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Effect of Foliar application of humic acid on growth and flowering in *Freesia hybrida*

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Abstract

The experiment was carried out in the nursery of the University of Kufa during 2022-2021 to study the response of the freesia plant to treatment with humic acid in growth and flowering; the corms were planted in pots containing an agricultural medium consisting of river sand and peat-moss at a ratio of 1:3 .The experiment included the effect of the spraying of humic acid in four concentrations (0, 2, 4 and 6 ml. L^{-1}) and with three sprays; the first spray in the stage of true leaves on 12/92021, the second was 14 days after the first spray was carried out on 12/23/2021 and the third spray was on 5/1/2022 sequentially. The experiment was applied using the Randomized Complete Block Design (R.C.B.D) at the probability level (0.05). The results showed the humic acid at a concentration of 6 ml. L^{-1} achieved a significant increase in the shoot dry weight, the stem inflorescence length, the flower number per inflorescence, the flowering age, the flower diameter, the chlorophyll, carbohydrates, nitrogen percentage and potassium, either at concentrations of 4 and 6 ml. L^{-1} achieved a significant increase in inflorescences number, flowering date, beginning date of flowering start, and increased the phosphorous percentage. At the same time, the control treatment (spraying with distilled water) gave the lowest average in all studied traits.

Keywords: *Freesia hybrid*, humic acid, flowering, foliar application

Introduction

The freesia plant is one of the most important ornamental bulbs globally with picking flowers and a long vase life, and it is characterized by an attractive aromatic smell and multiple colors. *Freesia* hybrida L. belongs to the family Iridacease [1]. It is believed that the original home is South Africa and was cultivated in Europe in the eighteenth century. It is one of the winter annual bulbs under the climatic conditions of Iraq. They are herbaceous plants which grow from a conical corm , which sends up a tuft of narrow leaves , it have fragrant narrowly funnel-shaped flowers, the plant engender from cross-breeding between several species, including *Freesia aurea, Freesia refracta, and Freesia Odorata* [2].

Humic acid is a decomposing material that is extracted using aqueous solutions of sodium hydroxide or potassium hydroxide from the soil [3]. Where studies have proven that spraying with foliar fertilizers has a significant effect in improving the growth and flowering indicators of different ornamental plants. Humic acid is one of the main important products of the decomposition of organic matter (humus) because of its effect on plant growth and thus affecting the processes of photosynthesis and respiration, as it activates some enzymes, including oxidase, phosphoylase, phosphatase, as well as inhibiting other enzymes such as peroxidase. , IAA oxidase, Fitase [4]. Humic acids also increase the transport and availability of nutrients [5 ; 6]. Bhatla, 2018 [7] stated that adding nutrients by spraying on the vegetative system is considered a complement to the ground additions, as it covers about 85% of the plant's need, but it does not eliminate the importance of the roots in absorbing nutrients from the soil solution. Therefore, we aim to know the best concentrations of humic acid spray and its effect on increasing the production of cut flowers and prolonging the life of the flower.

Materials and methods

Cultivation of corms

The experiment was carried out in the nursery of the University of Kufa in the canopy covered with green saran during the growing season 2022-2021, to show the response of the freesia plant to spraying with humic acid in growth and flowering indicators. The white Freesia ambassador (white) corms produced by the Dutch company Symbiosis International b.v. were planted on 25/10/2021 in plastic pots with a diameter of 22 cm and a height of 19 cm containing an agricultural medium consisting of a mixture of soil and peat-moss at a ratio of 1:3. The experiment included the use of four concentrations of spraying with humic acid (0 , 2 , 4 & 6 ml. L^{-1}) on the vegetative total, with three sprays, and the interval between each spray is 14 days. The experiment was designed using the Randomized Complete BlocK Design (R.C.B.D), then a process was conducted and the comparison was made according to the least significant difference (L.S.D) test at the probability level 0.05.[8].

The studied parameters included the shoot dry weight (gm), flowering date (day), the stem inflorescence length (cm), the inflorescences number (inflorescence. $plant^{-1}$), the flowering age (day), the flowers number per inflorescence (flowers. $inflorescence^{-1}$), flower diameter (cm), and the chemical Indicators that included the total chlorophyll pigment (mg. 100 gm^{-1}) [9], total soluble carbohydrates (mg. g^{-1}) [10], nitrogen (%), Phosphorous (%), Potassium (%) [11].

