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Effect of Biostimulants on Growth and Yield of Chrysanthemum (*Dendranthema grandiflora*) Cv. "Paper Yellow"

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Abstract

The present study "Effect of biostimulants on growth and yield of chrysanthemum (*Dendranthema grandiflora*) cv. Paper yellow" was carried out at farmers field, Rayakottai, Krishnagiri, Tamil Nadu during 2022-2023. The word "Chrysanthemum" comes from two Greek words, Chrysos means golden and anthos means flower which means golden flower. It is native to the Northern hemisphere and is widely distributed in Europe and Asia. However, the origin of chrysanthemum is China. The results revealed that all the treatments differed significantly with respect to growth parameters. Among the treatments, the treatment T9 (0.8% of fulvic acid + 5ml/L of *Ascophyllum nodosum*) was found to be superior for all the growth parameters viz., plant height (65.06 cm), number of branches plant^{-1} (16.90). Among the treatments, T9 (0.8% of fulvic acid + 5ml /L of *Ascophyllum nodosum*) recorded the maximum days taken for 50% bud initiation (84.16 days). All the treatments differed significantly with respect to yield parameters. Among them, T9 (0.8% of fulvic acid + 5ml /L of *Ascophyllum nodosum*) recorded best values regarding flower yield plant^{-1} (108.78 g), flower yield hectare^{-1} (36.26 t).

Key words**:** Chrysanthemum*,* Biostimulants*,* Growth*,* ield parameters

Chrysanthemum (*Dendranthema grandiflora*) is one of the most beautiful and oldest flowering plant, commercially grown in different parts of the world. Chrysanthemum occupies a prominent place in ornamental horticulture and is one of the commercially exploited flower crops, belongs to the family 'Asteraceae' and referred as "Queen of the East". The word "Chrysanthemum" comes from two Greek words, Chrysos means golden and anthos means flower which means golden flower. It is the second largest cut flower all over the globe and one of the most popular and commercial loose flower crops grown in India. Over 140 cultivars of chrysanthemum have gained the royal horticultural society Award of Garden Merit. Its erect and tall growing cultivars are suitable for background planting in border for cut flowers. White and yellow chrysanthemum flowers are used for culinary purposes. Chrysanthemum plants have been shown to reduce the indoor air pollution.

It is native to the Northern hemisphere and is widely distributed in Europe and Asia. However, the origin of chrysanthemum is in China [1]. Chrysanthemum prefers well drained sandy loam soils with good tilth with proper aeration and drainage facility. Chrysanthemum has shallow but fibrous root system. It is sensitive to the water logging. Chrysanthemum can be commercially propagated by suckers and terminal cuttings [2]. Suckers arise from the underground stem and these are separated and planted in prepared nursery beds for stock plants. Cuttings of 5-7cm in length are taken from healthy stock plants. The cuttings are prepared by removing basal leaves and reducing the leaf area of remaining leaves to half. Chrysanthemum is one of the most important traditional flowers of India mainly used as a potted plant, loose flower, cut flower and as border plant in the garden. It is important in manufacturing of Pyrethrin insecticide.

MATERIALS AND METHODS

The study entitled "Effect of biostimulants on growth and yield of chrysanthemum (*Dendranthema grandiflora*) cv. Paper yellow" was carried out at farmers field, Rayakottai, Krishnagiri, Tamil Nadu, India during 2022-2023. The experimental site is located at 12.52 °N latitude and 78.2 °E longitude at an elevation of about 492 m above mean sea level (MSL). The region has minimum temperature of 21 °C and mean maximum temperature of 36 °C with temperature range from 29 °C to 36.2 °C during summer and 23 °C to 29 °C during winter period of 2021-2023. Rainfall of 830 mm per annum received mostly from north east monsoon which starts from October to mid of December. The temperature range in the

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experimental period from December 2022 to May 2023 was between 26.4 °C to 35.7 °C. The experiment conducted in randomized block design, with three replications and eleven treatments. The treatment schedule was as follows, T_1: Control, T_2: 0.4% Fulvic acid, T_3: 0.8% Fulvic acid, T_4: 0.5% Humic acid, T_5: 1% Humic acid, T_6: 2.5 ml L^{-1} *Ascophyllum nodosum*, T_7: 5 ml L^{-1} *Ascophyllum nodosum*, T_8: 0.4% Fulvic acid + 2.5 ml L^{-1} *Ascophyllum nodosum*, T_9: 0.8% Fulvic acid + 5 ml L^{-1} *Ascophyllum nodosum*, T_{10}: 0.5% Humic acid + 2.5 ml L^{-1} *Ascophyllum nodosum*, T_{11}: 1% Humic acid + 5 ml L^{-1} *Ascophyllum nodosum*.

