Original Research Article

Effect of Seaweed Extract ~~Application Rate and Method~~ on Growth, Flowering and Yield of Pansy

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ABSTRACT

Pansies, part of the Viola genus, are vibrant flowers with velvety petals and a distinct center blotch. They are popular as ornamental plants due to their colorful appearance. Seaweed extract, derived from various types of seaweed or marine algae, is utilized in agriculture, gardening, and skincare. Seaweed is nutrient-rich, containing essential macro and micronutrients, making seaweed extract a valuable natural fertilizer to enhance plant growth and health. Therefore, present investigation was carried during the *Winter*-2022 with a view to determine the effect different concentration of seaweed extract application on pansy variety Majestic Giant Mix for its growth, flowering, yield and to work out the economics of various treatments. The study was examined carried out using completely randomized block design. From the present investigation, it is concluded that treatment T_4 i.e., application of Seaweed extract @ 4ml/l as drench application found superior in terms of plant height (16.00 cm), plant spread (17.56), number of branches per plant (28.81), days taken for first flower opening (30.00), days taken for 50% flowering (58.33), stalk length (8.60 cm), flower diameter (7.83) number of leaves (43.33), number of flowers perplant (38.88) and seed yield per plant (3.00g).

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Keywords: *Pansy, Seaweed extract, Drench, Foliar.*

INTRODUCTION

The garden pansy (*Viola* × *wittrockiana*) is a type of large-flowered hybrid plant cultivated as a garden flower. It is derived by hybridization from several species in the section *Melanium* ("the pansies") of the genus *Viola*, particularly *V. tricolor*, a wildflower of Europe and western Asia known as heartsease (Yockteng, 2003). The flower is 5 to 8 ~~centimetres~~ cm in diameter and has two slightly overlapping upper petals, two side petals, and a single bottom petal with a slight beard emanating from the flower's centre. These petals are usually white or yellow, purplish, or blue. The plant may grow to 23 cm in height and prefers sun to varying degrees and well-draining soils. Chromosome number of pansy is 2n=48. Pansys are divided into two basic groups, garden hardy and exhibition. In the early 19th century, Lady Mary Elizabeth Bennet (1785–1861), daughter of Emma, Lady Tankerville and the Earl of Tankerville, collected and cultivated every sort of *Viola tricolor* (commonly, heartsease) she could procure in her father's garden at Walton-upon-Thames, Surrey. Under the supervision of her gardener, William Richardson, a large variety of plants was produced via crossbreeding. In 1812, she introduced her pansies to the horticultural world. Modern horticulturists have developed a wide range of pansy flower colours and bicolour including yellow, gold, orange, purple, violet, red, white, and even near-black (very dark purple). Pansies typically display large showy face markings. Pansies are not only aesthetically pleasing but also attract pollinators like bees and butterflies to the garden. They are often used as decorative plants in parks, gardens, and various floral arrangements. Pansies, for best growth, are watered thoroughly about once a week, depending on climate and rainfall. The plant should never be over-watered. To maximize blooming, plant foods are used about every other week, depending on the type of food used. Regular deadheading can extend the blooming period. The largest producer of pansies can vary over time as production levels can fluctuate due to factors such as climate, market demand, and agricultural practices. However, some countries are known for their significant production of pansies and other ornamental plants. Netherland is the largest producer of pansy in the world flowed by

