Bionatura
Latin American Journal of Biotechnology and Life Sciences

Article

The effect of spraying with amino acids and iron on some characteristics of vegetative and flowering growth of petunia

Mushtaq T. AL-Zurfi [1], *Karim M. Bhiah* [2]*, *Jamal A. Abbass* [3], *Ahmed I. Mohammed* [4] and *Amani G. Abboud* [5]

[1] *Faculty of Agriculture/ Horticulture and Land Scape Department/ University of Kufa- Iraq. mushtaq.alzurfi@uokufa.edu.iq*

[2] **Faculty of Agriculture/ Soil and Water Department, University of Kufa- Iraq. karimm.bhiah@uokufa.edu.iq*

[3] *Faculty of Agriculture/ Horticulture and Land Scape Department, University of Kufa- Iraq. jamal.selman@uokufa.edu.iq*

[4] *Faculty of Agriculture/ Horticulture and Land Scape Department/ University of Kufa- Iraq. kbhiah@gmail.com*

[5] *Faculty of Agriculture/ Horticulture and Land Scape Department, University of Kufa- Iraq. kbhiah@gmail.com*

* *Correspondence: karimm.bhiah@uokufa.edu.iq. Tel: 07804496022*

Available from. http://dx.doi.org/10.21931/RB/2023.08.04.47

ABSTRACT

A pot experiment was conducted during the 2019-2020 season at the temporary place of the Faculty of Agriculture/ University of Kufa/ Najaf city/ Iraq to estimate the response growth and flowering of petunia hybrid to Spraying amino acids and iron. The amino acid concentrations were 0, 3, and 6 $ml.l^{-1}$, and three iron concentrations were 0, 15, and 30 $mg.l^{-1}$.It is clear that the interaction between amino acid {6 $ml.l^{-1}$}and iron {15$mg.l^{-1}$} produces an increase in vegetative and flowering characters, the number of leaves and branches, length of flowering branches, number of flowers, Flower diameter, The age of the flower in the plant & the flower content of carotene pigment increased remarkably, while amino acid {6 $ml.l^{-1}$} and iron {30 $mg.l^{-1}$} have significant effect on leaf chlorophyll content, and total soluble carbohydrates.

Keywords: Petunia plant; amino acids; Iron; Auxins; growth; flowering.

INTRODUCTION

Petunia is an herbaceous winter annual plant, one of the oldest and most successful annual flowers known in Iraq. Its leaves are simple, alternate or opposite, simple in shape, and belong to the Solanaceae[1]. The flowers are big, trumpet-shaped, and abundant on the plant during flowering. Many colors, including white, red, pink, violet and pink, have full-edge petals and fringes[2]. Petunias are unsuitable for picking, and many types differ in shape and size. It is native to South America. The increase and improvement of petunias rely on many elements, including temperature and day length, as beneath short-day prerequisites, boom slows down, and finally, flowers shape short, abundantly branched, and very short internodes. In long-day conditions, the principal department is elongated, branching decreases, and the internodes become larger. The most suitable temperature for vegetative growth is 10 °Cfor a short day. Also, flowers on the plant form over along day at a temperature between 17-24 °C. The formation of bud s andflowers and their development are not related to the duration of the day in case the temperature drops to 13 °C, but the formation of flowers takes place on both long and short days4. It succeeds in sunny and semi-shady places. Petunia is suitable for cultivation in the front panels. It is considered one of the exhibition plants. It is suitable for hanging baskets, balconies and pots, and pond cultivation.