Results and Discussion

It is noted from the results of Table (1) that spraying humic acid on freesia plants at a concentration of 6 ml. L^{-1} led to a significant increase in the shoot dry weight 7.70 g, compared to the control spray (distilled water) 4.97 g. The results of the

same table showed that spraying humic acid at a concentration of 6 ml. L^{-1} gave a significant increase in the indicators of flowering, as it increased the stem inflorescence length, the inflorescence number, the flowering age and the flower diameter, which were 38.84 cm and 39.66 flowers. inflorescence^{-1}, 22.38 days and 6.36 cm compared to the control spray (distilled water) were 31.57 cm and 33.57 flowers. inflorescence^{-1}, 18.70 days and 5.25 cm, while at concentrations 4 and 6 ml. L^{-1} reduced the number of days to open the first flower bud and an increase in the inflorescences number, as it reached 133.60, 132.92 days, and 5.29, 5.78 inflorescences. plant^{-1} compared to the control spray (distilled water), it was 135.60 days and 3.95 inflorescences. Plant^{-1}.

Table (1): Effect of spraying humic acid on the vegetative and flowering characteristics of *Freesia hybrida*

Characteristics / humic acid	Shoot dry weight (gm)	Flowering date (day)	Inflorescences number (inflor.. plant^{-1})	Flowers number per inflorescence (flowers. Inflor.$^{-1}$)	Stem inflorescence length (cm)	Flower diameter (cm)	Flowering age (day)
0 ml. L^{-1}	4.97 c	135.60 c	3.95 c	33.57 c	31.57 d	5.25 d	18.70 d
2 ml. L^{-1}	6.85 b	134.23 b	4.85 b	35.12 c	33.20 c	5.63 c	19.47 c
4 ml. L^{-1}	7.09 b	133.60ab	5.29ab	37.33 b	36.7 b	6.18 b	21.18 b
6 ml. L^{-1}	7.70 a	132.92 a	5.78 a	39.66 a	38.84 a	6.36 a	22.38 a
L.S.D 0.05	0.409	0.983	0.665	1.896	1.358	0.160	0.433

The results of Table (2) showed that spraying the plant with humic acid at a concentration of 6 ml. L^{-1} led to a significant increase in the chemical indicators, as the leaves content of chlorophyll, carbohydrates, nitrogen and potassium increased, reaching 38.33 mg. 100 g^{-1} , 0.62 mg. g^{-1}, 1.40%, and 2.79% compared to the control spray (distilled water), which amounted to 13.23 mg. 100 g^{-1} , 0.46 mg. gm^{-1}, 0.58% and 0.51%, while at concentrations 4 and 6 ml. L^{-1} led to a significant increase in leaves phosphorous, which reached 1.55 and 1.62%, respectively, compared to the control treatment, which amounted to 0.91% .

Table: (2) Effect of spraying humic acid on the chemical charateristics of *Freesia hybrida*

Characteristics / humic acid	Total chlorophyll pigment (mg. 100 gm^{-1})	Total soluble carbohydrates (mg. g^{-1})	Nitrogen (%)	Phosphorous (%)	Potassium (%)
0 ml. L^{-1}	13.23 d	0.46 c	0.58 d	0.91 c	0.51 d
2 ml. L^{-1}	18.46 c	0.53 b	0.78 c	1.20 b	1.22 c
4 ml. L^{-1}	24.55 b	0.56 b	1.08 b	1.55 a	2.06 b
6 ml. L^{-1}	38.33 a	0.62 a	1.40 a	1.62 a	2.79 a
L.S.D 0.05	2.791	0.029	0.101	0.106	0.143

Spraying with humic acid has achieved an increase in the characteristics of vegetative growth represented by the shoot dry weight. Plants that promote growth such as cytokinins and auxins. It was found that a large number of plant growth regulators are present in humic acid, and a number of them have been extracted, such as indole acetic acid, gibberellin and cytokinin, which have a significant impact on plant growth [12].