Germany, United States, Italy, accounting for over 83% of the global production. According to the Food and Agriculture Organization (FAO) of the United Nations, Netherland produced over 97,000 metric tons of pansy in 2021. Pansy production in India has been growing steadily over the years, as the demand for ornamental flowers has increased both domestically and internationally. The area under production of pansy in India is estimated to be around ~~2~~two thousand hectares and production is 6.14 million tons. Tamil Nadu ranks first in pansy production followed Karnataka and Andhra Pradesh. In Uttar Pradesh, area under production is 0.23 thousand hectares with production of 0.13 million tons. (*Source: NHB,* Ministry of Agriculture & Farmers Welfare, Government of India, 2021-22). Seaweed extracts are used in agricultural practice and are already commercialized. Such as, seaweed liquid fertilizers (SLF) are available as manure, foliar spray, soil conditioners and soil drench (Thirumaran, 2009). Seaweed fertilizer was found to be superior to chemical fertilizer. The presence of high level of organic matter aids in retaining moisture and minerals in upper soil that is available to roots (Sivasankari et al. 2006). Plant absorbs nutrients either through roots or from the leaf surface. Seaweed extracts alter physical, biochemical, and biological properties of the soil and may also affect the architecture of plant roots facilitating efficient uptake of nutrients. Brown seaweeds contain polyuronides such as alginates and fucoidans. Alginic acid showed soil- conditioning properties and chelated metal ions forming high molecular weight polymers (Hanan, 2011). Pansy is a small herbaceous annual flowering plant belonging to family violaceae. Pansy is a type of large, flowered hybrid plant cultivated as a garden flower. These perennials can bring carpets of colour to any outdoor space. Itis also a purifying herb, which contain powerful plant compounds that possess anti-inflammatory and antioxidant properties. The application of bio stimulant such as seaweed extract has many advantages with respect to soil production and flower production. It helps to produce good quality pansy flowers. Seaweed extracts are organic biofertilizers rich in micro and macronutrients, humic acids, and phytohormones which enhances soil fertility. They also enhance bacterial activity in soil medium. So, it is necessary to identify the effectiveness of seaweed extract on growth and yield of pansy flowers. The goal of this experiment is to realize how seaweed extract affectgrowth, flowering, and yield of pansy.

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MATERIAL AND METHODS

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The present investigation was done to understand the effect of seaweed extracts at different concentrations on plant and floral growth and yield of Pansy variety Majestic Giant Mix. The investigation was carried out at Horticultural Research Farm (HRF), Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj during *Winter Season* 2022. The different combination doses of seaweed extractare T_0 (Control); T_1 (Drenching seaweed extract @ 1 ml/L); T_2 (Drenching seaweed extract @ 2 ml/L); T_3 (Drenching seaweed extract @ 3 ml/L); T_4 (Drenching seaweed extract @ 4 ml/L); T_5 (Foliar application of

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seaweed extract @ 1 ml/L); T_6 (Foliar application of seaweed extract @ 2 ml/L); T_7 (Foliar application of seaweed extract @ 3 ml/L) and T_8 (Foliar application of seaweed extract @ 4 ml/L).

Observations were recorded ~~at~~ on different growth parameters ~~like~~ viz.,plant height, number of branches per plant, plant spread, flowering parameters like days to first flower opening, days to 50% flowering, flower diameter, stalk length and yield parameters like number of flowers per plant and seed yield per plant. The data were statisticallyanalysed by the method suggested by Fisher and Yates, 1963. ~~The different combination doses of seaweed extractare T_0 (Control); T_1 (Drenching seaweed extract @ 1 ml/L); T_2 (Drenching seaweed extract @ 2 ml/L); T_3 (Drenching seaweed extract @ 3 ml/L); T_4 (Drenching seaweed extract @ 4 ml/L); T_5 (Foliar application of~~

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~~seaweed extract @ 1 ml/L); T_3 (Foliar application of seaweed extract @ 2 ml/L); T_2 (Foliar application of seaweed extract @ 3 ml/L) and T_4 (Foliar application of seaweed extract @ 4 ml/L).~~

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RESULTS AND DISCUSSION

A) Vegetative Parameters

Plant height and Number of leaves per plant

The maximum plant height at 90 DAP (16.00 cm) was observed with treatment T_4 (Drenching seaweed extract @ 4 ml/L) followed by T_3 (Drenching seaweed extract @ 3 ml/L) with 15.16 cm. Minimum plant height at 90 DAP (11.50 cm) was observed in T_0 (Control), while the remaining treatments were moderate in their growth habit. Increasing the dose of seaweed extract application in pansy through drenching method enhances plant height due to several reasons. Firstly, seaweed extracts contain natural growth-promoting hormones like auxins, cytokinin, and gibberellins, which stimulate cell division and elongation, leading to increased plant height. Secondly, the extract improves nutrient uptake and enhances photosynthesis, resulting in better overall plant growth. Lastly, seaweed extracts enhance the plant's resistance to environmental stressors, such as drought and diseases, allowing the plant to allocate more energy towards vertical growth. Similar findings were reported by **Tartil *et al.*, (2016)** in pot marigold; **Karim *et al.*, (2017)** and **El-Hady (2020)** in Tuberose; **Sohier *et al.*, (2018)** in Dahlia**; Khadim (2019)** in Carnation**; Sumangala *et al.*, (2019)** and **Kularthne *et al.*, (2020)** in rose**; Alhasan *et al.*, (2021)** in gerbera**; Zelikovic *et al.* (2021)** in pansy**; Al-Hatem *et al.* (2023)** in Chrysanthemum**.**

