



RESPONSE OF THREE *GLADIOLUS* CULTIVARS TO SPRAYING WITH DIFFERENT CONCENTRATION OF AMINO ACID, TRYPTOPHAN

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Abstract

The study was conducted in the lath house, belong to Agriculture research station, College of Agriculture, University of Kirkuk of Al Sayada district located south of Kirkuk governorate, during the period of March/2019 to August/2019, to investigated the effect of spray of three concentration of amino acid of Tryptophan (0, 150, 300) mg.l⁻¹ on growth, flowering, yield of corms and cormlets of three *Gladiolus* cultivars (*Gladiolus hybrida*): Far west, Comedie, Costa. The study was laid out in factorial Randomized Complete Block Design (R.C.B.D), the results are summarized as follows : Treatments of amino acid Tryptophan spray led to improving all the vegetative, flowering and yielding attributes, the concentration 300 mg.l⁻¹ had a significant effect on increasing the number of leaves (13.20) leaf.plant⁻¹, plant height (109.94) cm, leaf area (158.30)cm², early of flowering date (87.15) day and increase diameter of new corms (2.44) cm, The three cultivars varied morally in their characteristics, Far west cultivar outperformed the rest of the cultivars when increase of plant height (111.63)cm, vase life (8.76)day, While Comedie cultivar predominated in most characteristics with highest number of leaves (15.60) leaf.plant⁻¹, early of flowering date (81.26) day, leaf area (188.17)cm² and increase number of florets (8.50). The interaction between tryptophan and three cultivars shows significant differences between treatments, Comedie cultivar was outperformed on other two cultivars when spraying with a concentration of amino acid of Tryptophan at 300 mg.L⁻¹ by giving the largest number of leaves (17.15) leaf. Plant⁻¹.

Key words: *Gladiolus*, Tryptophan, Cultivars

Introduction

Gladiolus is one of the most important cut flowers worldwide, it is known as the king of flowering bulbs and belongs to the Iridaceae includes the genus *Gladiolus* about 250 species, the native habitat of *Gladiolus* is South Africa as some species grow in the Mediterranean region, and the name of the genus *Gladiolus* is taken from the Latin word Gladius, that meaning of sword a reference to the shape of the leaves sword (Baily, 1969; Hussain and Lee, 2008). As for the name of the species (*hybrida*), it is due to the fact that the cultivated *Gladiolus* cultivars are all hybrids and there are no pure cultivars, The importance of the *Gladiolus* plant is due to the short growth period, which averages three months from the cultivation of corms to flowering, as well as the possibility of cultivating it and producing its beautiful flowers throughout the year and the multiplicity of its forms and the colors of its flowers (Al batal, 2004). Netherlands is the first country to export *Gladiolus* corms in the world. *Gladiolus* production ranks second after tulips in

European countries and is ranked fourth globally in terms of trade in cut flowers, As the production of *Gladiolus* flowers occupies about 5.8% of the global production of flowering bulbs, India produces approximately 127 million inflorescences annually, with an estimated area of 1270 hectares of land cultivated with *Gladiolus* (Anonymous, 2000 & Singh 2006). Amino acids are vital stimulants that have positive effects on growth and yield, and greatly reduce infections resulting from abiotic stresses (Kowalcy and Zielony, 2008), Accordingly tryptophan is one of those amino acids which basic units for building proteins and among the essential amino acids and contains an amino group and a carboxylic group and a side indole chain which makes it an aromatic amino acid unipolar and the synthetic form of tryptophan is C₁₁H₁₂N₂O. Khattab *et al.*, (2016) showed that tryptophan with a concentration of 300 mg.L⁻¹ significantly affected most of the studied traits of *Gladiolus* As it led to the early time required for the color to appear in the first flower and the chemical content of the plant, While the

concentration resulted in 900 mg.L⁻¹ of tryptophan resulted in a significant effect on the length of spike compared to other concentrations used, Al-Saad (2010) confirmed in study For two cultivars of *Gladiolus* (White prosperity and Pastoral) The superiority of the white prosperity was significantly higher in most studied traits than the other cultivar. Ali (2019) showed in a study of two *Gladiolus* cultivars (Rosiebee red and Cartago), that there were significant differences between the two cultivars, the Rosiebee red variety outperformed most of the vegetative traits and gave the largest leaf area with the highest total carbohydrate and total chlorophyll content In return, the Cartago cultivar gave the largest number of shoots and the accelerator to emerge from the color of the first floret and took 45.38 days and the largest number of corms.

Materials and Methods

The study was carried out in the lath house of the Agricultural Research Station/College of Agriculture/ University of Kirkuk, located in the Sayada region, south of Kirkuk Governorate, for the period from 20/3/2019 to 28/8/2019, to studying the response of three *Gladiolus* cultivars to three levels of amino acid tryptophan at (0, 150, 300) mg.L⁻¹ on growth and yield of *Gladiolus* plant: (Far west, Comedie & Costa), These cultivars were planted on 20/3/2019 and the last corms was extracted on 28/8/2019 two weeks after the complete dryness of the vegetative parts, The pots used in the experiment with a diameter of 24 cm and a weight of (6.5) kg, the pots were filled with a mixture of medium (2 soil: 1 peat moss). A weekly program was established to prevent fungal diseases and insect infections and the fungicide was applied to Finch containing the active substance (Metalaxy 1 35%) and The fungicide Tai-Sam that contains the active substance (Thiophanate-Methy 170%), and the insecticide xenon its active ingredient (Diazinon 60%) to prevent insect infections, All the characteristics were taken when the color started to appear in the first floret. These characteristics included the following: Characteristics of vegetative growth: number of leaves (leaf.plant⁻¹), leave area (cm²).

Characteristics of flowering : the time required for flowering (flowering date) (day), number of florets on spike (floret.plant⁻¹), Vase life (day).

Characteristics of yield: diameter of new corm (cm), wet weight of corms (g), wet weight of cormels (g).

After collecting the data, perform the statistical analysis of the results using the statistical program (SAS) to analyze the data, and adopt the Duncan’s Multiple Range Test to compare the averages at the 5% level.