Petunia multiplies by seeds in spring and autumn[5]. Foliar application is spraying nutrients on plant 6, as the leaves are essential for many vital activities that can absorb nutrients like the roots [7]. Most plants can absorb nutrients through the leaves via leaves stomata or both. It absorbs ions through ion exchange[8]. [9] indicated that adding nutrients by spraying them on the leaves is more effective than other methods for treating the deficiency of nutrients. Amino acids are organic nitrogen compounds and essential components in the synthesis of proteins. They are also materials for building and forming other organic compounds such as hormones, enzymes and vitamins[10]. There are two forms of amino acids, the first of which is the free form (L-amino acids), which are absorbed and built from the plant. The second is D-amino acids, which do not participate in forming proteins, as they play a role in forming enzymes[11]. Amino acids have particular importance in stimulating and growing cells, and they serve as stores that help maintain pH inside the plant[12,13]. Through its effect on auxins and gibberellins[14], the plant has a role in increasing the photosynthesis process[15]. It is one of the important factors that help open stomata through raising the osmosis of the cytoplasm of the guard cells and has a chelating effect on the microelements, as it helps to increase the speed of absorption and transfer of elements inside the plant by increasing the permeability of the cell membrane[16,17]. The amino acids also have a role in protecting plants from stress, as they work using osmotic substances that regulate the transport of ions and open stomata, remove the toxins of traditional elements and increase the effectiveness of iron from enzymes and their construction[18]. Furthermore, it activates the carbonic metabolism process and increases the effectiveness and the activity of antioxidant enzymes[19]. Its easy permeability and absorption also characterize it, as it affects the permeability of plant membranes. Thus, the ease of transporting nutrients within the plant is a natural cell for nutrients that are sprayed with it[20]. This result is inconsistent with the findings of[21]. Iron has a significant role in many physiological processes of plants through the activation of enzymatic processes and chlorophyll formation in plant[s22,23,24]. More than 75% of the total iron of cells is found in chloroplasts. In the lipoproteins of chloroplast and mitochondrial cell membranes[25]. As to the peroxidase enzyme, it is essential to stimulate the polymerization process of phenols to license [26] and regulate iron absorption [27]. This result is consistent with the findings of[28] when spraying chelated iron on (*Calendula officinalis* L.). This study aims to show the petunia's response to growth and flowering to amino acids and iron.

MATERIALS AND METHODS

The experiment was conducted in the temporary place of the Faculty of Agriculture, University of Kufa, during the 2019/2020 season to estimate the effect of spraying amino acids and iron on the growth and flower of petunia. Petunia seeds were collected from a private nursery (An-Najaf Center), An-Najaf al-Ashraf City, Iraq. On 10/1/2019, seedlings were prepared from a private nursery, produced from seed cultivation by a German company, and planted in a plastic pot with a diameter of 25 cm and a height of 20 cm; it has three kg of Soil. A factorial experiment was carried out in a randomized complete block design (RCBD) with two factors in three replicates, the first-factor amino acids in three concentrations {0, 3 and 6 $ml.l^{-1}$} (Table 1), The second-factor iron at three concentrations {0,15 & 30 mg $.l^{-1}$}. The amino acids and iron were sprayed twice: the first when five real leaves appeared and the second 15 days after the first spray. Averages were compared according to the Least Significant Difference test {LSD}of the level of probability5%[29]. Standard cultural practices were carried out for each experimental unit, including irrigation and weeding, whenever the plant needed it. Five pots in each experiment unit, each pot contains one plant=135 plants. The physical and chemical properties of the potting Soil are in Table 2. The experiment ended on 2/2/2020. The following growth indicators were measured.

Total (N)	Organic material	Total amino acids	Free amino acids
w/w			
6.5%	**15%**	**20%**	**11.50%**

Table 1. The ingredients of amino acid fertilizer{Spanish company}.

Property	{unit}	{value}
Potential of hydrogen		7.52
Electrical Conductivity	**dS m^{-1}**	2.85
Nitrogen	**g 100 kg^{-1}**	0.52
Phosphorus	**mg l^{-1}**	2.69
Potassium	**Centimole kg^{-1}**	15.1
Magnesium	**Centimole kg^{-1}**	1.8
Organic matter	**%**	0.75
Soil texture	Sandy	
Clay	**%**	3.0
Silt		4.2
Sand		92.8

Table 2. Physical and chemical properties of the potted Soil.

