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Effect of Bio-stimulants and their Application Methods on Growth, Flowering, Yield and Vase life of Asiatic lilium cv. Fangio

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The present investigation entitled "Effect of bio-stimulants and their application methods on growth, flowering, yield and vase life of Asiatic lilium cv. Fangio" was carried out during November, 2022 to March, 2023 in, Horticulture Research Farm, Department of Horticulture, Naini Agricultural Institute, SHUATS. The experiment was conducted in Completely Randomized Design with ten treatment combinations, with application of three Biostimulants like Humicil, Hydropro gold and Biovita at different levels, which was replicated thrice. It was concluded that the application of biostimulants

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rendered their significant effect on almost all the growth, flowering yield and vase life characters as well as quality of lilium. The treatment T3 i.e., application of Biovita (Foliar method) found superior in terms of Plant height(70.84 cm), Stem girth (0.80 cm) Number of leaves(87.47),Leaf area (13.63 cm^2), Bud diameter (2.56 cm), Flower diameter (14.68 cm), Fresh weight of stem (34.73 g), Vase life (12.60 days), Diameter of bulb (5.21 cm), Weight of bulb per plant (64.75 g) Number of flowers per plant (4.91), Number of flowers per 200 m^2 (10924.83), Weight of bulbs per plant (0.071 kg), and Weight of bulbs per 200m^2 (157.02 kg).

Keywords: Bio-stimulants; growth; yield; Asiatic lilium cv.; fangio.

1. INTRODUCTION

Asiatic lilies, scientifically known as *Lilium asiatica* are belongs to the family Liliaceae, is one among the important bulbous plants which is widely acclaimed for its use as cut flowers and pot plants and ranks fourth among the cut flowers in the world. It is native to the Northern hemisphere and geometrically distributed over China. In India, Lilium are found growing naturally in Nilgiri Hills and Himalayan regions [1]. The Netherlands, Japan and U.S.A. (Oragon) are the prime producers of both cut flowers and bulbs. The commercial cultivation of Lilium in India [2] has been restricted to the states; Tamil Nadu, Kerala, Karnataka, Himachal Pradesh, Uttar Pradesh and Maharashtra. Lilium has been admired for its aesthetic beauty and has been depicted as a symbol of purity and regality. Lilium is one of the important geophytes, endowed with showy flowers, appealing colour pattern and durable spikes flowers. Flower colour varies from orange, red, yellow to pink, white etc. They are mostly odourless. These are late flowering in nature, plants are tall with large and broad leaves. Flowers are large, fragrant, tend to be outward facing. They are also compact, with plant height of 60-150 cm that bears 3-4 flowers per umbel. Flowers are of 15-20 cm diameter that may point up, out or down and stalk length may from 50 to 100 cm. Blooms may be red, orange, pink, white or yellow in colour. They grow well in full sun or light shade.

The aim of modern agriculture is to reduce inputs without reducing the yield and quality. The identification of organic molecules able to activate plant metabolism may allow an improvement in plant performance in a short period of time and in a cheaper way. Biostimulants are plant extracts and contain a wide range of bioactive compounds that are mostly still unknown. These products are usually able to improve the nutrient use efficiency of the plant and enhance tolerance to biotic and abiotic stresses [3]. Plant biostimulants are the materials which include substances and microorganisms which stimulate natural processes when applied to plants or the rhizosphere the main functions of plant biostimulants include nutrient uptake, nutrient efficiency, tolerance to abiotic stresses, increase crop quality.

Humic substances are naturally occurring end-products resulting from the decomposition of microorganisms such as bacteria and fungi, and the chemical decomposition of animal and plant residues in the soil. Humic acid and fulvic acids combine to convert minerals into organic compounds that can be digested very easily by plants [4]. Humic acid could directly influence plant growth components such as cell permeability, respiration, photosynthesis, and cell elongation [5].