Results and Discussion

Characteristics of Vegetative Growth

Number of leaves (leaf.plant⁻¹)

The results in Fig. 1A indicate the superiority of the

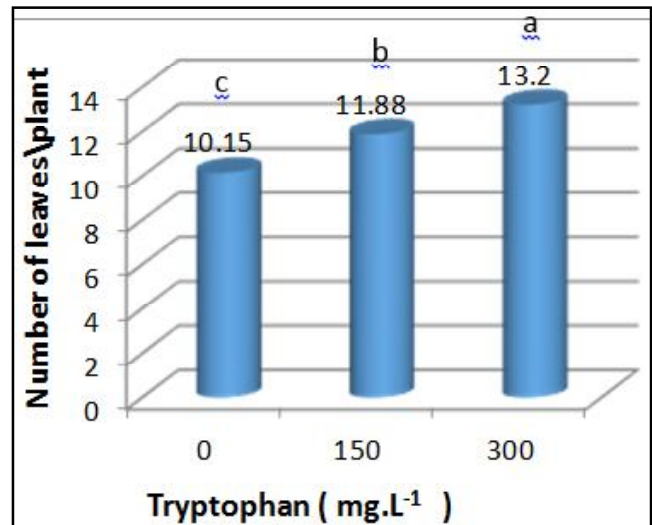


Fig. 1A: Effect of tryptophan on the number of leaves/plant.

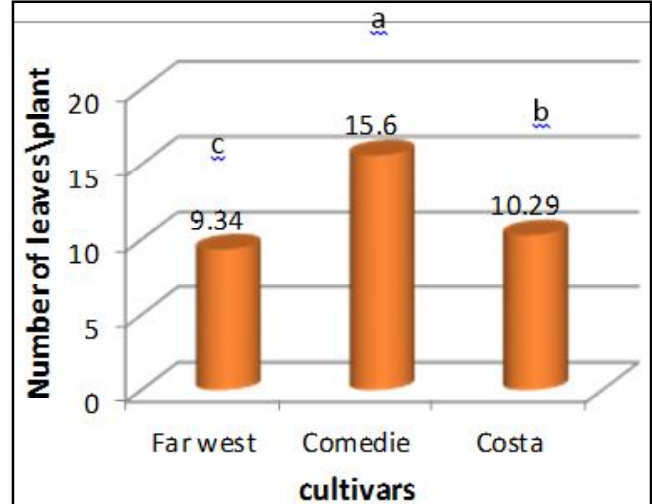


Fig. 1B: Effect of cultivars on the number of leaves/plant.

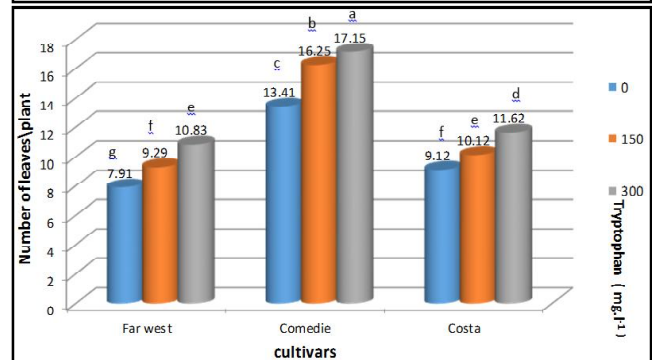


Fig. 1C: Effect of interaction between tryptophan and cultivars on number of leaves.

Fig. 1: Effect of amino acid of tryptophan on number of leaves of three *Gladiolus* cultivars.

spray with the amino acid tryptophan at concentration 300 mg.L⁻¹ given the largest number of leaves, reached to 13.20 leaf.Plant⁻¹ compared with control, which the lowest number of leaves 10.15 leaf.Plant⁻¹, The reason for this significant increase may be due to the beneficial effect of amino acids on the production of new cells by restoring the enzymes involved in protein synthesis (Levitt, 1980), This result is consistent with what Hassan (1997) reached in his study on the bulb of *Narcissus tazetta*, and Wahba *et al.*, (2002). The results in Fig. 1B indicate the moral superiority of the Comedie cultivar over the rest of the cultivars and gave the largest number of leaves 15.60 leaf. Plant⁻¹, while the Far West gave the lowest number 9.34 leaf.Plant⁻¹, the main reason for this may be attributed to the variation between the cultivars in the genotypes of the cultivated cultivars (Sindhu *et al.*, 2016), This is consistent with Reshma *et al.*, (2017). Fig. 1C indicates the effect of interaction between the amino acid tryptophan and cultivars, the superiority of the cultivar Comidie and the concentration 300 mg.L⁻¹ was significant in the average number of leaves 17.15 leaf.Plant⁻¹.

Leaf area (cm²)

The results in Fig. 2A indicate the superiority of the spray with the amino acid of tryptophan in the total Leaf area at a concentration of 300 mg.L⁻¹ and giving the largest leaf area of the plant was 158.30 cm², while the control gave the lowest Leaf area 108.83 cm². Fig. 2B indicates that the Comedie variety was significantly superior to the other cultivars and gave the largest leaf area of the plant reached 188.17 cm² and gave the Far west cultivar the lowest leaf area 97.90 cm². The interaction between the cultivars and amino acid of tryptophan shows a significant difference between the treatments, as the comedie cultivar significantly exceeded when spraying with a concentration of 300 mg.L⁻¹ of tryptophan by giving the largest leaf area of the plant reached 214.49 cm², while the lowest leaf area of the plant was 78.26 cm² in the control plants of Far west cultivars, this may be due to the positive role of spraying with the amino acid of tryptophan as well as the effect of the variety and its superiority in its characteristics, in addition to their positive effect interfering with the biological processes that occur within the plant.

