1- Humic acid @ 0.4%, T_2- Humic acid @ 0.6%, T_3- Humic acid @ 0.8%, T_4- Biovita @ 0.4%, T_5- Biovita @ 0.6%, T_6- Biovita @ 0.8%, T_7- Biozyme @ 0.4%, T_8- Biozyme @ 0.6%, T_9- Biozyme @ 0.8% and T_{10}- Control (water). Biostimulants were sprayed thrice (sprayed at 20, 40, and 60 days after transplanting). In randomized complete block design (RCBD), each treatment was duplicated three times. Numerous flowering, quality, and yield indicators were observed. Among all the treatments Biovita @ 0.6% showed earliness in the flower bud initiation (35.66 days), first flowering (40.55 days), 50 per cent flowering (55.35 days) and also, registered the maximum duration of flowering (58.66 days), shelf life (3.66 days), stalk length (15.87 cm), number of flowers per plant (189.26), flower yield per plant (622.66 g), flower yield per plot (22.42 kg) and flower yield per hectare (69.18 tons). However, Biozyme @ 0.8% showed the maximum blossom diameter (6.19 cm), number of petals (72.28), and flower weight (3.44 g). Meanwhile the minimum values for all the parameters were recorded in the control. Thereby, Biovita @ 0.6% showed potential for improving annual chrysanthemum flowering, quality, and yield.

Keywords: Annual chrysanthemum, biostimulants, flowering, quality, yield.

INTRODUCTION

Chrysanthemum coronarium L., also known as annual chrysanthemum, is a member of the daisy family Asteraceae and is an annual herbaceous plant with an aromatic flavour. It is additionally known as garland chrysanthemum or edible chrysanthemum. It originates from the Mediterranean region. It is a robust, hardy plant that produces attractive blooms in a range of yellow and white hues in either single or double forms (Desai, 1962). It is grown commercially in a number of Indian states to produce loose flowers that are used to make garlands and religious offerings. The flowers can be used alone or in combination with marigolds and other flowers. It is mostly utilized as a garden plant in beds and borders. Due of their simplicity of production, annual chrysanthemums are more well-liked by farmers. The short lifespan of annual chrysanthemum and their ability to produce yellow and white blooms with good keeping qualities attract growers (Kumar *et al.*, 2020).

For a sustainable yield, the expanding agricultural techniques require more fertilizers, and the uncontrolled use of chemical fertilizers has had a detrimental effect on the ecosystem. In order to combat this, biostimulants derived from natural resources have been developed as an addition to mineral fertilizers and offer the potential to increase crop production as well as quality (Rawat

and Vishal 2002). Over the past ten years, there has been a significant increase in the usage of biostimulants, which have the ability to positively alter plant development.

According to Zhang and Schmidt (2000), bio stimulants are substances other than fertilizers that, when used sparingly, encourage plant development. They are also known as metabolic enhancers. Along with raising yield and quality, they encourage plant growth. For horticultural and agricultural crops, there are hundreds of biostimulant products on the market. Several experimental studies revealed the effect of biostimulants in improving growth, quality and yield of different flower crops *viz.*, Bhargavi *et al.* (2018) revealed that the minimum number of days to first flower initiation (100.00), 50 percent flowering (112.33) and maximum flower duration(65.82 days) was recorded with Biovita (0.6%) in chrysanthemum. Harish *et al.* (2019) found that the Biozyme at 0.4 per cent recorded minimum number of days taken for initiation of inflorescence (75.00), days taken for first floret opening (80.67), days to 50 per cent flowering (84.67) and maximum number of spikes per plant (1.51), spike yield per plot (45.30) and spike yield per hectare (2,26,500) in gladiolus. Thus, in the current trial, an effort was made to ascertain the effectiveness of biostimulants on the flowering, quality, and yield of annual chrysanthemum.

MATERIALS AND METHODS

In the academic year 2022–2023, research was conducted in the Department of Floriculture and Landscape Architecture, College of Horticulture, Mudigere, Keladi Shivappa Nayaka University of Agricultural and Horticultural Sciences, Iruvakki, Shivamogga, Karnataka. The soil was fine-tilled before flat beds measuring 1.8 m × 1.8 m were made in an open field. Annual chrysanthemum seedlings that were thirty days old were transplanted at a distance of 30 cm × 30 cm. With 10 treatments and three replications, the experiment was set up using a randomized block design (RBD). T_1- Humic acid @ 0.4%, T_2- Humic acid @ 0.6%, T_3- Humic acid @ 0.8%, T_4- Biovita @ 0.4%, T_5- Biovita @ 0.6%, T_6- Biovita @ 0.8%, T_7- Biozyme @ 0.4%, T_8- Biozyme @ 0.6%, T_9- Biozyme @ 0.8% and T_{10}- Control (water) were the treatments. The biostimulants were sprayed 20, 40 and 60 days after transplanting (DAT), respectively. Statistics were computed on the observations once they were recorded.

RESULTS AND DISCUSSION

Based on the observations made over the course of the research, the results were evaluated in great detail and summarized in Tables 1-3 and Fig. 1.