Vegetative Growth Parameters

Number of leaves {$leaf.Plant^{-1}$}was counted as the average of five randomly selected from each experimental unit—total number of branches {$branch.Plant^{-1}$} calculates the total number of branches for each experimental unit. The weight of dry shoot {g} was calculated at the end of the experiment. It was done by removing the whole plant from the pots, then cutting the stem and the leaves together, removing the root system, and placing it in a room with good ventilation for three days, after which it was placed in an {oven} at a temperature of {70} °C for 8 hours, then take the weight using the sensitive balance, for each experimental unit, and each treatment. Estimation of the total chlorophyll content of leaves {mg.100g^{-1}} The total chlorophyll in the leaves was estimated by following[30] by taking a weight of 0.5 g of fresh leaf and adding 10 ml of acetone at a concentration of 85% and crushed by a ceramic mortar until the white tissue completed the volume to 30 ml and then the dye was estimated by a {UV-Visible Spectrophotometer}to measure optical absorption at the positive lengths of 645 and 663 nanometers—estimation of leaves content of total soluble carbohydrates {mg.g^{-1}}. Carbohydrates were estimated by following[31] by taking the weight of 10 mg of dry ground leaves and adding to the 5 ml of sulfuric at a concentration of 80% and 1 ml of phenol at a concentration of 5% to turn it into an orange color, and this is an indication of the reaction response estimated by UV- device—visible spectrophotometer at a wavelength of 490 nanometers.

Flowering parameters

The length of the flowering branches (cm) was measured by measuring tape for each experimental treatment. The number of flowers (flower.Plant^{-1}) was calculated cumulatively for each experimental treatment and each treatment. Vernia measured the diameter of the flower (cm) for each experimental treatment. Day of flower per plant (day). The number of flowering days on the plant until wilting was calculated for each experimental unit. Determination of the carotene content of the flowers (mg.100g^{-1}) 0.25 g of fresh flower petals was taken, 30 ml of 80% acetone was added to it, crushed by a ceramic mortar, the solution was filtered by filter paper, and the sample was read by a UV-Visible spectrophotometer at a wavelength of 480 nm for each experimental treatment[32].

RESULTS

Data presented in Table 3 showed a significant increase in the vegetative growth parameters of Petunia when spraying Amino acids at a concentration of {6ml.l^{-1}}as Number of Leaves, number of branches, weight dry of the shoot system, the content of leaves of total chlorophyll and total soluble carbohydrates), which receded {48.00 leaves. Plant^{-1}, 5.52 branch. Plant^{-1},5.47 g,24.13 mg. 100 g^{-1} and 11.98 mg. g^{-1}}respectively, compared to the control, which gave the lowest rate of {37.33 leaf. Plant^{-1} and 2.88 branches. Plant^{-1}, 3.52 g, 20.62 mg.100 g^{-1}, and 9.98 mg. g^{-1}} respectively. The results of the same table showed that spraying iron at a concentration {of 30 mg.l^{-1}} significantly increased the total Leaves, the number of branches, the dry weight of the shoot, the content of leaves from the total chlorophyll and the total soluble carbohydrates, which receded {50.22 leaf—plant4.66 branch. Plant^{-1}, 5.07 g, 23.47 mg.100 g^{-1} and 11.00 mg. g^{-1}} compared with control, which observed the lowest rate, {44.67 leaf.plant^{-1}, 3.71 branch.plant^{-1} 4. 11 g 23.19 mg.100 g^{-1}& 10.24 mg.g^{-1}} respectively.

Treatment	Conc.		No. Of leaf.plant^{-1}	No. Of Branch .plant^{-1}	Dry shoot system (g)	carbohydrate in leaf mg. g^{-1}	chlorophyll in leaf mg.100g^{-1}
Amino acid ml.l^{-1}	**0**		**37.33**	**2.88**	**3.52**	**9.38**	20.62
	3		**42.22**	**4.55**	**4.59**	**10.71**	22.56
	6		**48.00**	**5.52**	**5.47**	**11.98**	24.13
LSD 0.05			**1.930**	**0.440**	**0.296**	**0.220**	2.018
Iron mg.l^{-1}	**0**		**44.67**	**3.71**	**4.11**	**10.24**	23.19
	15		**49.61**	**4.45**	**4.44**	**10.84**	22.64
	30		**50.22**	**4.66**	**5.07**	**11.00**	23.47
LSD 0.05			**1930**	**0.440**	**0.296**	**0.220**	2.018
Amino acid ml.l^{-1} X Iron mg.l^{-1}	**0**	**0**	**34.00**	**2.33**	**3.24**	**9.25**	20.24
		15	**37.00**	**2.61**	**3.28**	**9.28**	20.32
		30	**41.00**	**3.66**	**4.04**	**9.62**	21.30
	3	**0**	**44.33**	**3.66**	**3.95**	**10.29**	24.87
		15	**48.33**	**5.00**	**4.37**	**10.80**	22.29
		30	**52.00**	**5.51**	**5.45**	**11.05**	23.51
	6	**0**	**55.67**	**5.33**	**5.15**	**11.18**	24.48
		15	**63.62**	**6.00**	**5.74**	**12.12**	25.33
		30	**57.85**	**5.54**	**5.23**	**12.45**	25.60
LSD 0.05			**3.344**	**0.763**	**0.513**	**0.382**	3.976

Table 3. The impact of spraying Amino acids and iron on vegetative growth.