Characteristics of Flowering

Flowering date (day)

The results in Fig. 3A indicate the presence of significant differences for spraying the amino acid of tryptophan on flowering date, as treatment began with tryptophan at a concentration of 300 mg.L⁻¹ per flowering and the minimum duration required for flowering took

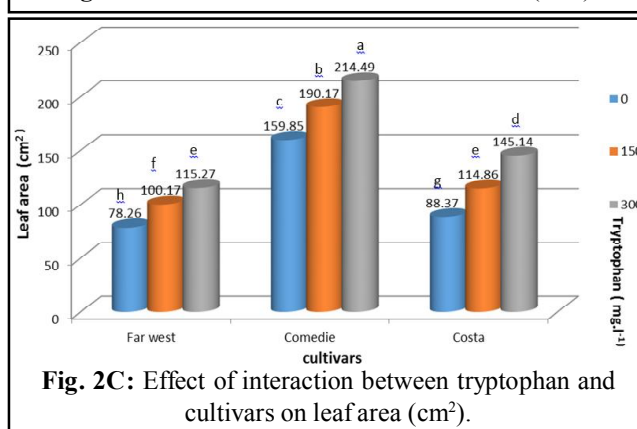
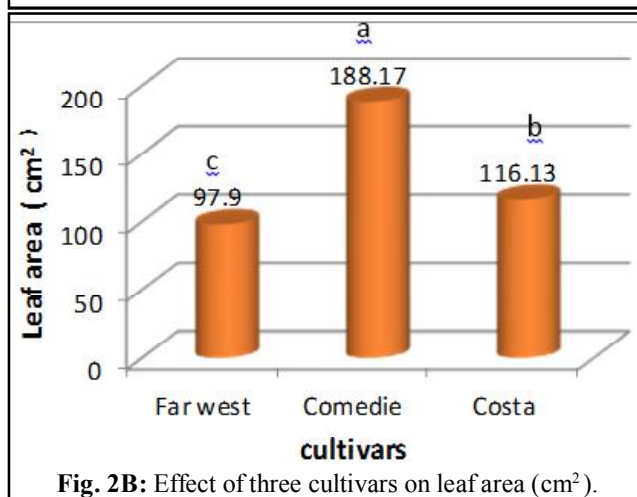
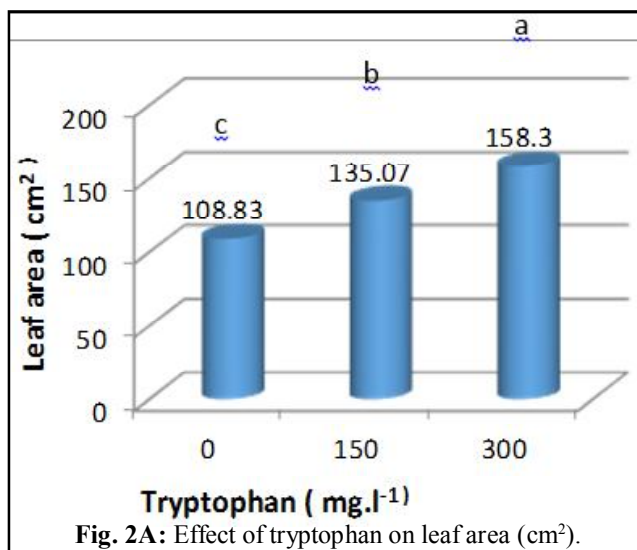


Fig. 2: Effect of amino acid of tryptophan on leaf area (cm²) of three *Gladiolus* cultivars.

87.15 days, Whereas the control plants took the longest period required for flowering and reached (95.73) days, The reason may be attributed to the positive role of tryptophan in the synthesis of indole acetic acid IAA and other vital organic materials such as RNA, DNA (Goss, 1973) and this leads to stimulation of flowering and early development, which is consistent with Safaa and Khalil

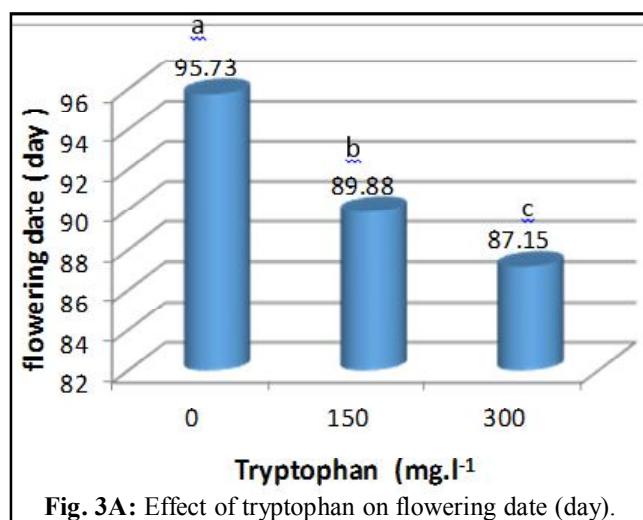


Fig. 3A: Effect of tryptophan on flowering date (day).

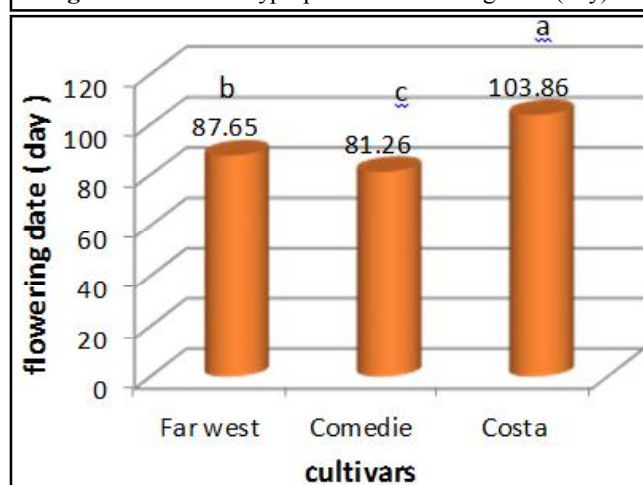


Fig. 3B: Effect of the cultivars on flowering date (day).