The maximum number of leaves at 90 DAP (43.33 leaves) was observed with treatment T_4 (Drenching seaweed extract @ 4 ml/L) followed by T_3 (Drenching seaweed extract @ 3 ml/L) with 42.33 leaves. Minimum number of leaves at 90 DAP (36.66 leaves) was observed in T_0 (Control), while the remaining treatments were moderate in their growth habit. When applying a higher dose of seaweed extract to pansies through the drenching method as compared to foliar spraying, it promotes the development of a greater number of leaves for several reasons. Firstly, drenching ensures direct root absorption, allowing the plants to access a larger quantity of nutrients and growth-promoting compounds present in the seaweed extract. Secondly, the increased availability of nutrients stimulates leaf production and expansion. Lastly, drenching provides a more sustained and continuous supply of the seaweed extract to the roots, leading to prolonged stimulation of leaf growth compared to the relatively short-lived effect of foliar spraying. The findings of the present investigation are in conformity with the reports of **Tartil *et al.*, (2016)** in pot marigold; **Karim *et al.*, (2017)** and **El-Hady (2020)** in Tuberose; **Sohier *et al.*, (2018)** in Dahlia**; Khadim (2019)** in Carnation**; Sumangala *et al.*, (2019)** and **Kularthne *et al.*, (2020)** in rose**; Alhasan *et al.*, (2021)** in gerbera**; Zelikovic *et al.* (2021)** in pansy**; Al-Hatem *et al.* (2023)** in Chrysanthemum**.**

Plant spread and number of branches per plant

The plant spread significantly varied among different treatment combinations. The maximum plant spread at 90 DAP (17.56 cm) was observed with treatment T_4 (Drenching seaweed extract @ 4 ml/L) followed by T_3 (Drenching seaweed extract @ 3 ml/L) with 17.10 cm. Minimum plant spread at 90 DAP (12.06 cm) was observed in T_0 (Control), while the remaining treatments were moderate in their growth habit (Table 1). Increasing the dose of seaweed extract application in pansies through the drenching method results in better plant spread compared to foliar spraying, for several reasons. Firstly, drenching allows for direct root absorption of the extract, facilitating enhanced nutrient uptake and promoting overall plant growth. This leads to the development of a stronger root system, enabling the plants to spread and establish themselves more effectively. Secondly, the continuous supply

of nutrients and growth-promoting compounds through drenching stimulates lateral branching and encourages the plants to produce more side shoots, resulting in a fuller and more expansive plant spread. The findings of the present investigation are in conformity with the reports of **Tartil *et al.*, (2016)** in pot marigold; **Karim *et al.*, (2017)** and **El-Hady (2020)** in Tuberose; **Sohier *et al.*, (2018)** in Dahlia**; Khadim (2019)** in Carnation**; Sumangala *et al.*, (2019)** and **Kularthne *et al.*, (2020)** in rose**; Alhasan *et al.*, (2021)** in gerbera**; Zelikovic *et al.* (2021)** in pansy**; Al-Hatem *et al.* (2023)** in Chrysanthemum**.**

The maximum number of branches at 90 DAP (28.81 branches) was observed with treatment T_4 (Drenching seaweed extract @ 4 ml/L) followed by T_3 (Drenching seaweed extract @ 3 ml/L) with 28.34 branches. Minimum number of branches at 90 DAP (20.33 branches) was observed in T_0 (Control), while the remaining treatments were moderate in their growth habit. The findings of the present investigation are in conformity with the reports of **Tartil *et al.*, (2016)** in pot marigold; **Karim *et al.*, (2017)** and **El-Hady (2020)** in Tuberose; **Sohier *et al.*, (2018)** in Dahlia**; Khadim (2019)** in Carnation**; Sumangala *et al.*, (2019)** and **Kularthne *et al.*, (2020)** in rose**; Alhasan *et al.*, (2021)** in gerbera**; Zelikovic *et al.* (2021)** in pansy**; Al-Hatem *et al.* (2023)** in Chrysanthemum**.**