Table 3 showed that there was a significant interaction between spraying amino acids and iron at a concentration of 6 ml.l^{-1} with 15 mg.l^{-1}}This resulted in a significant increase in the number of total Leaves, Number of branches, Dry weight of the Shoot system, the content of leaves of total chlorophyll and total soluble carbohydrates}which receded{63.62 leaves. Plant^{-1},6. 00 branches. Plant^{-1},5.74 g, 25.60 mg.100 g^{-1} and 12.45 mg.g,) Respectively, compared with control, that recorded a lower rate, {34.00 leaves. Plant $^{-1}$},2.33 branches .plant^{-1}, 3.24g, 20.24 mg. 100g^{-1} and 9.25 mg. g^{-1} respectively,.
The data exhibited in Table 4 showed a significant increase in the flowering parameters of petunia when spraying amino acids at a concentration of 6 ml. l^{-1}, as the length of the flowering branches, number of flowers, flower diameter, day flower on the plant and the content of flowers of carotene pigment, which receded{13.85

cm,74. 56 flower. Plant^{-1}, 7.76 cm, 9.61 days and 5.11 mg.100 g^{-1}} compared to the control, which gave the lowest rate of {9.97 cm, 55.00 flower. Plant^{-1}, 5.73 cm, 6.22 days and 3.66 mg.100g^{-1}} respectively.

Treatment	Conc.		length of flowering branches (cm)	No. of flower (Flower.plant^{-1})	Flower diameter (cm)	Day of flower on the plant (day)	Flower carotene content (mg.100g^{-1})
Amino acid ml.l^{-1}	0		9.97	55.00	5.73	6.22	3.66
	3		11.52	63.00	6.61	7.77	5.03
	6		13.85	74.56	7.76	9.61	5.11
LSD 0.05			0.433	1.534	0.146	0.440	0.308
Iron mg.l^{-1}	0		11.72	60.44	6.40	7.41	4.35
	15		12.76	65.22	6.78	8.00	4.78
	30		12.86	67.22	6.92	8.22	4.57
LSD 0.05			0.433	1.534	0.146	0.440	0.308
Amino acid ml.l^{-1} X Iron mg.l^{-1}	0	0	9.30	51.33	5.53	6.00	3.37
		15	10.16	55.31	5.70	6.00	3.49
		30	10.46	58.25	5.96	6.66	4.13
	3	0	11.63	60.67	6.30	7.33	4.53
		15	12.91	62.00	6.66	7.54	5.29
		30	13.00	67.11	6.68	8.33	5.27
	6	0	14.23	69.33	7.36	9.00	5.16
		15	15.20	78.45	8.00	10.22	5.55
		30	15.13	76.00	7.93	9.96	4.31
LSD 0.05			0.750	2.657	0.252	0.763	0.533

Table 4. The impact of spraying amino acids iron on flowering characteristics.

Table 4 also showed that spraying iron at {30mg.l^{-1}} Led to a significant increase in the flowering parameters of petunia, as {length of the flowering branches, number of flowers, flower diameter, day flower on the plant, and the content of flowers from carotene pigment}, which reached {12.86 cm,67. 22 flower.Plant^{-1}, 6.92 cm, 8.22 days, and 4.57 mg.100 g^{-1}}Compared to the comparison treatment that gave the lowest rate of {11.72 cm, 60.44 flowers.Plant^{-1}, 6.40 cm, 7.41 days and 4.35 mg. 100g^{-1}}respectively. The same table also showed that spraying amino acids at 6 ml.l^{-1} with iron at {30 mg. l $^{-1}$} Led to a significant increase in flowering parameters from petunia, such as {length of flowering branches, number of flowers, flower diameter, day flower on the plant, and flower content of the carotene pigment}which receded{15.20 cm,78.45 flowers. Plant^{-1},8.00 cm,10.22 days and 5.55 mg. 100g^{-1} compared to the control, which recorded the lowest rate of {9.30 cm,51.33 flowers. Plant^{-1}, 5.53 cm, 6.00 days, and 3.37 mg.100 g^{-1}} respectively.