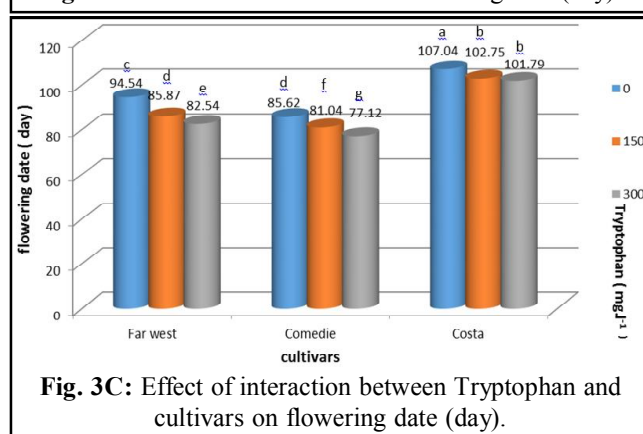


Fig. 3C: Effect of interaction between Tryptophan and cultivars on flowering date (day).

Fig. 3: Effect of the amino acid of tryptophan on flowering date of three *Gladiolus* cultivars.

(1992). Fig. 3B shows that the Comedie cultivar has grown early in flowering and took the minimum necessary period (81.26) days, while the Costa cultivar took the longest period required for flowering (103.86) days. The reason for these differences may be due to the genetic factors controlling the performance and impact of these species Different in the flowering characteristics of

Gladiolus (Ali *et al.*, 2015), With regard to the interaction between cultivars and amino acid of tryptophan , according to the Fig. 3C the Comedie variety prized in the time required for flowering when spraying at a concentration of 300 mg.L⁻¹ and took (77.12) days, while the Control plants of the Costa cultivar took the longest period required for flowering and it took (107.04) days.

Number of florets (florete.plant⁻¹)

The results in Fig. 4A indicate that the tryptophan amino acid superiority to the number of florets at a concentration of 300 mg.l⁻¹ and gave the largest number of florets 8.52 floret. Plant⁻¹, Whereas control of plants gave the lowest number of florets 6.93 floret. Plant⁻¹, and the reason for this may be due to the role played by the amino acid and with an appropriate concentration that works to improve the vegetative growth of the plant *Gladiolus* and accordingly the plant begins to produce and accumulate Biosynthesizes and increases their quantity, which is consistent with what Ahmad *et al.*, (2007 and 2008) found on other plants, Regarding the effect of cultivars , Fig. 4B shows the superiority of the Comedie cultivar significantly and gave the largest number of florets 8.50 floret. Plant⁻¹, while the lowest average number of florets on the Far west 6.80 floret.plant⁻¹ and with regard to the interaction between the cultivars and amino acid of tryptophan, it significantly outperformed the cultivar Comedie at a concentration of 300 mg.l⁻¹ gave the largest number of florets 9.66 floret.plant⁻¹, while the lowest number of florets of control plant of the Far West cultivar 6.37 floret.plant⁻¹ according to Fig. 4C, which explains the positive effect and effective role of each factor separately and their joint overlap in improving plant characteristics.

Vase Life (day)

The results in Fig. 5A indicate the superiority of spraying with the amino acid of tryptophan on Vase life, treatment with tryptophan at a concentration of 300 mg.L⁻¹ and gave the longest vase life (7.94) days, while the plants treated with tryptophan at concentration of 150 mg.L⁻¹ took the least vase life (7.34) days, This may be attributed to the fact that the amino acid of tryptophan increases the tolerance of environmental stresses such as temperature and balance of the level of plant hormones and physiological processes (Rao *et al.*, 2012). Fig. 5B shows a significant superiority of the Far West Cultivar, and the longest vase life took (8.76) days, while the Costa Cultivar took the shortest vase life (6.88) days, With regard to the interaction between the cultivars and the amino acid tryptophan, the Far West cultivar significantly increased in all concentrations 0, 150 and 300 mg. Liters

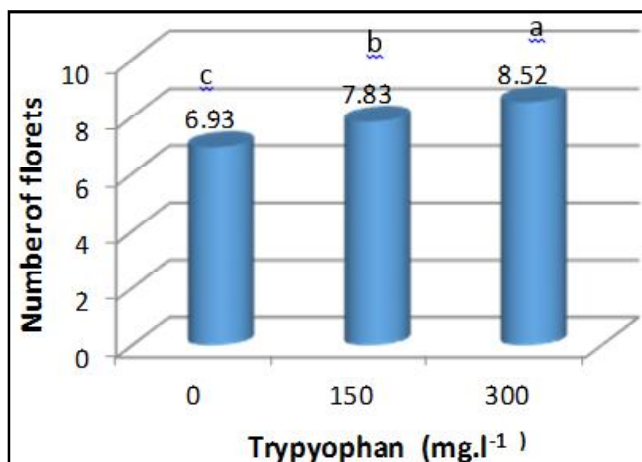


Fig. 4A: Effect of tryptophan on number of Florets.

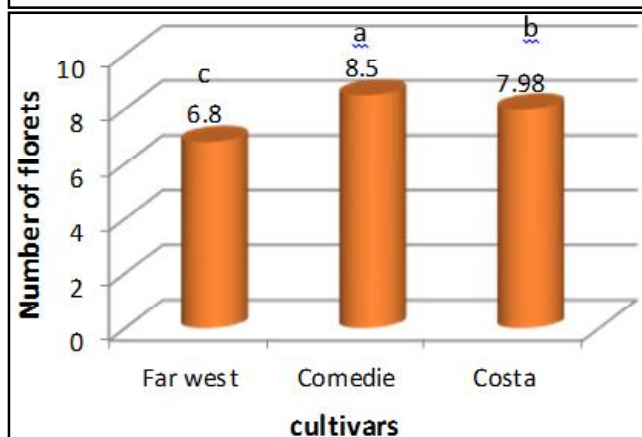


Fig. 4B: Effect of Cultivars on number of Florets.