Biostimulants impact on flowering parameters. In Table 1 and Fig. 1, data related to blooming parameters are presented.

Flower bud initiation, first flowering and 50 % flowering (days). The treatment Biovita @ 0.6 per cent recorded minimum days for flower bud initiation, first flowering, and 50 per cent flowering (35.66, 40.55 and 55.35, respectively). Whereas, maximum days for flower bud initiation, first flowering, and 50 per cent flowering (40.66, 49.33 and 68.33, respectively) were recorded in control. Early floral characteristics might be the consequence of treatment with sea weed extracts, which encouraged the formation of florigen and other flower-inducing compounds in the plants, perhaps causing earlier blooming. Similar set of results were disclosed by Shinde *et al.* (2010) in Marigold, Pruthvi *et al.* (2017); Bhargavi *et al.* (2018) in chrysanthemum.

Flowering duration. The treatment Biovita @ 0.6 per cent recorded maximum duration of flowering (58.66 days) and minimum duration of flowering (44.79 days) were recorded in control (fig 1). Increased nutrient absorption and the presence of stored carbohydrates in the sea weed extract *Ascophyllum nodosum* might be the cause of the long flowering duration. These outcomes align with the results of Shinde *et al.* (2010) in Marigold, Tirki and Gantait (2021); Anitha and Kannan (2015) in dendrobium orchid.

Biostimulants impact on floral quality parameters. Table 2 contains the information on floral quality characteristics.

Flower diameter, flower weight and number of petals. In the current investigation, Biozyme at 0.8% recorded the largest flower diameter (6.99 cm), which was statistically comparable to Biovita at 0.6% (5.99 cm), and Biozyme at 0.8% recorded the largest flower weight (3.44 g) and number of petals per flower (72.28). Whereas, control recorded minimum flower diameter (4.73 cm), flower weight (1.81 g) and number of petals (38.66). The increased flower size might be the result of increased food production that was directed to the blooming region thus, increasing the flower diameter, weight, and number of petals. The results presented above are in line with those of Amir *et al.* (2015) in pansy, Renata *et al.* (2015) in ageratum, Karthiraj *et al.* (2008) in china aster, Harish *et al.* (2019) in gladiolus, Karim *et al*. (2017) in tuberose and Naik and Jature (2009) in rose.

Stalk length. Significant differences were observed among different treatment with respect to stalk length, maximum stalk length (15.87 cm) was recorded with Biovita @ 0.6 per cent and least was recorded in control (11.24 cm). The longer stalks in plants treated with seaweed extract might be the result of an increase in the activity of the enzymes which are necessary for cell elongation. The results are in conformity with the findings of Bhargavi *et al.* (2018) in chrysanthemum, Hegde *et al.* (2016) in chrysanthemum.

Shelf life of flowers. The foliar application of Biovita at 0.6% and Biozyme at 0.8% was found to be more effective in terms of shelf life, with a maximum shelf life of 3.66 days and a minimum shelf life of 1.5 days was recorded with control. This might be due to the entrance of seaweed extract into the plant, which might have mediated the respiration by serving as a hydrogen acceptor and therefore, modifying the carbohydrate metabolism of plants and increasing the accumulation of sugar as deduced by Cacco and Agnola (1984). Flowers have lasted longer because seaweed extract includes cytokinin and auxin, which might have raised their antioxidant levels and resistance to senescence.

The findings are consistent with the results of Hegde *et al.* (2016); Bharghavi (2018) in chrysanthemum.

Biostimulants impact on flower yield parameters. The data regarding flower yield parameters are given in table 3.

Number of flowers per plant. Regarding the quantity of flowers produced per plant, there were significant disparities between the various treatments. The highest number of flowers per plant (189.26) was observed with Biovita treatment at 0.6%, whereas minimum number of flowers per plant (90.47) was observed with control. The improvement in vegetative growth might have increased the amount of photosynthates generated, which were then likely directed towards flower production, thus, increasing the number of flowers. Similar results were disclosed by Russo *et al.* (1994) in marigold, Tartil *et al.* (2016); Tirki and Gantait (2021); Bhargavi *et al.* (2018) in chrysanthemum, Praveen *et al.* (2021) in rose, and Al-Hamzawi (2019) in Chinese carnation and *Gazania splender*.

Flower yield per plant, per plot and per hectare. The maximum flower yield per plant (622.66 g), per plot (22.42 kg) and per hectare (69.18 tons) was obtained in Biovita at 0.6 per. Whereas, the minimum was recorded in treatment control (163.75 g, 5.90 kg and 18.19 tons, respectively). The inclusion of various growth factors in seaweed extracts, such as betaines, polyamines, oligosaccharides, amino acids, and vitamins, might account for the improvement in flower production above control. These substances have been demonstrated to have a good impact on plant shoot and root growth through the synthesis of carbohydrates and proteins, which improved plant growth and resulting in an adequate C:N ratio. Consequently, there will be an increased yield. This is backed by the research findings of Hegde *et al.* (2016); Pruthvi *et al.* (2017); Khandelwal *et al.* (2003); Shinde *et al.* (2010) in marigold, and Praveen *et al.* (2021) in rose.