The reason may be that humic acid is rich in nitrogen and phosphorous, which are included in the composition of nucleic acids, DNA, RNA, proteins and enzymatic chaperones, which contribute to cell division and construction and activate the vital activities of the plant, which leads to an increase in plant height, and this is consistent with what was stated [13].

It has been shown that humic acid has an important role in physiological processes that comes through encouraging the action of enzymes and transferring the products of the carbon metabolism process as well as its role in cell division and elongation [14], which leads to increased growth, which may be represented in increasing the dry weight in the plant by increasing levels humic acid may be attributed to the increase in plant height, which is reflected in the accumulation of the products of this process in storage centers and thus increase the plant dry weight, or it may be at-

tributed to its physiological role in the plant through the presence of auxin and cytokinin, which affects plant growth and thus increase the fresh and dry weight of the plant [15]. In addition to the role of humic acid in improving the properties of the planting medium, as this acid contains a number of essential nutrients for plant growth, including nitrogen, phosphorous and potassium [16], and thus increased the concentration of these elements in the plants. The reason may be that humic acid increases the internal concentration of plant hormones, including IAA and GA3, whose areas of activity are a source of attraction for nutrients, which led to its increase in the plants [7].

The reason for improving the flowering characteristics of plants treated with humic acid may be due to the improvement of the vegetative growth characteristics of the plant, which leads to an increase in the rates of photosynthesis that increases the accumulation of processed nutrients that leads to an improvement in plant growth [17]. It can be attributed to its role in physiological processes and its contribution to the development of vegetative growth and the improvement of the efficiency of carbonic representation, which was well reflected in the improvement of floral growth by securing the major and minor elements that it contains, as the major and minor elements are important for the flowering process as well as other compounds that are produced as a result of improving. The process of carbon metabolism and its availability to the plant [18].

Since humic acid reduces the number of days to full flowers, this may be due to the fact that humic acid increases the content of chlorophyll in plant leaves, which in turn increases the photosynthesis process and on the other hand increases the availability of nutrients from major and minor elements to the plant and thus the plant will reach the flowering stage in Fewer days and earlier flowering [19 ; 20] and similar results were also reported by Ali et al. (2014) [21]. Humic acid increases the diameter of the flowers, and this may be due to the fact that humic acid plays an important role in the accumulation of nutrients in the plant due to the availability of more of these elements by spraying, which leads to an increase in the diameter of flowers [22].

The spraying of humic acid has a significant effect on increasing the levels of chemical elements in the leaves, and the increase in the concentrations of nitrogen, phosphorous and potassium in the leaves may be a result of the increase in the concentration of the level of humic acid to the role that this acid plays in increasing the permeability of cell membranes, as it stimulates the absorption of water and nutrients It

also helps in its movement and the transfer of cellular minerals, and this in turn helps in activating plant enzymes, and humic contains a group of guanine, which is a hydrogen receptor, and at the same time it is the stimulant and chemical mediator of oxidation and reduction processes [23].

The increase in nitrogen and phosphorous may be attributed to the role of these acids in improving the absorption of water and nutrients and working to improve the physical and chemical properties and fertility of the soil. These acids contribute to releasing potassium in the soil solution, which makes it easier for plants to absorb it. Thus, increasing its levels in plant tissues [24]. Humic acid also contains organic compounds, amino acids and mineral elements, especially potassium, which regulates the process of opening and closing stomata and respiration, thus improving the photosynthesis process. It also regulates the rate of transpiration, which increases the withdrawal of water and nutrients from the soil [25]. This process generally requires Withdrawal of a larger amount of elements, especially nitrogen, as nitrogen is included in the construction of the chlorophyll molecule, amino acids, and growth regulators such as auxin IAA, which works on cell division and elongation. The increase in the elements in the leaves may be due to the role of humic acid and its being a rich source of elements sprayed on the leaves as well as containing amino acids whose composition mainly enters nitrogen and is ready for absorption and representation directly [26], and may also be due to what humic acid contains from Organic and amino acids that increase the permeability of cell membranes, as the researchers indicated that these acids modify the phospholipids of the cell membranes, and as a result, the cell membrane becomes better in transporting nutrients from outside the cell to the cytoplasm, which improves the nutritional status and the absorption of elements that enter into important physiological processes such as photosynthesis and related processes [27], or perhaps humic acid increased the percentage of absorbed elements due to its activation of the enzyme H-ATPase in the cell membrane of cells [28] and this enzyme increases the absorption and transport of nutrients and amino acids through wood and phloem [26], and that humic acid contains potassium, which is a companion to the negative nitrate ion when it is transferred from the roots to the leaves [29] leading to Increased nitrogen in the leaves.