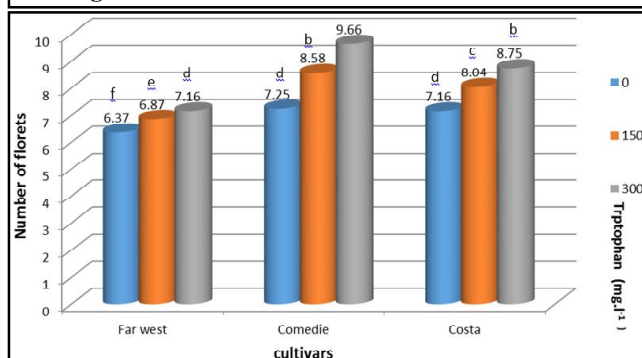


Fig. 4C: Effect of the interaction between tryptophan and cultivars on the number of florets of *Gladiolus* plants.

Fig. 4: Effect of amino acid of tryptophan on the number of florets of three *Gladiolus* cultivars.

and gave the longest vase life (8.75, 8.58 and 8.95) days respectively, while the control plants for Costa cultivar took the shorter vase life reached 6.62 days, according to Fig. 5C.

Characteristics of yield:

Diameter of new corm (cm)

The results in Fig. 6A indicate the moral superiority of the spray with the amino acid of tryptophan on Diameter New corms, as the concentration exceeds 300

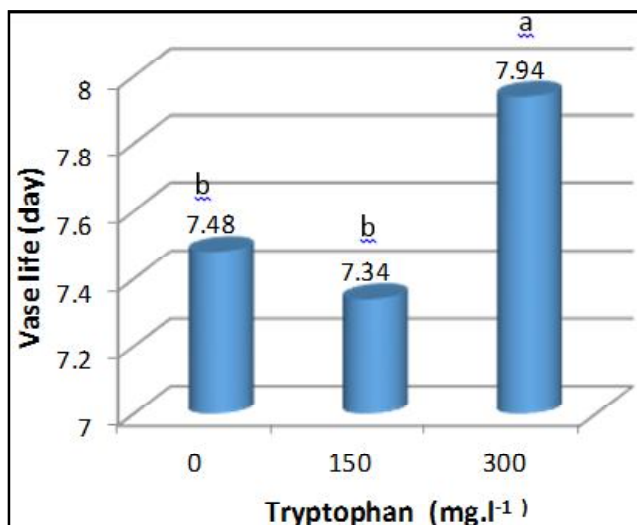


Fig. 5A: Effect of Tryptophan on vase life of *Gladiolus*.

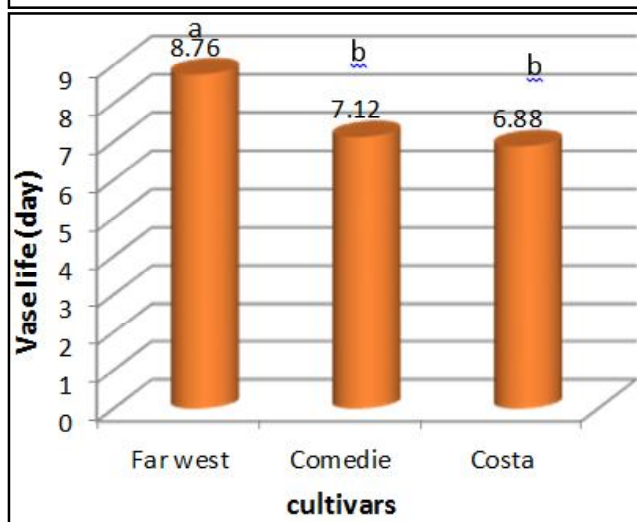


Fig. 5B: Effect of cultivars on vase life of *Gladiolus*.

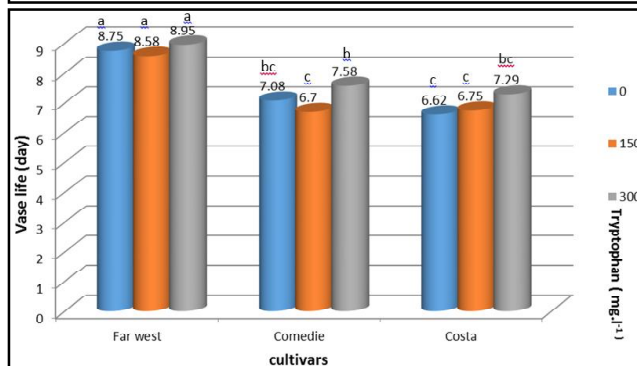


Fig. 5C: Effect of interaction between Tryptophan and cultivars on vase Life of *Gladiolus*.

Fig. 5: Effect of amino acid of tryptophan on vase life of three *Gladiolus* cultivars.

mg. L⁻¹, by giving the largest diameter of new corms 2.44 cm, while in Control plants the lowest diameter of new corms were 2.12 cm, The reason for this may be attributed to the amino acid of tryptophan, with use best concentration on the plant, which has a positive effect on

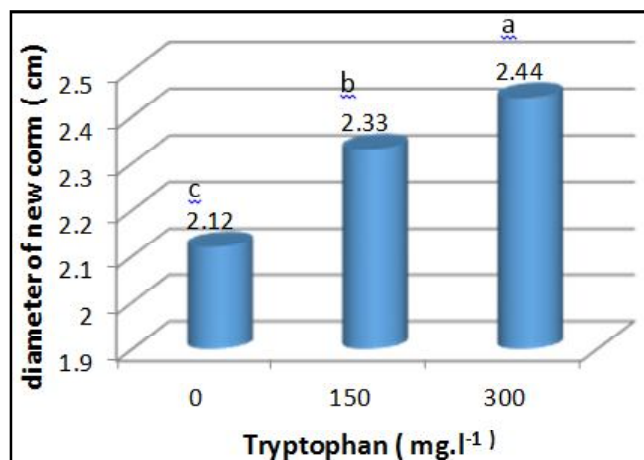


Fig. 6A: Effect Tryptophan on diameter of new corm (cm).