Protein hydrolysates and amino acid mixtures are obtained from chemical or enzymatic hydrolysis of plant and animal feedstock.These play multiple roles in N uptake and assimilation, plant signaling, C:N metabolism in the plant, and can increase microbial biomass, soil respiration and soil fertility. Studies proved that amino acid can affect directly or indirectly the physiological 1403 activities where they participate to protein synthesis and carbohydrate construction by constructing chlorophyll and enhancing photosynthesis as well as they contribute to stimulating the activity of many enzymes and coenzymes [6].

Seaweed extracts are derived from the extraction of several macroalgal species, leading to the production of complex mixtures of biologically active compounds depending on the extraction method [7]. Seaweed extracts are nutrient supplements in agriculture and horticulture to boost plant growth and productivity as an alternative to chemical fertilizers. Seaweed extracts are rich in mineral elements like calcium, magnesium, potassium, chlorine, sulphur, phosphorous, iodine, zinc and copper.

2. MATERIALS AND METHODS

A field experiment entitled "Effect of bio-stimulants and their application methods on growth, flowering, yield and vase life of Asiatic lilium cv. Fangio" was carried out in the Horticulture Research Farm, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture Technology and Sciences during November 2022- March 2023. The Lilium bulbs of *Fangio* variety were planted on pots containing a mixture of coirpeat, perlite and sand of ratio 2:1:2 and kept under shadenet condition. The size of the pots selected for experiment is 23 cm x 19 cm. The experiment was conducted in Completely Randomized Design with ten treatments and three replication.The experiment include foliar, drench and foliar+drench application of biostimulants, at an interval of 20,40 and 60 days. Three plants were selected randomly from each treatment per replication and their observations were recorded at 20 days interval. Data were statistically analysed by the method suggested by Fisher and Yates, 1963.

3. RESULTS AND DISCUSSION

Effect of Bio-stimulants and their Application Methods on Growth, Flowering Yield and Vase life of Asiatic Lilium cv. Fangio are presented in Tables 2 and 3 respectively.

3.1 Growth Parameters

Plant Height (cm): At 60 days after transplanting (DAT), the treatment T3, which involved spraying 2ml/l Biovita through foliar application at 20 days interval exhibit the highest plant height (70.84 cm) which was significally superior to all the treatments. Followed by the treatment T1, which employed 2ml/l Humicil through foliar application at 20 days interval with plant height (67.72 cm). In contrast, the control treatment (T0) recorded the lowest plant height (53.70 cm).

The remarkable increase in plant height is observed in the treatments using biovita (foliar method). This is attributed that application of seaweed extract in lilium through foliar method enhances plant height due to several reasons such as foliar applications has been attributed to the immediate interaction with the plant tissues. The extract improves nutrient uptake and enhances photosynthesis, resulting in better overall plant growth and 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. [8] in pot marigold; Karim et al. [9] and El-Hady [10] in Tuberose.

Stem Diameter (cm): At 60 days after transplanting (DAT), the treatment T3, which involved spraying 2 ml/l Biovita through foliar application at 20 days interval exhibit the highest stem diameter (0.80 cm) which was significally superior to all the treatments. Followed by the treatment T1, which employed 2 ml/l Humicil through foliar application at 20 days interval with stem diameter (0.78 cm). In contrast, the control treatment (T0) recorded the lowest stem diameter (0.59 cm).

The remarkable increase in stem diameter is observed in the treatments using Biovita (foliar method) can be attributed to the composition of the seaweed extract such as natural growth hormones (auxins and cytokinins) that promote plant growth via increasing the number of metabolic events such as cell division and enlargement. Also, the extract contains a

Table 1. Treatment details

Treatment symbol	Treatment combination	Concentration
T_0	Control	0
T_1	Humicil (Foliar)	2 ml/l
T_2	Hydropro gold (Foliar)	2 ml/l
T_3	Biovita (Foliar)	2 ml/l
T_4	Humicil (Drench)	2 ml/l
T_5	Hydropro gold (Drench)	2 ml/l
T_6	Biovita (Drench)	2 ml/l
T_7	Humicil (Foliar+Drench)	2ml/l + 2ml/l
T_8	Hydropro gold (Foliar+Drench)	2ml/l + 2ml/l
T_9	Biovita (Foliar+Drench)	2ml/l + 2ml/l

considerable amount of macro and micro elements which play an important role in the activation of many enzymes and coenzymes which are involved in several biological processes leading to cell division and enlargement.