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B) Floral parameters

Days taken for first flower opening and days to 50% flowering

There was significant difference between the treatments ~~at among the treatments applied~~with respect to days for first flowering. It was found that T_4 (Drenching seaweed extract @ 4 ml/L) had minimum days taken for first flower opening (30.00 ~~DAP~~days followed byT_3 (Drenching seaweed extract @ 3 ml/L) with 31.33 DAP whereas the maximum stem length was observed in treatment T_0 (Control) with 37.00 DAP (Table 1). It was found that T_4 (Drenching seaweed extract @ 4 ml/L) had minimumdays taken for 50% flowering (58.33 ~~DAP~~ daysfollowed by T_3 (Drenching seaweed extract @ 3 ml/L) with 61.33 DAPwhereas the maximum stem length was observed in treatment T_0 (Control) with 70.00 DAP. Increasing the dose of seaweed extract application in pansies through the drenching method promotes early flowering compared to the foliar spraying method for several reasons. Firstly, drenching ensures direct root absorption, providing a moreefficient and comprehensive uptake of growth-promoting compounds. These compounds stimulate flower bud initiation and development, leading to earlier flowering. Secondly, the drenching method provides a sustained andcontinuous supply of nutrients and hormones to the roots, allowing the plant to allocate more energy towards reproductive processes like flowering. This targeted and continuous nutrient availability accelerates the flowering process, resulting in earlier and more abundant blooms compared to the relatively limited effect of foliar spraying. The findings of the present investigation are in conformity with the reports of **Tartil *et al.*, (2016)** in pot marigold;**Karim *et al.*, (2017)** and **El-Hady (2020)** in Tuberose; **Sohier *et al.*, (2018)** in Dahlia**; Khadim (2019)** in Carnation**; Sumangala *et al.*, (2019)** and **Kularthne *et al.*, (2020)** in rose**; Alhasan *et al.*, (2021)** in gerbera**; Zelikovic *et al.* (2021)** in pansy**; Al-Hatem *et al.* (2023)** in Chrysanthemum**.**

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Stalk length and flower diameter

It was found that T_4 (Drenching seaweed extract @ 4 ml/L) had maximum Stalk length (8.60 cm) followed by T_3 (Drenching seaweed extract @ 3 ml/L) with 8.10 cm whereas the minimum ~~stem~~ stalk ? length was observed in treatment T_0 (Control) with 5.36 cm (Table 1). It was found that T_4 (Drenching seaweed extract @ 4 ml/L)

had maximum Flower

diameter 7.83 cm followed by T_3 (Drenching seaweed extract @ 3 ml/L) with 7.46 cm whereas the minimum stem length was observed in treatment T_0 (Control) with 4.33 cm. Increasing the dose of seaweed extract application in pansies through the drenching method enhances stalk length and flower diameter compared to the foliar spraying method for several reasons. Firstly, drenching ensures direct root absorption of growth-promoting compounds, stimulating cell elongation and elongation of the stem. This results in longer stalks and increased overall plant height. Secondly, the drenching method provides a sustained and continuous supply of nutrients and hormones to the roots, supporting consistent and prolonged stem growth. This sustained nutrient availability allows for the development of longer stalks compared to the relatively limited effect of foliar spraying, leading to enhanced stalk length in pansy plants. The findings of the present investigation are in conformity with the reports of **Tartil *et al.*, (2016)** in pot marigold; **Karim *et al.*, (2017)** and **El-Hady (2020)** in Tuberose; **Sohier *et al.*, (2018)** in Dahlia**; Khadim (2019)** in Carnation**; Sumangala *et al.*, (2019)** and **Kularthne *et al.*, (2020)** in rose**; Alhasan *et al.*, (2021)** in gerbera**; Zelikovic *et al.* (2021)** in pansy**; Al-Hatem *et al.* (2023)** in Chrysanthemum.

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C) Yield parameters

Number of flowers per plant and seed yield per plant

It was found that T_4 (Drenching seaweed extract @ 4 ml/L) had maximum Number of flowers per plant 38.88 flowers followed by T_3 (Drenching seaweed extract @ 3 ml/L) with 32.44 flowers whereas the minimum stem length was observed in treatment T_0 (Control) with 22.17 flowers. The findings of the present investigation are in conformity with the reports of **Tartil *et al.*, (2016)** in pot marigold; **Karim *et al.*, (2017)** and **El-Hady (2020)** in Tuberose; **Sohier *et al.*, (2018)** in Dahlia**; Khadim (2019)** in Carnation**; Sumangala *et al.*, (2019)** and **Kularthne *et al.*, (2020)** in rose**; Alhasan *et al.*, (2021)** in gerbera**; Zelikovic *et al.* (2021)** in pansy**; Al-Hatem *et al.* (2023)** in Chrysanthemum**.**