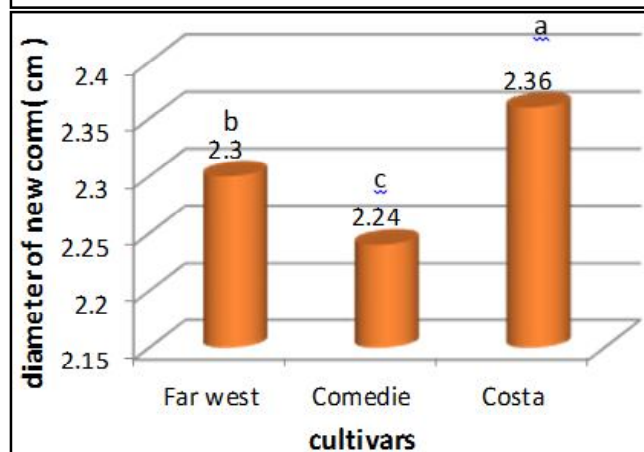


Fig. 6B: Effect of cultivars on diameter of new corm (cm).

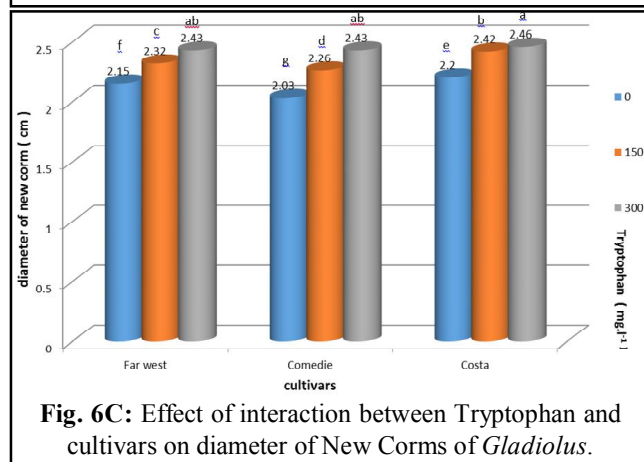


Fig. 6C: Effect of interaction between Tryptophan and cultivars on diameter of New Corms of *Gladiolus*.

Fig. 6: Effect of amino acid of tryptophan on diameter of new corms (cm) of three *Gladiolus* cultivars.

photosynthesis, respiration rate and leaf content of carbohydrates, This is consistent with Dhopte and Lail (1987). As for the effect rate of the cultivars, Fig. 6B showed a significant superiority for the Costa cultivar and gave the largest diameter for the new corms, which was 2.36 cm, while the lowest diameter for the new corms of the Comedie reaching 2.24 cm. This difference between the cultivars may be attributed primarily to the

genetic system of cultivated cultivars in which further genetic modification may occur due to prevailing environmental conditions and over a wide range of agricultural cultivars. This has been observed by Kumar (2009) and Shaukat *et al.*, (2013). With regard to the interaction between the cultivars and the amino acid of tryptophan, the Costa cultivar was significantly superior at the concentration of 300 mg.L⁻¹ of tryptophan and gave the largest diameter of the corms were reached 2.46 cm, while the lowest diameter of the new corms in plants compared to the Comedie cultivar was 2.03 cm, according to the Fig. 6C.

Wet Weight of corms (g)

The results in Fig. 7A indicate the superiority of spraying with the amino acid of tryptophan on wet weight of corms, the concentration exceeds 150 mg.L⁻¹ of tryptophan giving the largest wet weight of corms, which is 4.15 g, while the control plants gave the least wet weight of the corms, to 3.17 g, Perhaps the reason for this is due to the role of tryptophan as a precursor to the production of auxins in the Apical meristem and roots (Arshad and Frankenberger, 1991) which leads to stimulating *Gladiolus* to grow, and accordingly the plant produces large corms and thus the wet weight of the corms increases. Fig. 7B showed a significant superiority of the Far West cultivar and gave the largest weight of the corms, amounting to 4.31g, whereas the lowest wet weight of the corms was from the Costa cultivar, reaching 2.85g, This difference may be attributed to the genetic system of cultivated cultivars in which further genetic modification may occur due to prevailing environmental conditions and a wide range of agricultural cultivars. This has been observed by Kumar (2009) and Shaukat *et al.*, (2013), With regard to the interaction between the cultivars and the amino acid of tryptophan, Fig. 7C showed a significant superiority of the Comedie cultivar and at a concentration of 150 mg.L⁻¹ of tryptophan and gave the largest wet weight of Corms reached 5.06g and a wet weight of corms of control plants of Costa cultivar, Its reached 2.29g.

Wet weight of cormels (g):

The results in Fig. 8A indicate the significant superiority of spraying with the amino acid of tryptophan I on wet weight of cormels as the concentration exceeds 300 mg.L⁻¹ of tryptophan by giving the largest wet weight of cormels reached 1.76g, while in control plants the lowest wet weight of cormels were 1.03g, the reasons for this may be due to the same reasons that were mentioned in discussing the wet weight of the corms, As for the effect rate of the cultivars, Fig. 8B showed a

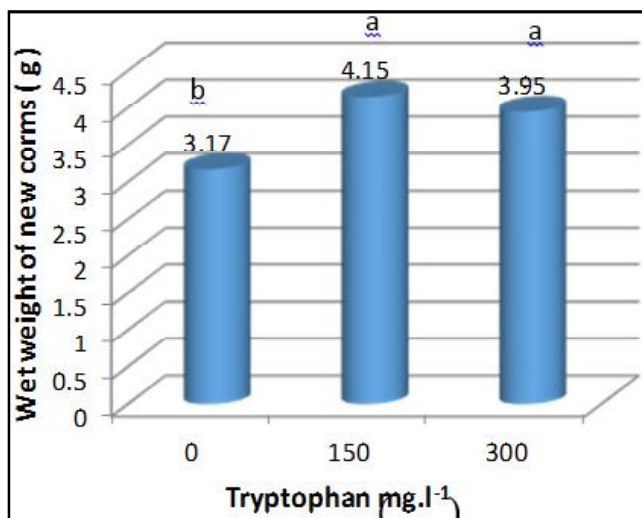


Fig. 7A: Effect of tryptophan on the wet weight of corms (g).