These results are supported by the findings of Poincelot [11] in cosmos, Dhutraj [12] in gaillardia and Violeta et al. [13] in chrysanthemum.

Number of Leaves: At 60 days after transplanting (DAT), the treatment T3, which involved spraying 2 ml/l Biovita through foliar application at 20 days interval exhibit the highest number of leaves (87.47) which was significally superior to all the treatments. . Followed by the treatment T1, which employed 2 ml/l Humicil through foliar application at 20 days interval with number of leaves (86.06). In contrast, the control treatment (T0) recorded the lowest number of leaves (75.10).

The remarkable increase in number of leaves is observed in the treatments using biovita (foliar method) can be attributed to the presence of cytokinins and auxin precursors, as well as macro and micronutrients in the seaweed extract. These components promote cell division and expansion, facilitating rapid vegetative development. Furthermore, auxin and cytokinins directly influence the maintenance, and growth of shoot apical and axillary meristems.

These results are supported by the findings of Machado et al. [14] and Rajarajan et al. [15], in marigold.

Leaf Area: At 60 days after transplanting (DAT), the treatment T3, which involved spraying 2ml/l Biovita through foliar application at 20 days interval exhibit the highest leaf area (13.63 cm^2) which was significally superior to all the treatments. Followed by the treatment T1, which employed 2 ml/l Humicil through foliar application at 20 days interval with leaf area (13.48 cm^2). In contrast, the control treatment (T0) recorded the lowest leaf area (6.94 cm^2).

The remarkable increase in leaf area is observed in the treatments using biovita (foliar method) can be attributed to the expansion of leaf area through a higher concentration of seaweed extract possibly due to micronutrients in the supplement, which include potassium, improves the plant's metabolism, the production of amino acids and proteins, as well as the emergence of photosynthetic pigments.

These results are supported by the findings of Alkhuzaey and Al-asadi [16] in daffodil and Teobaldelli et al. [17] in Gerbera.

3.2 Floral Parameters

Bud Diameter: Among all the treatments, the treatment T3, which involved spraying 2 ml/l Biovita through foliar application at 20 days interval exhibit the highest bud diameter (2.56 cm)) which was significally superior to all the treatments. Followed by the treatment T1, which employed 2ml/l Humicil through foliar application at 20 days interval with bud diameter (2.50 cm). In contrast, the control treatment (T0) recorded the lowest bud diameter (2.23 cm).

The remarkable increase in bud diameter is observed in the treatments using biovita (foliar method) can be attributed that application of biostimulants reduced the duration of crop and increased diameter of flower buds due to the immediate interaction with the plant tissues. De Lucia and Vecchietti, [18] in lilium.

These results are supported by the findings of Syed khudus and Ajit Kumar [3].

Flower Diameter: Among all the treatments, the treatment T3, which involved spraying 2 ml/l Biovita through foliar application at 20 days interval exhibit the highest flower diameter (14.68 cm) which was significally superior to all the treatments. Followed by the treatment T1, which employed 2ml/l Humicil through foliar application at 20 days interval with flower diameter (14.66 cm). In contrast, the control treatment (T0) recorded the lowest flower diameter (13.33 cm).

The remarkable increase in flower diameter is observed in the treatments using biovita (foliar method) can be attributed that the larger flower diameter was observed in foliar spray of seeweed extract because they are the precusors of auxin,cytokinin and micronutrients.

These results are supported by the findings of Karthiraj et al. [19] in China aster; Shinde et al. [20] in marigold; in chrysanthemum and Bashir et al. [21] in gladiolus.