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It was found that T_4 (Drenching seaweed extract @ 4 ml/L) had maximum Seed yield per plant (3.00 g) followed by T_3 (Drenching seaweed extract @ 3 ml/L) with 2.93 g whereas the minimum stem length was observed in treatment T_0 (Control) with 1.56 g (Table 1). By increasing the dose of seaweed extract applied to pansies through the drenching method, the seed yield is significantly improved compared to foliar spraying. Drenching facilitates direct root absorption of growth-promoting compounds, optimizing nutrient uptake and enhancing reproductive processes. This results in healthier and more vigorous seed production. Moreover, the continuous supply of nutrients and hormones provided by drenching sustains flowering and seed development over an extended period. This prolonged nutrient availability enhances pollination, fertilization, and seed formation, leading to a substantial increase in seed yield compared to the comparatively limited impact of foliar spraying. The findings of the present investigation are in conformity with the reports of **Tartil *et al.*, (2016)** in pot marigold; **Karim *et al.*, (2017)** and **El-Hady (2020)** in Tuberose; **Sohier *et al.*, (2018)** in Dahlia**; Khadim (2019)** in Carnation**; Sumangala *et al.*, (2019)** and **Kularthne *et al.*, (2020)** in rose**; Alhasan *et al.*, (2021)** in gerbera; **Zelikovic *et al.* (2021)** in pansy**; Al-Hatem *et al.* (2023)** in Chrysanthemum**.**

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Conclusion

From the present investigation, it is concluded that treatment T_4 i.e., application of Sea weed extract @ 4ml/l as drench application found superior in terms of plant height (16.00 cm), plant spread (17.56), number of branches per plant (28.81), days taken for first flower opening (30.00), days taken for 50% flowering (58.33), stalk length

(8.60 cm), flower diameter (7.83) number of leaves (43.33), number of flowers per plant (38.88) and seed yield per plant (3.00g).

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Table 1 Performance of different doses of seaweed extract on vegetative and floral parameters ~~studied for Pansy.~~ of pansy

Treatment Notation	Treatment details	Plant height (cm) [90 DAP]	No of leaves per plant [90 DAP]	Plant spread (cm) [90 DAP]	No of branches per plant [90 DAP]	Days taken for first flower opening (DAP)	Days taken for 50% flowering (DAP)	Stalk length (cm)	Flower diameter (cm)	No of flowers per plant	Seed yield per plant (g)
T_0	Control	11.50	36.66	12.06	20.33	37.00	70.00	5.36	4.33	22.17	1.56
T_1	Drenching seaweed extract @ 1 ml/L	12.96	38.33	15.60	23.73	35.00	65.00	7.16	6.06	27.34	1.96
T_2	Drenching seaweed extract @ 2 ml/L	14.50	41.33	16.80	27.87	32.00	62.00	8.00	7.26	31.22	2.83
T_3	Drenching seaweed extract @ 3 ml/L	15.16	42.33	17.10	28.34	31.33	61.33	8.10	7.46	32.44	2.93
T_4	Drenching seaweed extract @ 4 ml/L	16.00	43.33	17.56	28.81	30.00	58.33	8.60	7.83	38.88	3.00
T_5	Foliar application of seaweed extract @ 1 ml/L	12.83	37.33	14.86	22.50	36.33	66.33	6.63	5.73	25.15	1.80
T_6	Foliar application of seaweed extract @ 2 ml/L	13.20	39.33	15.90	24.82	34.33	64.33	7.46	6.40	28.14	2.06
T_7	Foliar application of seaweed extract @ 3 ml/L	13.70	40.00	16.13	26.32	33.33	63.33	7.60	6.83	28.95	2.40
T_8	Foliar application of seaweed extract @ 4 ml/L	14.00	40.33	16.40	27.56	33.00	60.00	7.86	7.10	29.77	2.77
'F' test		**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
S.E. (m) ±		**0.17**	**0.31**	**0.10**	**0.23**	**0.22**	**0.70**	**0.08**	**0.17**	**0.52**	**0.05**
C.D. at 5%		**0.36**	**0.94**	**0.31**	**0.50**	**0.66**	**1.48**	**0.17**	**0.36**	**1.11**	**0.11**
C.V.		**1.53**	**1.36**	**1.13**	**1.13**	**1.14**	**1.35**	**1.39**	**3.18**	**2.20**	**2.81**

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