RESULTS AND DISCUSSION

Significant differences were observed in all the characters and plant height was affect due to biostimulants at 75 DAT present in (Table 1). Among all the treatments, T_9 (0.8% fulvic acid + 5ml L^{-1} of *Ascophyllum nodosum*) recorded highest plant height (65.06 cm), followed byT_{11} (1% humicacid + 5ml L^{-1} of *Ascophyllum nodosum*) recorded plant height (62.07 cm) at 75 DAT. Among the different treatments T_1 (control) recorded significantly the lowest value (54.13 cm) at 75 DAT. Maximum plant height (65.06 cm) was shown by (T_9) *Ascophyllum nodosum* @ 5ml L^{-1} and fulvic acid 0.8% might be due to that, *Ascophyllum nodosum* is responsible for the cell enlargement, cell division and internodal elongation because it contains growth regulators like auxins and cytokinins. Thus, it results in the increased plant height and also rapid vegetative growth. Fulvic acid in combination with sea weed extract contains micro nutrients, macro nutrients N, P, K, amino acids there by helps in the development of plant growth, Similar findings were reported by Hegde *et al*. [3] in chrysanthemum, Bhargavi *et al*. [4] in chrysanthemum.

Plant spread in North-South direction was found to be significant in all the biostimulant treatments at 75 DAT. Among the treatments, T_9 (0.8% fulvic acid + 5ml L^{-1} of *Ascophyllum nodosum*) recorded highest plant height (29.71 cm), followed by T_{11} (1% humic acid + 5ml L^{-1} of *Ascophyllum nodosum*) recorded plant height (28.34 cm) at 75 DAT. Among the different treatments T_1 (control) recorded significantly the lowest value (22.90 cm) at and 75 DAT. Similar findings were reported by Bhargavi *et al*. [4] in chrysanthemum, Praveen *et al*. [5] in rose and Haider *et al*. [6] in potato. Plant spread in East - West was found significant in all biostimulant treatments at 75 DAT. Among the treatments, T_9 (0.8% fulvic acid + 5ml L^{-1} of *Ascophyllum nodosum*) recorded highest plant height (29.63 cm), followed by T_{11} (1% humic acid + 5ml L^{-1} of *Ascophyllum nodosum*) recorded plant height (28.27 cm) at 75 DAT. Among the different treatments T_1 (control) recorded significantly the lowest value (23.03 cm) at 75 DAT. Similar findings were reported by Bhargavi *et al*. [4] in chrysanthemum, Praveen *et al*. [5] in rose and Haider *et al*. [6] in potato.

Table 1 Effect of biostimulants on growth and yield characters of chrysanthemum at 75 DAT

Treatments	Plant height (cm)	Plant spread (cm) (N-S)	Plant spread (cm) (E-W)	Number of branches plant^{-1}	Days taken for first flower bud initiation	Days taken for first 50% flower bud initiation (days)	Flower yield per plant (g)	Estimated flower yield ha^{-1} (t)
T_1: Control	54.13	22.90	23.03	10.50	90.32	101.74	68.47	22.82
T_2: 0.4% Fulvic acid	56.34	25.73	25.66	14.64	86.64	95.44	94.20	31.4
T_3: 0.8% Fulvic acid	57.37	26.20	26.13	14.90	85.43	94.11	95.92	31.97
T_4: 0.5% Humic acid	55.17	25.19	25.13	14.33	88.01	96.95	92.25	30.74
T_5: 1% Humic acid	56.20	25.66	25.59	14.60	86.81	95.62	93.96	31.32
T_6: 2.5 ml L^{-1} *Ascophyllum nodosum*	57.64	26.32	26.25	14.97	85.11	93.75	96.38	32.12
T_7: 5 ml L^{-1} *Ascophyllum nodosum*	58.62	26.77	26.70	15.23	83.96	92.49	98.01	32.67
T_8: 0.4% Fulvic acid + 2.5 ml L^{-1} *Ascophyllum nodosum*	60.83	27.78	27.70	15.80	81.37	89.63	101.71	33.9
T_9: 0.8% Fulvic acid + 5 ml L^{-1} *Ascophyllum nodosum*	65.06	29.71	29.63	16.90	76.40	84.16	108.78	36.26
T_{10}: 0.5% Humic acid + 2.5 ml L^{-1} *Ascophyllum nodosum*	59.73	27.27	27.20	15.51	82.66	91.06	99.86	33.28
T_{11}: 1% Humic acid + 5ml L^{-1} *Ascophyllum nodosum*	62.07	28.34	28.27	16.12	79.91	88.03	103.78	34.5
S.Ed	0.349	0.164	0.166	0.096	0.486	0.536	0.616	0.183
CD at 5%	0.733	0.344	0.336	0.201	1.021	1.125	1.294	0.357