Number of Flowers per Plant: Among all the treatments, the treatment T3, which involved spraying 2 ml/l Biovita through foliar application

at 20 days interval exhibit the highest number of flowers per plant (4.91) which was significally superior to all the treatments. Followed by the treatment T1, which employed 2ml/l Humicil through foliar application at 20 days interval with number of flowers per plant (4.67). In contrast, the control treatment (T0) recorded the lowest number of flowers per plant (1.60).

The remarkable increase in number of flowers per plant is observed in the treatments using biovita (foliar method) can be attributed that seaweed extract also contains essential elements especially nitrogen and phosphorous in which is responsible for maximum shoot growth, number of branches and hence the ultimate size of the plant resulting in the production of higher photosynthesis, which subsequently led to desirable C: N ratio. These favourable situations led to the production of more number of flowers and ultimately higher yield. Seaweed extract consists of several components, vitamins and macronutrients such as NPK in addition to micronutrients which improve plant vegetative growth and in turn increased flower number and this agrees with the results of AlDullamy [22] on dianthus.

These results are supported by the findings of Pruthvi et al. [23] in chrysanthemum.

Fresh Weight of Stem: Among all the treatments, the treatment T3, which involved spraying 2 ml/l Biovita through foliar application at 20 days interval exhibit the highest fresh weight of stem (34.73 g) which was significally superior to all the treatments. Followed by the treatment T1, which employed 2ml/l Humicil through foliar application at 20 days interval with (34.20 g). In contrast, the control treatment (T0) recorded the lowest fresh weight of stem (25.16 g).

The remarkable increase in fresh weight of stem is observed in the treatments using biovita (foliar method) can be attributed that this increment in vegetative fresh weight of plant due to seaweed application may be due to the positive effect of seaweed extract on increasing most vegetative growth characters i.e., plant height, stem diameter, Number of leaves etc.

These results are supported by the findings of Norrie and Keathley [24], Hussein et al. [25] and Delucia and Vecchietti [18].

Vase Life: Among all the treatment T3, which involved spraying 2 ml/l Biovita through foliar application at 20 days interval exhibit the highest vase life (12.60 days) which was significally superior to all the treatments. Followed by the treatment T1, which employed 2 ml/l Humicil through foliar application at 20 days interval with (12.43 days). In contrast, the control treatment (T0) recorded the lowest vase life (8.46 days).

The remarkable increase in flower vase life is observed in the treatments using biovita (foliar method) can be attributed that Plants treated with seaweed extract were superior in flowering properties, as a result of seaweed extract contains zinc, a catalyst for oxidative stress in plant cells, regulates the consumption of sugars, increases the energy in the plant, participates in the formation of starch, increases the carbohydrate content and thus prolongs the flowering life of the plant.

These results are supported by the findings of Jyung et al. [26]; Al-Rayes [27].

3.3 Bulb Parameters

Bulb diameter: Among all the treatments, the treatment T3, which involved spraying 2 ml/l Biovita through foliar application at 20 days interval exhibit the highest bulb diameter (5.21 cm) which was significally superior to all the treatments. Followed by the treatment T1, which employed 2 ml/l Humicil through foliar application at 20 days interval with (4.87 cm). In contrast, the control treatment (T0) recorded the lowest bulb diameter (3.54 cm).

The remarkable increase in bulb diameter is observed in the treatments using biovita (foliar method) can be attributed that Seaweed extract enriched in vitamins A, B and E may help to enhance reproductive characters, vitamin E is known to have a significant effect on bulb and neck diameter, and fresh and dry weight.

These results are supported by the findings of Hussein et al. [28] and Madhusudan et al. [29]

Bulb Weight: Among all the treatments, the treatment T3, which involved spraying 2 ml/l Biovita through foliar application at 20 days interval exhibit the highest bulb weight (64.75 g) which was significally superior to all the treatments. Followed by the treatment T1, which employed 2 ml/l Humicil through foliar application at 20 days interval with (63.63 g). In contrast, the control treatment (T0) recorded the lowest bulb weight (46.14 g).