References

1) Li, Y. R.; L. Liu; D. Wang; L. Chen and Chen, H. 2021. Biological effects of electron beam to target turning X-ray (EBTTX) on two freesia (*Freesia hybrida*) cultivars. PeerJ, 9, e10742.

2) Huang, M.; R. Fan; X. Ye; R. Lin; Y. Luo; N. Fang; H. Zhong and Chen, S. 2018. The transcriptome of flower development provides insight into floral scent formation in *Freesia hybrida*. Plant Growth Regulation, 86(1): 93-104.

3) Baigorri, R.; M. Fuentes; G. Gonzalez-Gaitano; J. M. Garcia-Mina; G. Almendros and Gonzalez-Vila, F. J. 2009. Complementary multianalytical approach to study the distinctive structural features of the main humic fractions in solution: gray humic acid, brown humic acid, and fulvic acid. Journal of agricultural and food chemistry, 57(8):3266-3272.

4) Ali, A. Y. A. ; M. E. H. Ibrahim ; G. Zhou ; N. E. A. Nimir ; X. Jiao ; G. Zhu ; A. M. I. Elsidding ; W. Zhi ; X. Chen and Haitong, L. 2019. Ameliorative effects of jasmonic acid and humic acid on antioxidant enzymes and salt tolerance of forage sorghum under salinity conditions. Agronomy journal, 111(6): 3099-3108.

5) Yildiztekin, M.; A. L. Tuna and Kaya, C. 2018. Physiological effects of the brown seaweed (Ascophyllum nodosum) and humic substances on plant growth, enzyme activities of certain pepper plants grown under salt stress. Acta Biologica Hungarica, 69(3):325- 335 .

6) Olk, D. C; D. L. Dinnes; J. R. Scoresby; C. R. Callaway; and Darlington, J. W. 2018. Humic products in agriculture: potential benefits and research challenges—a review. Journal of Soils and Sediments, 18(8): 2881-2891.

7) Bhatla, S. C. and Lal, M. A. 2018. Plant physiology, development and metabolism. Springer.

8) Grant, T. 2010. The Randomized Complete Block Design (RCBD). Department of Horticulture and Crop Science, OARDC, The Ohio State University, USA.

9) Červená, L.; G. Pinlová; Z. Lhotáková; E. Neuwirthová, E; L. Kupková; M. Potůčková and Campbell, P. E. 2022. Determination of Chlorophyll Content in Selected Grass Communities of KRKONOŠE Mts. Tundra Based on Laboratory Spectroscopy and Aerial Hyperspectral Data. UMBC Faculty Collection.

10) Hajihashemi, S.; F. Noedoost; J. M. Geuns; I. Djalovic and Siddique, K. H. 2018. Effect of cold stress on photosynthetic traits, carbohydrates, morphology, and anatomy in nine cultivars of Stevia rebaudiana. Frontiers in Plant Science, 9, 1430.

11) Al-Sahaf, F. H. 1989. Plant Nutrition Application. Ministry of Higher Education and Scientific Research. Book House Press. University of Musul. Iraq. pp 198.

12) Atiyeh, R. M.; S. Lee; C. A. Edwards; N. Q. Arancon; and Metzger, J. D. 2002. The influence of humic acids derived from earthworm-processed organic wastes on plant growth. Bioresource technology, 84(1): 7-14.

13) Mudroňová, D.; V. Karaffová; T. Pešulová; J. Koščová; I. C. Maruščáková; M. Bartkovský; D. Marcincakova; Z. Sevcikova and Marcinčák, S. 2020. The effect of humic substances on gut microbiota and immune response of broilers. Food and Agricultural Immunology, 31(1): 137-149.