DISCUSSION

Notes from Table 3 and Table 4 show that the spraying of amino acids led to a significant increase in the parameters of vegetative growth and flowering. This may belong to the important role of amino acids in the physiological processes of the plant via the manufacture of proteins, auxins and carbohydrates [33,34] and in the synthesis of RNA and DNA and IAA [34] which is vital for cell division and elongation [35] and lead to giving the highest number of inflorescences[36]. It is also noted from Table 3 and Table 4 that iron spraying had a significant increase in the characteristics of the shoot and flowering system. This may be due to the effect of iron in the photosynthesis process and the production of energy, ATP, which is important in the vital processes of the plant, rather than entering into the composition of the nucleic acids DNA and RNA necessary for the division cells, which encourages the formation of leaf buds and then increases the number of leaves [26]. This may be attributed to the fact that iron contributes to the oxidation-reduction reactions in the plant, as it enters the composition of many oxidation and reduction enzymes such as cytochromes, peroxidases, oxidases and others. It also has a role in the process of photosynthesis, as 70% of the total iron is found in the chloroplasts, and this explains its importance in the process of carbon metabolism and then increasing the percentage of carbohydrates in the leaves[37,38,39]. In addition, iron has a key role in the formation of chlorophyll through the participation of iron in the condensation of succinic acid and glycine to form Y-aminolevulinic acid, which in turn condenses to form pyrrole groups, which also condense to form protoporphyrin. This substance is for the formation of chlorophyll, stimulated by iron, [40,41]and this may be due to the effect of iron in increasing vegetative growth and increasing the number of leaves, and the importance of iron in the vital processes within the plant that accelerate the transformation of some vegetative buds to flower[42,43]and then increase Flower buds and then to an increase in the flowers number [9,44].

CONCLUSIONS

In this work, spraying amino acids and iron caused a significant increase in vegetative indices flowering growing (leaves, branches, shoot system and number of flowers) in addition to chlorophyll and carbohydrates of petunia.

Author Contributions

Mushtaq T. AL-Zurfi: formal analysis, Karim M. Bhiah: writing, Jamal A. Abbass: project administration, Ahmed I. Mohammed: data curation and review and editing. Amani G. Abboud: methodology and investigation.

Acknowledgments

The authors thank the Faculty of Agriculture/University of Kufa.