The remarkable increase in bulb weight is observed in the treatments using biovita (foliar method) can be attributed that all concentrations of seaweed exhibited higher bulb weight. This could be ascribed to auxin supplied by the seaweed which in turn enhanced cell division, elongation, and differentiation in addition to enhanced uptake of higher proteins and nucleic acid reserves eventually ensuring higher bulb weight.

These results are supported by the findings of Venkatesan et al. [30] and Karjalainen et al. [31].

3.4 Yield Parameters

Number of Flowers per 200 m^2: Among all the treatments, the treatment T3, which involved spraying 2 ml/l Biovita through foliar application at 20 days interval exhibit the highest number of flowers per 200 m^2 (10924.83) which was significally superior to all the treatments. Followed by the treatment T1, which employed 2 ml/l Humicil through foliar application at 20 days interval with (10376.74). In contrast, the control treatment (T0) recorded the lowest number of flowers per 200 m^2 (3555.20).

The remarkable increase in number of flowers per 200m^2 is observed in the treatments using biovita (foliar method) can be attributed that seaweed extract also contains essential elements especially nitrogen and phosphorous in which is responsible for maximum shoot growth, number of branches and hence the ultimate size of the plant resulting in the production of higher photosynthesis, which subsequently led to desirable C: N ratio. These favourable situations led to the production of more number of flowers and ultimately higher yield. Seaweed extract consists of several components, vitamins and macronutrients such as NPK in addition to micronutrients which improve plant vegetative growth and in turn increased flower number and this agrees with the results of AlDullamy [22] on dianthus.

These results are supported by the findings of Pruthvi et al. [23] in chrysanthemum.

Weight of Bulbs per 200 m^2 (kg): Among all the treatments, the treatment T3, which involved spraying 2 ml/l Biovita through foliar application at 20 days interval exhibit the highest weight of bulbs per 200 m^2 (kg) (157.02 kg) which was significally superior to all the treatments. Followed by the treatment T1, which employed 2ml/l Humicil through foliar application at 20 days interval with (139.98 kg). In contrast, the control treatment (T0) recorded the lowest weight of bulbs per 200 m^2 (101.47 kg).

The remarkable increase in weight of bulbs per 200 m^2 (kg) is observed in the treatment using biovita (foliar method). It can be attributed that all concentrations of seaweed exhibited higher bulb weight. This could be ascribed to auxin supplied by the seaweed which in turn enhanced cell division, elongation, and differentiation in addition to enhanced uptake of higher proteins and nucleic acid reserves eventually ensuring higher bulb weight.

These results are supported by the findings of Venkatesan et al. [30] and Karjalainen et al. [31].

Table 2. Effect of biostimulants on growth and floral parameters of lilium

Treatments	Plant height (cm)	Stem diameter (cm)	Number of leaves	Leaf area (cm^2)	Bud diameter (cm)	Flower diameter (cm)	Number of flowers per plant
T0	53.70	0.59	75.10	6.94	2.23	13.33	1.60
T1	67.72	0.78	86.06	13.48	2.50	14.66	4.67
T2	60.35	0.72	79.60	7.38	2.33	13.55	3.03
T3	70.84	0.80	87.47	13.63	2.56	14.68	4.91
T4	63.30	0.74	80.78	9.60	2.43	13.92	3.50
T5	60.32	0.68	78.94	7.18	2.33	13.48	2.86
T6	67.08	0.76	84.47	12.32	2.46	14.62	4.49
T7	63.29	0.72	80.32	8.34	2.40	13.82	3.26
T8	60.29	0.68	77.33	6.94	2.26	13.44	1.85
T9	66.05	0.75	81.09	11.07	2.46	14.14	3.88
CD	3.99	0.017	3.20	3.33	0.11	0.48	0.52
CV	3.68	0.33	2.30	20.10	2.84	2.04	8.92

