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EFFECT OF AMINO ACID OF TRYPTOPHAN ON SOME PHYSIOLOGICAL CHARACTERISTICS OF SAFFRON PLANT (CROCUS SATIVUS L.)

*** Lina Saadoun Abdul Majeed**
**** Kefaia Ghazi Al-saad**
***** Mohsin Omar Muhammad**
Kirkuk University / College of Agriculture
rivanlina36@gmail.com

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Abstract:

The study was carried out in the Lath house , Department of Horticulture and Landscaping / University of Kirkuk / Agricultural Research Station / Al Sayada, for the period from September 15/9/2021 to April 20/4/2022, for the purpose of studying the effect of soaking the corms with the amino acid tryptophan at concentrations (0,150,300) mg. L^{-1} before planting for 24 hours affected the growth, flowering and yield of the corms of saffron plant (*Crocus sativus* L)., obtained Saffron corms from the Islamic Republic of Iran, and the bulbs were extracted after two weeks of complete drying of the vegetation After seven months of cultivation, on 4/20/2022, the factorial experiment was designed according to the R.C.B.D Randomized Completely Block Design, the results were analyzed according to the statistical program SAS, 2004 ,The Statistical Analysis, and Duncan's Multiple Range Test was used to compare averages at the level of probability 5%.Soaking the corms with a concentration of 150 mg.L^{-1} of the amino acid tryptophan before planting had a significant increase in the average number of leaves in the first stage(14.60 leaves. $Plant^{-1}$), the longest leaf for both stages (18.31 and 38.88) cm, number of corms and their wet weight (3.45 corm, 19.08 g), respectively. The highest average number of leaves after flowering is 28.66 leaves. $Plant^{-1}$, the number of flowers is 1.5 flowers. $Plant^{-1}$, and the dry weight of the stigmas is (0.082) g. As for the soaking at a concentration of 300 mg.L^{-1}, the highest rate of the number of branches was (4.74 and 5.62) bud.$plant^{-1}$ for both stages, respectively, the number of leaves after flowering was 28.66 leaves.$plant^{-1}$ and the number of flowers 1.5 flower.$plant^{-1}$ and The dry weight of the stigmas was 0.082 g, while the control plants (soaking with water only) had the lowest average number of branchess (3.60 and 5.08) bud.$plant^{-1}$ for both stages..

Keywords: Saffron plant, amino acid, tryptophan

INTRODUCTION

The saffron plant (Crocus sativus L.) belongs to the Iris family (Iridaceae), and the genus of saffron contains 80 species and about (30) species of which are cultivated as ornamental plants only (Davies et al., 2005), and some of it is used as a seasoning, and as a dye. The food is bright yellow in color, and it was grown in Persia and Greece, and its cultivation moved from the East to Europe, then to America, and the global production volume of saffron is 300 tons annually, at a rate of 95% of global production. A hectare produces about 25 kg of stigmas. Dried, and it gives a quantity of flowers of 60 thousand flowers about 0.5 kg of stigmas. Iran and Spain are among the most important producing countries (Hosseini and Mollafilabi, 2017). Saffron occupies an advanced rank among medicinal and aromatic crops in terms of the most expensive spice in the world, and it is called red gold (Poggi et al., 2010). It gives it a special flavor and has multiple uses in the industry, as it enters the dyeing of textiles and perfumes, and it has been used since ancient times in the treatment of many diseases such as gastroenteritis and as a sedative for stomach disorders (Al-Shihabi, 1988). The most important chemical compounds that give saffron its distinctive properties are: - Glycosides (crocin - picrocrocin) and safranal aldehyde, Crocin is: (Crocin (C44H64O) a colored substance that dissolves in water and alcohol giving a strong amber-yellow colour. As for Picrocrocin (C16H26O): it is a glycoside that splits into volatile sucrose and is responsible for the taste and smell of saffron. Safranal (C10H14O safranal) also shares With picrocrocin in giving saffron its distinctive aroma, saffron stigmas contain proteins, sugars, vitamins and amino acids, 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 C11H12N20. 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 resultedin a significant effect on the length of spike compared to other concentrations used, Muhand and Al-saad(2020)Summarized that 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, Spray of amino acid of Tryptophan led to improving Response of Three *Gladiolus* Cultivars to Spraying with different concentration of amino acid of Tryptophan . In addition to the fact that it plays an important role in encouraging early growth, as well as multiple physiological roles, this study came to know and demonstrate the effect of soaking with the amino acid tryptophan in improving the growth, flowering and yield of corms of the saffron plant.