Table 1: Effect of foliar spray of biostimulants on flowering of annual chrysanthemum.

Tr. No.	Treatments	Days taken for Flower bud initiation	Days taken for first flowering	Days taken for 50% flowering
T_1	Humic acid @ 0.4%	37.53	43.11	63.11
T_2	Humic acid @ 0.6%	38.50	42.00	61.50
T_3	Humic acid @ 0.8%	39.06	42.74	60.99
T_4	Biovita @ 0.4%	36.53	42.45	59.45
T_5	Biovita @ 0.6%	35.66	40.55	55.35
T_6	Biovita @ 0.8%	37.12	42.00	58.29
T_7	Biozyme @ 0.4%	37.87	43.28	60.59
T_8	Biozyme @ 0.6%	36.33	42.19	58.87
T_9	Biozyme @ 0.8%	36.66	41.56	57.29
T_{10}	Control (water spray)	40.66	49.33	68.33
S.Em±		0.49	0.41	0.56
C.D@5%		1.46	1.20	1.68

Table 2: Effect of foliar spray of biostimulants on annual chrysanthemum flower quality.

Tr. No.	Treatments	Flower diameter (cm)	No of petals per flower	Flower weight (g)	Stalk length (cm)	Shelf life of flowers (days)
T_1	Humic acid @ 0.4%	5.18	46.31	2.42	12.31	2.56
T_2	Humic acid @ 0.6%	5.49	50.97	2.64	13.44	2.56
T_3	Humic acid @ 0.8%	5.36	53.59	2.57	13.08	3.00
T_4	Biovita @ 0.4%	5.48	55.79	2.51	12.83	3.00
T_5	Biovita @ 0.6%	5.99	68.72	3.29	15.87	3.66
T_6	Biovita @ 0.8%	5.60	61.05	2.71	14.21	3.00
T_7	Biozyme @ 0.4%	5.35	59.86	2.48	13.15	3.00
T_8	Biozyme @ 0.6%	5.57	63.35	2.99	14.19	3.50
T_9	Biozyme @ 0.8%	6.19	72.28	3.44	14.99	3.66
T_{10}	Control (water spray)	4.73	38.66	1.81	11.24	1.50
S.Em±		0.08	0.82	0.04	0.18	0.05
C.D@5%		0.23	2.44	0.12	0.55	0.15

Table 3: Effect of foliar spray of biostimulants on yield parameters of annual chrysanthemum.

Tr. No.	Treatments	Number of flowers per plant	Flower yield per plant (g)	Flower yield per plot (kg)	Flower yield per hectare (tons)
T_1	Humic acid @ 0.4%	120.81	292.36	10.52	32.48
T_2	Humic acid @ 0.6%	142.67	376.65	13.56	41.85
T_3	Humic acid @ 0.8%	148.33	381.21	13.72	42.36
T_4	Biovita @ 0.4%	155.17	389.48	14.02	43.28
T_5	Biovita @ 0.6%	189.26	622.66	22.42	69.18
T_6	Biovita @ 0.8%	171.92	465.90	16.77	51.77
T_7	Biozyme @ 0.4%	145.50	360.84	12.99	40.09
T_8	Biozyme @ 0.6%	158.84	474.93	17.10	52.77
T_9	Biozyme @ 0.8%	174.66	600.83	21.62	66.76
T_{10}	Control (water spray)	90.47	163.75	5.90	18.19
S.Em ±		2.51	5.34	0.23	0.61
C.D@5%		7.45	15.86	0.68	1.82

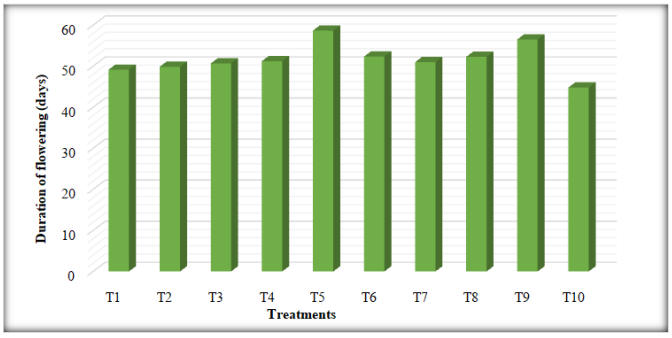

Fig. 1. Effect of foliar spray of biostimulants on flowering duration of annual chrysanthemum.

Plate 1. Annual chrysanthemum flowers of T_5 and Control.

CONCLUSIONS

Based on the findings of the current study, it can be said that applying Biovita at a rate of 0.6% significantly increased blooming, quality, and yield under open-field conditions. Therefore, the Biovita treatment at 0.6% may be suggested for annual chrysanthemum commercial production.

FUTURE SCOPE

Future research must be done to determine the effects of various biostimulants and biofertilizers used together on the growth, blooming, and yield of annual chrysanthemum. Different bio-stimulants modes of action can be analysed.

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