Table 3. Effect of biostimulants on floral, bulb and yield parameters of lilium

Treatments	Fresh weight of stem (g)	Vase life(days)	Bulb Diameter (cm)	Weight of bulb per plant(g)	Number of flowers per 200 m^2	Weight of bulbs per 200 m^2 (kg)
T0	25.16	8.46	3.54	46.14	3555.20	101.47
T1	34.20	12.43	4.87	63.63	10376.74	139.98
T2	27.83	10.46	4.08	50.81	6747.43	111.84
T3	34.73	12.60	5.21	64.75	10924.83	157.02
T4	30.76	11.56	4.45	56.29	7777.00	123.69
T5	26.83	9.70	3.92	48.91	6369.73	107.39
T6	33.60	12.40	4.74	62.45	9976.78	137.02
T7	29.20	10.56	4.25	53.60	7258.53	117.76
T8	25.83	9.20	3.71	50.92	4703.23	105.17
T9	32.26	11.66	4.57	57.96	8636.17	128.13
CD	1.05	0.39	0.10	3.05	1352.06	12.21
CV	2.04	2.07	1.34	3.20	10.32	5.52

4. CONCLUSION

Based on the findings of the current study, it can be concluded that treatment T9 which involved spraying 2ml/l Biovita through foliar application at 20 days interval was effective in enhancing Lilium growth, flowering yield and vase life as seaweed is an effective biostimulant compared to available synthetic fertilizers. Therefore, seaweed provide not only growth hormones but also micro and macro nutrients for enhance the growth and quality of plants.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Bose TK, Yadav LP. Lilium. In: Commercial flowers. Naya Udhyog, Calcutta, India. 1998;789.
2. Valliapan K. Tamil Nadu - Flower bowl of India. Floriculture Today. 2005;10(2):36-37.
3. Khudus S, Kumar A. Beneficial Effects of Biostimulants in Various Flower Crops and Ornamental Plants. Int. J. Curr. Microbiol. App. Sci. 2020;9(10):1873-1878.
4. Kumar HD, Aloke P. Role of biostimulant formulations in crop production: An overview. Int. J. Appl. Res. Vet. Med. 2020;8:38–46.
5. Nardi S, Pizzeghello D, Muscolo A, Vianello A. Physiological effects of humic substances on higher plants. Soil Biol Biochem. 2002;34:1527–1536.
6. El-Shabasi MS, Mohamed SM, Mahfouz SA. Effect of foliar spray with some amino acids on growth, yield and chemical composition of garlic plants. The 6 th Arabian Conf. for Hort., Ismailia, Egypt; 2005.
7. El Boukhari MEM, Barakate M, Bouhia Y, Lyamlouli K. Trends in Seaweed Extract Based Biostimulants: Manufacturing Process and Beneficial Effect on Soil-Plant Systems. Plants. 2020;9:359.
8. Tartil M, Emam, Hosni AM, Ibrahim AK, Hewidy M. Response of pot marigold (*Calendula officinalis* L.) to different application methods and concentrations of seaweed extract. Arab University Journal of Agricultural Sciences. 2016;24(2):581-591.
9. Karim KB, Kumar NV, Raghupati B, Pal AK. Effect of Biostimulants on Growth and Floral Attributes of Tuberose (*Polianthes tuberosa* L.) cv. Prajwal. International Journal of Current Microbiology and Applied Sciences. 2017;6(6):2557-2564.
10. El-Hady WMF. Response of tuberose plants to chitosan and seaweed foliar application. Scientific Journal of Flowers & Ornamental Plants. 2020;7(2):153-161.
11. Poincelot R. Use of a commercial organic biostimulant for field' grown bedding plants. J Home and Consumer Hort. 1994;1(1):95-110.
12. Dhutraj SV. Effect of various bioenzymes on growth, flower yield and vase life of gaillardia. (M.sc. (agri) Thesis) MAU, Parbhani; 2016.
13. Violeta T, Lucia D, Irina S. The influence of some fertilizers and biostimulants upon the