14) Fawzy, Z. F.; M. A. El-Nemr and Saleh, S. A. 2007. Influence of level and methods of potassium fertilizer application of growth and yield of eggplant. J. of Applied. Sci. Res. 3(1): 42-49 .

15) Izhar Shafi, M.; M. Adnan; S. Fahad; F. Wahid; A. Khan; Z. Yue; S. Danish; M. Zafar-Ul-Hye; M. Brtnicky and Datta, R. 2020. Application of single superphosphate with humic acid improves the growth, yield and phosphorus uptake of wheat (Triticum aestivum L.) in calcareous soil. Agronomy, 10(9), 1224.

16) Harper, S. M.; G. L. Kerven; D. G. Edwards and Z. Ostatckboczyski. 2000. Characterization of fulvic acid and humic acid from leaves of Eucalyptus comaldulensis and from decomposed hay. Soil Biology and Biochemistry, 32(10), 1331-1336.

17) Aslam, S. M.; T. Khan; S. Ali; M. Nafees and Wahid, F. 2018. Response of marigold cultivars to different humic acid levels. IJARR, 3(4): 85-97 .

18) Ghanim, N. S. and Salih, Z. K. 2017. Effect of planting depth and seaweed on growth and flowering of tulip tulipa hybrids l. Iraq journal of Agric., 22(9) .

19) Liu, C. H; R. J. Cooper and Bowman, D. C. 1998. Humic acid application affects photosynthesis, root development, and nutrient content of creeping bent grass. Hort Science 33(6): 1023–1025 .

20) Nassour, Mazen and Hussam Hedewa. 2016. The effect of spraying humic acid on the growth, flowering and reproduction parameters of the cv. queen's blush (Gladiolus Hyprida cv. queen's blush). Tishreen University Journal for Research and Scientific Studies - Biological Sciences Series 6 (38.(

21) Ali, A.; S. U. Rehman; S. Raza and Butt, S. J. 2014. Combined effect of humic acid and NPK on growth and flower development of Tulipa gesneriana in Faisalabad (Pakistan). Journal of Ornamental Plants 4(4): 227-236.

22) Shehata; S. A.; A. A. Gharib; M. El-Mogy; M. A. Gawad and Shalaby, E. A. 2011. Influence of compost, amino and humic acids on the growth, and yield and chemical parameters of strawberries. Journal of Medicinal Plants Research, 5: 2304-2308.

23) Al-Hamdani, M. H. S. 2012. Effect of some organic compounds on vegetative growth and quantitative and qualitative yield characteristics of olive cultivar Olea europaea L. PhD thesis, College of Agriculture and Forestry. University of Mosul / Iraq.

24) Barzegar, T.; S. Mahmoodi; F. Nekounam; Z. Ghahremani, and Khademi, O. 2022. Effects of humic acid and cytokinin on yield, biochemical attributes and nutrient elements of radish (Raphanus sativus L.) cv. Watermelon. Journal of Plant Nutrition, 45(10), 1582-1598.

25) Abbasi, S. ; D. Lamb ; M. A. Rahman ; R. Naidu and Megharaj, M. 2021. Response of phosphorus sensitive plants to arsenate. Environmental Technology and Innovation, 24, 102008.

26) Pettit, R.E. 2004. Organic Matter, Humus, Humate, Humic Acid, Fulvic Acid and Humin; Their Importance in Soil Fertility and Plant Health. CTI Research, 10: 1-7 .

27) Al-Sahaf, F. H. 1989. Applied plant nutrition. Baghdad University. Ministry of Higher Education and Scientific Research. Iraq.

28) Qian, W.; W. Kangcai; C. Zhiwei and Xiaoyan, W. 2013. Effect of humic acid on secondary metabolism and growth physiolo -gical property of Pinellia pedatisecta under high temperature stress. Acta Botanica Boreali Occidentalia Sinica. 33(9): 1845-1850 .

29) Al-Saady, I. S. S. 2007. Evaluation Of Potasium State Added from Two Fertilizer Sources Under Irrigation Systems on Growth and Tomato Yield in Yellow Maiz. Ph.D. Dessertation. College of agriculture. University of Baghdad. pp.26 .