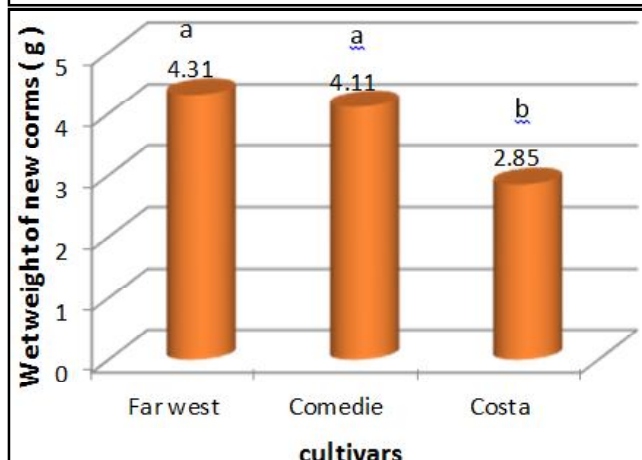


Fig. 7B: Effect of the cultivars on the wet weight of corms (g).

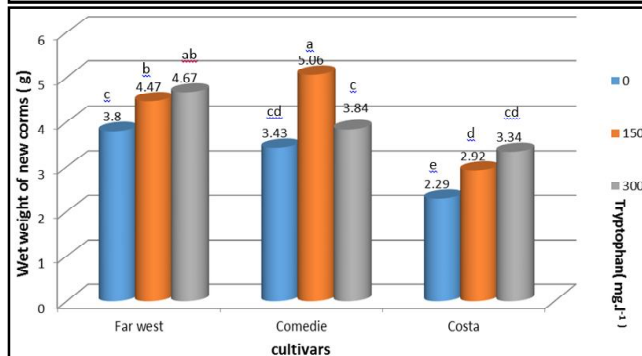


Fig. 7C: Effect of Tryptophan and cultivars interaction on the Wet Weight (g) of *Gladiolus* Corms.

Fig. 7: Effect of amino acid tryptophan of on the wet weight of new corms (g) of three *Gladiolus* cultivars.

significant superiority of the Far West cultivar and gave the largest weight of cormels reached 1.71g, while the lowest wet weight of cormels of the Comedie cultivar was reached 1.11g, With regard to the interaction between the cultivars and amino acid of tryptophan, Fig. 8C showed

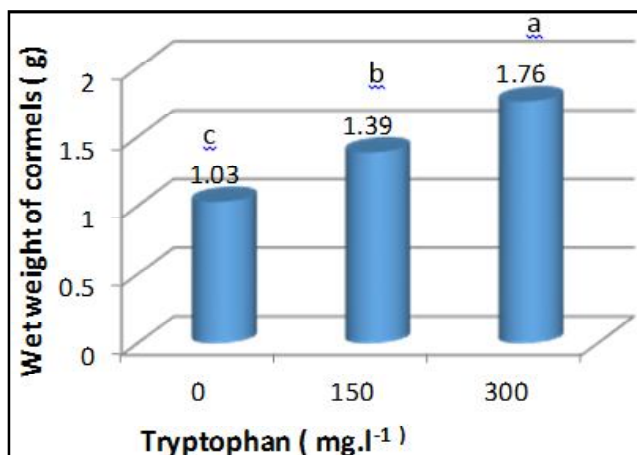


Fig. 8A: Effect of tryptophan on Wet weight of cormels (g).

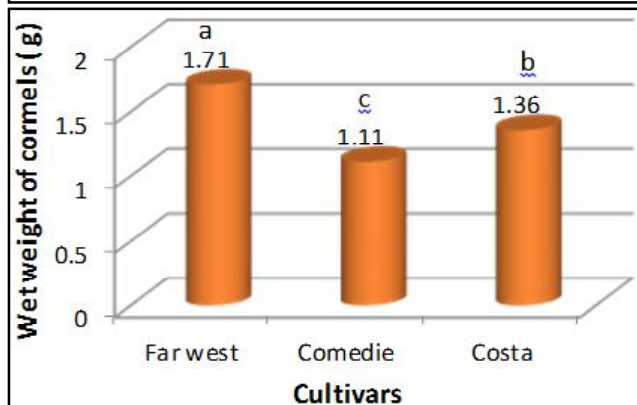


Fig. 8B: Effect of the cultivars on wet weight of cormels(g).

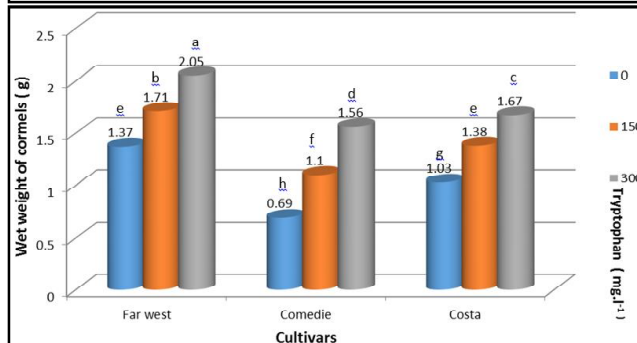


Fig. 8C: Effect of interaction between tryptophan and cultivars on wet weight of cormels (g).

Fig. 8: Effect of amino acid of tryptophan on wet weight of cormels (g) of three *Gladiolus* cultivars.

a significant superiority of the Far west cultivar and concentration of 300 mg.L⁻¹ of tryptophan gave the largest wet weight of cormels were 2.05g, while the lowest wet weight of cormels of control plants for the Comedie cultivar was 0.69g, This may be due to the positive effect of both factors on improving plant characteristics, as well as the variation of cultivars among them in response to spraying with the amino acid of tryptophan and unevenly.

Conclusion

1- Spray of amino acid of Tryptophan led to improving

all the vegetative growth, flowering, corms and cormels, that concentration 300 mg.L⁻¹ had a significant effect on increasing the number of leaves, plant height, leaf area, early of flowering date, diameter of new corms, wet weight of corms and cormels.