stem anatomy of *Chrysanthemum indicum* L. J Plant Dev. 2010;17(1):3-12.
14. Machado VPdO, Pacheco AC, Carvalho MEA. Effect of biostimulant application on production and flavonoid content of marigold (*Calendula officinalis* L.). Revista Ceres Vicosa. 2014;61(6): 983-8.
15. Rajarajan R, Selvaraju S, Vasanth M. Effect of foliar spray with seaweed extract on growth and chemical constituents of *Crossandra infundibuliformis* (L.) nees. International Journal of Advanced Research on Biological Sciences. 2014; 1(8):29-33.
16. Al-Khuzaey AH, Al-Asadi FA. Effect of Seaweed Extract Spray on Vegetative and Flowering Growth of Two Narcissus Species. Basrah Journal of Agricultural Science. 2019;32:134-139.
17. Teobaldelli M, Rouphael Y, Fascella G, Cristofori V, Rivera CM, Basile B. Developing an Accurate and Fast Non Destructive Single Leaf Area Model for Loquat (*Eriobotrya japonica* Lindl) Cultivars. Plants. 2019;8(7):230.
18. De Lucia B, Vecchietti L. Type of Bio-Stimulant and Application Method Effects on Stem Quality and Root System Growth in L.A. Lily. Europ. J. Hort. Sci. 2012;77(1): S10–15.
19. Karthiraj K, Patil R, Vasmate S, Manolikar R. Effect of bioenzyme on growth, flower yield and vase life of China aster. Asian J Hort. 2008;3(1):178-179.
20. Shinde D, Naik M, Bhosale A. Effect of bioenzymes on flowering, yield and vase life of marigold (*Tagetes erecta* L.). Asian J Hort. 2010;5(2):420-422.
21. Bashir M, Qadri RWK, Khan I, Zain M, Rasool A, Ashraf U. Humic acid application improves the growth, floret and bulb indices of gladiolus. Pakistan. J Sci. 2016;68(2):121-127.
22. Al-Dullamy HE. Effect of some nutrients, culture media and breeding method on producing dianthus flowers. MSC thesis. College of Agriculture. Basrah University; 2005.
23. Pruthvi PH, Hemlanaik B, Shivaprasad M, Beeralingappa. 2Effect of biostimulants on morphology, flowering and yield of Chrysanthemum (*Dendranthema grandiflora* Tzvelve) Cv. Kolar Local under naturally ventilated polyhouse. The bios can. 2017;12(1):273-276.
24. Norrie J, Keathley J. Benefit of Ascophyllumnodosummarin plant extract application to Thompson seedless grape production. Acta Hort. 2006;727:243-247.
25. Hussien AA, Ismail AA, Sabra FS. Bioactive substances extracted from seaweeds as a biocontrol agent's effects and identification. J. Agric. Res. Kafer El-sheikh Univ. 2011;37(1):183-208.
26. Jyung WH, Ehmann A, Schlender KK, Scala J. Zinc nutrition and starch metabolism in Phaseol*us vulgaris* L. Plant Physiol. 1975;55:414-420.
27. Al-Rayes AHJ. Plant Nutrition. Part I: Aspects of Plant Nutrition. Min. High. Educ. Sci. Res., Univ. Baghdad. 1987;224. (in Arabic).
28. Hussein MM, El-Gereadly NHM. Infleunces of alpha tochopherol (vitamin E) and potassium hydrogen phosphate on growth and endogenous phytohormones of onion plants grown under salinity stress. J. Agric. Sci. 2007;32:9141–9151.
29. Madhusudan C, Manoj S, Rahul K, Rishi CM. Seaweeds: A diet with nutritional, Medicinal and Industrial value. Res. J. Med. Plant. 2011;5:153–157
30. Venkatesan K, Seasonal PS. Influence of Seaweed Gel on Growth and Yield of Tomato (*Solanum lycopersicum* Mill.) Hybrid COTH Int. J. Curr. Microbiol. Appl. Sci. 2017;6:55–66.
31. Karjalainen R, Lehtinen A, Keinönen M, Julkunen-Tiitto R, Hietaniemi V, Pihlava JM, et al. Benzothiadiazole and glycine betaine treatments enhance phenolic compound production in strawberry. Acta Hortic. 2002;567:353–356.

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