Number of branches plant^{-1} was found to be significant in all the biostimulant treatments at 75 DAT present in (Table 1). Among the treatments, T_9 (0.8% fulvic acid + 5ml L^{-1} of *Ascophyllum nodosum*) recorded maximum number of branches plant^{-1} (16.90), followed by T_{11} (1% humic acid + 5ml L^{-1} of *Ascophyllum nodosum*) recorded number of branches plant^{-1} (16.12) at 75 DAT. Among the different treatments T_1 (control) recorded significantly the lowest number of branches plant^{-1} (10.50) at 75 DAT. This might be that *Ascophyllum nodosum* contains auxins i.e., in particular IAA helps in enhancement of adventitious root formation and helps in promotion of better growth. Cytokinins present in sea weed extract *Ascophyllum nodosum* promoted the production of laterals by inducing the axillary bud sprouting [7] (Selvakumari and Venkatesan, 2017). Fulvic acid directly transport the critical minerals to metabolic sites within the plants. Similar findings were reported by Tartil *et al.* [8] in pot marigold, Kahkashan *et al*. [9] in tuberose and Praveen *et al*. [5] in rose.

The mean number of days taken for 1st flower bud initiation was found to be significant in all the treatments. It was observed to be minimum number of days taken for 1st flower bud initiation was recorded in T_9 (0.8% fulvic acid + 5ml L^{-1} of *Ascophyllum nodosum*) (76.40 days), followed by T_{11} (1% humic acid + 5ml L^{-1} of *Ascophyllum nodosum*) (79.91 days). Among the different treatments T_1 (control) recorded maximum number of days taken for 1st flower bud initiation (90.32 days). The presence of cytokinins in *Ascophyllum nodosum* might induce the production of lateral shoot growth there by inducing the sprouting of axillary buds [7].

The number of days taken for 50% flower bud initiation was found to be significant in all the biostimulants treatments present in (Table 1). Among all the treatments T_9 (0.8% fulvic acid + 5ml L^{-1} of *Ascophyllum nodosum*) recorded minimum number of days taken for 50% flower bud initiation (84.16 days), followed by T_{11} (1% humic acid + 5ml L^{-1} of *Ascophyllum nodosum*) (88.03 days). While the maximum number of days taken for 50% flower bud initiation was recorded significantly in T_1 (control) (101.74 days). The presence of cytokinins in *Ascophyllum nodosum* might induce the production of lateral shoot growth thereby inducing the sprouting of axillary buds [7]. This is due to the availability of cytokinins which accumulates in the lateral buds would have made them more effective sink in the diversion of assimilates as well as other flower inducing hormones which ultimately resulted in 50% bud development in lesser duration.

Among the biostimulant treatments, T_9 (0.8% fulvic acid + 5ml L^{-1} of *Ascophyllum nodosum*) recorded highest flower yield plant^{-1} (108.78 g), followed by T_{11} (1% humic acid + 5ml L^{-1} of *Ascophyllum nod*osum) (103.78 g). While the lower flower yield plant^{-1} was recorded in T_1 (Control) (68.47 g) present in (Table 1). The greater availability of essential elements especially nitrogen and phosphorous in sea weed extracts which is responsible for maximum shoot growth, more number of branches and hence ultimate size of the plant resulting in the production of higher photosynthesis, which subsequently led to desirable C:N ratio. These favorable situations led to production of more number of flowers and ultimately higher yield. Similar findings were reported by Bhargavi *et al*. [4] in chrysanthemum, Praveen *et al*. [5] in rose.

All the biostimulant treatments differed significantly with respect to flower yield ha^{-1} presented in (Table 1). Among the treatments, T_9 (0.8% fulvic acid + 5ml L^{-1} of *Ascophyllum nodosum*) recorded maximum flower yield ha^{-1} (36.26 t), followed by T_{11} (1% humic acid + 5ml L^{-1} of *Ascophyllumnodosum*) (34.5 t). Whereas, the lowest flower yield ha^{-1} was recorded in T_1 (Control) (22.82 t). The higher yield may be due to better uptake of nutrients like nitrogen, phosphorus and synthesis of carbohydrates, proteins. This resulted in the better growth of plant in terms of plant height, plant spread, number of branches. There by it results in the higher yield. Similar findings were reported by Hegde *et al*. [3] in chrysanthemum, Bhargavi *et al*. [4] in chrysanthemum.

CONCLUSION

Based on the above facts and the results of the present studies on the effect of biostimulants on growth and yield characters of chrysanthemum, it can be concluded that among the biostimulants used, positive influence was recorded under growth promoter treatments viz. *Ascophyllum nodosum*, Fulvic acid and humic acid. Further, among the promoter treatments, *Ascophyllum nodosum* @5ml L^{-1} and Fulvic acid 0.8% showed superior results in enhancing the growth and flowering characters can be recommended.

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