- 2- The three cultivars varied morally in their characteristics, Far west cultivar outperformed the rest of the cultivars, its increase plant height and vase life, While Comedie cultivar predominated in most characteristics with highest number of leaves, early of flowering date, leaf area and increase number of florets.

The interaction between tryptophan and three cultivars shows significant differences between treatments, as the Comedie cultivar was outperformed on both cultivars when spraying of amino acid of Tryptophan at concentration of 300 mg.L⁻¹.

References

- Albatal, Nabil (2004 and 2005). Producing Protected Ornamental Plants. Publications of the University of Damascus. Syrian.
- Al-Saad, Kefaia Ghazi (2010). Effect of planting dates, gibberellic acid and Licorice root extract on growth and yield of *Gladiolus hybrida*. Ph.D.Thesis - College of Agriculture - University of Mosul - Iraq.
- Ahmad, R., M. Khalid, M. Naveed, S.M. Shahzad, Z.A. Zahir and S.N. Khokhar (2008). Comparative efficiency of auxin and its precursor applied through compost for improving growth and yield of maize. *Pak. J. Bot.*, **40**: 1703-1710.
- Ali, Janet Sabah Omar Hama (2019). Effect of salicylic acid and Alar on growth and yield of two *Gladiolus* cultivars (*Gladiolus hybrida*). Master Thesis. Department of Horticulture and Landscape design - College of Agriculture - University of Kirkuk - Iraq.
- Ali, Z., A. Qadeer, H.M. Ahmad, O. Aziz, M. Qasam and Q. Ali (2015). Assessment of effect of different herbicides on morphological traits of *Gladiolus grandiflorus*. *Life Science Journal*, **12**(4): 87-93.
- Anonymous (2000). Inventarisatie wereldbooleanareaal. *Bloembollen cultuur*, **21**: 4 (C.F.De).
- Hertogh, A.A. and Le Nard (1993). The physiology of flower bulb. Elsevier scientific publisher. Amsterdam. The Netherland.
- Arshad, M. and W.T. Frankenberger (1991). Yield response of watermelon and muskmelon to L-tryptophan applied to soil. *Hort. Sci.*, **26**: 35-37.
- Baily, L.H. (1969). Manual of cultivated plant. Printed in the United states of American, eleventh Printing. The macmillan Company.
- Dhopte, A. and S. Lail (1987). Relative efficiency of antitranspirant, growth regulators and mineral nutrients in hirsutum cotton under dry land conditions, *Ann. Plant Physiol.*, **1**(1): 56-71.
- Goss, A. (1973). Amino acid synthesis and metabolism. Physiology of plants and their cells. Pergamon Press INC, New York-Toronto, Oxford, Sydney, Braunschweig. 202.
- Hanan, Z. (2000). Effect of tryptophan and paclobutrazol on Caraway (*Carum carvil* L.) and Coriander (*Coriandrum sativum* L.) plants. M.Sc. Thesis. Fac. of Agric., Cairo.
- Hassan, A.O.G (1997). Physiological studies on (Narcissus tazetta) plant. Ph. D. Thesis, Fac. Agric., Moshtohor Zagazg Univ., Egypt.
- Hussain, S. and S. Lee (2008). *Gladiolus* production a successful example in the climate of Khanaspur, Ayobia District Hazar, NWF (Province) Pakistan. *The Geographical Journal of Korea*, **48**(2): 177-181.
- Khattab, M., A. Shehata, E.A. El-Saadate and K. Al-Hasni (2016). Effect of glycine, methionine and tryptophan on the vegetative growth, flowering and corms production of *Gladiolus* plant. *Alex Sci. Exch. J.*, **37**(4): 647-659.
- Kowalczyk, K. and T. Zielon (2008). Effect of Amino plant and Asahi on yield and quality of lettuce grown on Rockwool. Book of Abstracts of the Conference of bio stimulators in modern agriculture, 7-8 February, Warsaw, Poland, 40.
- Kumar, R. (2009). Evaluation of exotic *Gladiolus* under subtropical midhills of Meghalaya. *Indian J. Agril. Sci.*, **79**: 115-117.
- Levitt, J. (1980). Response of plants to environmental stresses. Pp. 309-317. 2nd. Ed. Vol. Academic press, New York.
- Rao, S.R., A. Qayyum, A. Razzaq, M. Ahmad, I. Mahmood and A. Sher (2012). Role of foliar application of salicylic acid and L-tryptophan in drought tolerance of maize. *J. Anim. Plant Sci.*, **22**: 768-772.
- Reshma, V.S., D.M. Panchbhai, P. Kumar and M.N. Adarsh (2017). Effect of GA3 spray on *Gladiolus* (*Gladiolus* spp.) cultivars under dry conditions of Vidharba Region. *International Journal of Pure and Applied Bioscience*, **5**(3): 123-129.
- Safaa, M. and M. Khalil (1992). Effect of tryptophan and arginine on growth and flowering of some winter annuals. *Egypt T. Appl. Sci.*, **7**(10): 82-93.
- Shaukat, S.A., S.Z.A. Shah, S.K. Shaukat and S.W. Shoukat (2013). Performance of *Gladiolus* (*Gladiolus grandiflora* L.) cultivars under the climatic conditions of Bagh Azad Jammu and Kashmir, Pakistan. *J. Central Eur. Agri.*, **14**: 158-167.
- Singh, A.K. (2006). Flower crops: Cultivation and Management. New india publishing Agency.
- Sindhu, S.S., A. Kumar, R. Kumar and V. Chaudhary (2016). Evaluation of *Gladiolus* (*Gladiolus graniflorus* L.) Cultivars under drip irrigation system. *International Journal of Tropical Agriculture*, **34**(4): 1097-1099.
- Wahba, H.E., S.M. Mohamed, G.E. Attoa and A.A. Frahat (2002). Response of antholyza aethiopicato foliar spray with some amino acids and mineral nutrition with sulphur. *Annals of Agric. Sci., Ain Shams Univ. Cairo*, **47**(3): 929-944.