REFERENCES

1. Al-Batal, N. Indoor Ornamental Plants, Faculty of Agriculture. Damascus University Publications,Syria **2005**,Al-Ajlouni Press.
2. Gerats, T.; Vandenbussche, M. Amodel System For comparative research petunia. ***Trends** Plant Sci.* **2005**,*10*(5):251-256.
3. Al-Shahat, N. A.Cultivation and production of flower and ornamental plants, Cairo,Egypt,**2002***, Arab House for Publishing and Distribution.*
4. Chalabi, S. K.; Al-Khayat, N. K.Ornamental Plants in Iraq, College of Agriculture, University of Baghdad. Iraq,**2013** University House for Printing, Publishing and Translation.
5. Al-Batal, N.Outdoor Ornamental Plants, Faculty of Agriculture. Damascus University Publications,Syria, **2010,**Rawda Press.
6. Kannan, S. Mechanism of foliar uptake of plant nutrients accomplishments and prospects. *J. Pl. Nutr*.,**1980**, *2* (6):717-735.
7. Peuke, A.S.; Jeschke, W.D.; Hartung, W.*Foliar application of nitrate or ammonium as sole nitrogen supply in Ricinus communis.in*The flows of cations chloride and absisic acid,*New Phytol*., **1998**, 140:625-636.
8. Mengel, K. Alternative or complementary role of foliar supply in mineral nutrition. *Acta. Horticlturae*, **2002**, 594: 33-48.
9. Tisdale, S. L.; Nelson, W. L.;Beaton, J. D. Soil Fertility and Fertilizers. 4^{th} Ed. Mac Millan Publ. Co. New York. USA. **2005**, Pp: 631- 671.
10. Abd El-Aziz, G. N.; Balboa K.L**.**Influence of tyrosine and Zinc on growth, flowering and chemical constituents of Salvia farinacea plant,*Egypt, J. Appl* Sci.**2007**, *3*(11):1479- 1489.
11. Khudai M Y, Abdulateef S M, Mouhammed T Th, Alamili H S. Use of modern geometric design of fish ponds to increase welfare and blood parameters. Revis Bionatura 2023;8 (2) 82. http://dx.doi.org/10.21931/RB/2023.08.02.82
12. Davies, D. D**.***Physiological Aspects of Protein Turnover*. In: Boulter, D., and B. Parthei (eds), Encycl. Phys. New Series, 14. Spring-Verlag. Berlin Heidelberg. Germany**1982**, pp.199-288.
13. Ibraheem M W, AL Mjbel A A, Abdulwahid A S, Mohammed Th. T. Characterization of the influence of diet on Japanese quail. Revis Bionatura. 2022;7(4) 21. http://dx.doi.org/10.21931/RB/2022.07.04.21.
14. Alrseetmiwe, D. S. .; Almayah, A. A. .; Nasser, A. A. .; Alnussairi, M.; Zadeh, H. A.; Mehrzi, F. A. Escherichia Coli Strain Bl21: Cloning And Expression Of An Optimized Interferon Alpha 2B (DE3). Journal of Life Science and Applied Research. 2020, 1, 40-44.
15. Yongin, K.; Seob, L. G.; Sang C.; Tayeak, H.; Jacok, G.Effect of 5-aminolevulinic acid on growth and inhibition of various plant speciesKor.,*JCSB***2003,**48: 127-133.
16. Westwood, M.N. Temperate-zone Pomology Physiology and Culture. Third edition. Himber Press, Portland, Oregon, USA.**1993**, pp. 523.
17. Weaver, R.Molecular Biology. 5^{th} edition. Oxford. England **2013**, pp 914.
18. Rai, V. K. Role of amino acids in plant responses to stresses. *Biol. Plantarum***2002**, 45:481-487.
19. Tantawy, A. S.; Abdel-Mawgoud A. M. R.; El-Nemr, M. A.; Chamoun, Y. G**.**Alleviation of salinity effect on tomato plant by application of amino acid and growth regulators. *Eur. J. Sci. Res*. **2009**, *30* (3):484-494.

20. Koksal, A. I.; Dumanoglu, H.; Gunes, N. T. The effects of different amino acid chelate foliar fertilizers on yield, fruit quality, shoot growth and Fe, Zn, Cu and Mn content of leaves in William spear cultivar of *Pyrus communis* L. *Turk. J. Agric. For***1999**, *23*:651-658.
21. Hassan, F. A.; Al Taher, Z. A. A.; Saleh, A. K. N**.** Effect of some amino acids and coconut liquid on vegetative and flowering growth and percentage of oil of geranium plants *Pelargonium hortorum*,*MJAS***2014**, *1*(3):1-20.
22. Hopkins, W. G**.** Introduction to Plant Physiology. John Wiley and Son Inc. New York. USA**1999**,pp.512.
23. Al-Tai, T. A. A. Fertilizers and soil conditioners (translator). Ministry of Higher Education higher education and scientific research. University of Al Mosul. Iraq., **1987**.
24. Hassan, N. A.; Al-Dulaimi, H. Y.; Al-Ethawi, L. A.Soil Fertility and Fertilizers. House of Wisdom for Printing and Publishing. University of Al Mosul. Iraq. **1990**.
25. Tisdale, S. L.; Nelson, W. L.; Beaton, J. D.; Havlin, H. L**.** Soil Fertility and Fertilization. Prentices Saddle River. New Jersey. USA. **2005**, pp. 220.
26. Abu Dahi, Y. M.; Al-Younes M. A. Plant Nutrition Guide. Ministry of Higher Education and Scientific Research. University of Al Mosul. Iraq., **1988**.
27. Marschner, H. Mineral Nutrition of Higher Plants. 2nd Edition. Academic Press. London. England.,**1986**.
28. Al-Asadi, Z. N.Effect of spraying with active yeast suspension and chelating iron on the vegetative and flowering growth of chrysanthemum *Calendula officinalis* L. *JOK***2014**, *12*(3):226-235.
29. Al-Rawi, K. M.; Khalaf Allah A. A. Design and analysis of agricultural experiments, Dar Al-Kutub for printing and publishing. University of Al Mosul. Ministry of Higher Education and Scientific Research. Iraq., **2000**.
30. Thabit S S, Awad M M, Abdulateef S M. Effects of In-Ovo Injection of sialic acid on Chick's embryonic development and physiological traits. Revis Bionatura 2023;8 (2) 49. http://dx.doi.org/10.21931/RB/2023.08.02.49.
31. Alaaraji, S.F.T., Mohisen, M.A., Awad, M.M. Assessment serum levels of neopterin, IL-6, IL-1β, hs-CRP, TNF-α and MMP 9 in iraqi rheumatoid arthritis patients (2020) Systematic Reviews in Pharmacy, 11 (12), pp. 88-93.
32. Abbas, M. F.; Abbas, M. G. Care and Storage of Practical Fruits and Vegetables. Faculty of Agriculture. Bashra University. Ministry of Higher Education and Scientific Research. Iraq**1992**.
33. Thomas, J.; Mandal, A.; Kumar R. R.; Chordia, A.Role of biologically active amino acid formulations on quality and crop productivity of Tea (*Camellia sp.*). Int. J. Agr. Res**2009**, *4* :228-236.
34. Wona, C.; Shena, X.; Mashiguchib, K.; Zhengc, Z.; Daia, X.; Chenga, Y.; Kasaharab, H.; Kamiyab,Y.; Choryc, J.; Zhaoa, Y. Conversion of tryptophan to indole-3-acetic acid by tryptophan aminotransferases of *Arabidopsis* and yuccas in *Arabidopsis*. *PNAS***2011**, *108*(45):18518–18523.
35. Al-Sahaf, F. H.Applied Plant Nutrition. Baghdad University. Ministry of Higher Education and Scientific Research. Iraq., 1989.
36. Al-Said, M. A.; Kamal A. M. Effect of foliar spray with folic acid and some amino acids on flowering, yield andquality of sweet pepper. *J. Agric. Sci. Mansoura Univ***2008**, *33*(10):7403 – 7412.
37. Al-Nuaimi, S. N. Principles of Plant Nutrition. Directorate of Books for Printing and Publishing. University of Al Mosul. Ministry of Higher Education and Scientific Research. Iraq., **2000.**

38. Focus, F.The importance of micronutrients in the region and benefits of including them in fertilizers. *Agrochemicals Report***2003**,*111*(1):15-22.
39. Barker, A. V.; Pilbeam D. J.Handbook of Plant Nutrition. Taylor & Francis Group. USA. Rai, V. K. Role of amino acids in plant responses to stresses.*Biol . Plantarum2007*, **45**: 481-487.
40. Youssef, A.S.M. Influence of some amino acids and micro-nutrients treatments on growth and chemical constituents of Echinacea purpurea plant. *J. Plant Production***2014**, *5* (4):527 –543.
41. Wahba, H.E.; Motawe H.M.; Ibrahim, A.Y. Growth and chemical composition of Urtica pilulifera L. plant as influenced by foliar application of some amino acids. *J. Mater. Environ. Sci***2015**, *6*(2): 499-506.
42. Otani, Y.; Endo, C.; Chin, D.P.; Mii, M. Highly efficient system for plant regeneration from leaf and stem explants in Dahlia. *Plant Biotechnol***2013**, *30*(2), 141–146.
43. Abd-Elkader, H. H.; Kasem, M. M.; Younis, T. T. E.; Gad, A. E. A. Impact of some Amino Acids on Vegetative Parameters, Flowering and Chemical Constituents of Dahlia Cut Flowers. *J. of Plant Production***2020**,*11* (4):333 – 339.
44. A. Zaili, S., M. Alabdaly, M. Responce Of Growth And Yield Of Local Garlic Allium Sativum To Potassium Fertilization And Planting Date. Anbar Journal Of Agricultural Sciences, 2023; 21(1): 54-63. doi: 10.32649/ajas.2023.179715.

Received: 26 September 2023 / Accepted: 15 April 2023 / Published:15 December 2023

Citation: AL-Zurfi M. T., Bhiah K. M., Abbass J. A., Mohammed A. I. and Abboud A. G.. The effect of spraying with amino acids and iron on some characteristics of vegetative and flowering growth of petunia. Revis Bionatura 2023;8 (4) 47. http://dx.doi.org/10.21931/RB/2023.08.04.47