MATERIALS AND METHODS

The experiment was conducted in the Lath house, the Department of Horticulture and Landscaping / University of Kirkuk / Agricultural Research Station / Al-Sayada, for the period from September 15/9/2021 to April 20/4/2022, for the saffron plant *Crocus sativus* L., as the land allocated for the procedure was prepared. In the experiment, plastic pots were placed under the pots, with a diameter of 20 cm and a capacity of 6.5 kg of the soil mixture. Before planting for the purpose of laboratory analysis. Table (1) shows the chemical and physical properties of the mixture. The saffron corms were soaked with a fungicide (1 gm Taisam + 1 gm of the fungicide Finish), i.e. at a concentration of 2 gm.L^{-1} for half an hour before planting, then The corms were soaked with three concentrations of the amino acid tryptophan (0,150,300) mg.L-1. And after preparing it in the form of an aqueous solution, by dissolving it with drops of ethyl alcohol until complete dissolution, and completing the volume to a liter of distilled water, and follow a weekly preventive program consisting of the insecticide Solde of Indian origin, the active ingredients in it (+ Bifenthrin 2% + Acetamiprid 2% Alphacypermethrin 5% by (2 ml.L^{-1} water) spraying on the leaves and the week following spraying with 1 gm each of the fungicide Taisam contains the active substance Thiophanate- methyl 70% Wp and 1 gm of the fungicide Finish contains 35% of the active substance: Metalaxyl, i.e. in an amount of (2 gm.L^{-1} water), as it was Shanay and Al- saad,2017 , Eman)added to the soil and spraying with the two pesticides was repeated every week respectively, until the end of the growing season. The growth of the bushes was monitored (and ,Al- saad ,2019) and weeded whenever needed. To it, corms were planted in plastic pots, with one corm in each pot, at a depth of 7 cm, and the plants were watered regularly whenever needed.

Table No. (1): Some physical and chemical properties of the soil mixture transported before planting.

Analysis type	Standard unit	Analysis result
N ready	mg.kg^{-1}	0.175
P ready	mg.kg^{-1}	27.55
K ready	mg.kg-1	49.60
Ca	Milleq.L^{-1}	48.60
Mg	Milleq.L^{-1}	19.80
PH The degree of reaction		7.11
electrical conductivityEC	Decisimens.m^{-1}	0.12
TDS	Milleq.L^{-1}	140
Sand	gm.kg-1	90
Clay	gm.kg-1	4
Green	gm.kg-1	6
organic matter	gm.kg-1	4.86
Tissue	**Sand loam**	

** The soil was analyzed in the soil laboratory of the Directorate of Agriculture of Kirkuk.

Table No. (2): The monthly average of the maximum and minimum temperatures during the study period.

the month	Average temperature during the study period (°C)	
	Maximum (°C)	Min (°C)
September	40.45	18.11
October	28.87	19.15
November	21.47	13.48
December	12.72	2.92
January	14.7	4.48
February	18.33	6.06
March	24.11	8.3
April	**29.76**	**16.45**

* Directorate of Meteorology / Agricultural Unit Division.

The following characteristics were studied and included:

First: the characteristics of vegetative growth: readings were taken for the characteristics of vegetative and flowering growth when the color appeared in the flowers, and the vegetative characteristics were taken in two stages, the first stage when the color began to appear in the flower, and the second after flowering, and it included:

1-vegetative characteristics : The number of branches (bud. plant^{-1}). , - The number of leaves (leaf. plant $^{-1}$) , the length of the longest leaf (cm)

2- floral characteristics :- The number of flowers (flower. plant^{-1}). 2- The dry weight of the stigma (gm).

3-corms yield : The number of corms , The wet weight of the corms (gm).

RESULTS AND DISCUSSION:

Results:

1- Vegetative Characteristics:

The results in Table (1) for the first and second stages indicate a significant effect of soaking with the amino acid tryptophan during the two stages. It had a positive effect on increasing the number of branches, and they reached (4.74 and 5.62) bud. plant^{-1}, respectively, at the level of 300 mg.L^{-1}, while The lowest average number of buds in the control plants was (3.60 and 5.40) bud.plant^{-1}, respectively**.** As for the number of leaves, the concentration of 150 mg.L^{-1} was superior in increasing the number of leaves in the first stage, and when the concentration of 300 mg.L^{-1} in the second stage was (14.66 and 28.66), respectively, it differed significantly with the comparison treatment plants in giving the least number of leaves and reached (13.73 and 26.54) leaf.plant^{-1}, respectively., and the amino acid tryptophan was significantly superior when soaking at a concentration of 150 mg.l^{-1} for both stages in increasing the length of the longest leaf, which amounted to (18.31 and 38.88) cm, respectively.

Table (1): The effect of soaking with the amino acid tryptophan on the vegetative characteristics of saffron plant *Crocus sativus* L. .

The amino acid of Tryptophan Mg.l^{-1}	number of branches bud. leaf^{-1} when the color begins to appear	number of branches bud. leaf^{-1} after flowering	number of Leaf Leaf.plant^{-1} when the color begins to appear	number of Leaf Leaf.plant^{-1} after flowering	the length of the longest leaf (cm) after flowering	the length of the longest leaf (cm) when the color begins to appear
0	3.600 c	18.23 b	13.73 c	26.54 c	18.23 b	37.10 b
150	4.371 b	18.31 a	14.66 a	26.57 b	18.31 a	38.88 a
300	4.743 a	17.73 c	14.60 b	28.66 a	17.73 c	36.08 c

*** Averages with similar letters are not significantly different among themselves at the 5% probability level, according to Dunkin's multiple range test.**

2- Floral characteristics :

The results in Table (2) indicate the significant effect of soaking with the amino acid tryptophan, as the concentration exceeded 300 mg.l^{-1} in increasing the number of flowers and reached 1.5 flowers. plant^{-1}, and to the positive role of soaking with the amino acid tryptophan at a concentration of 300 mg.l^{-1}. 1 in the increase in the dry weight of the stigma and reached 0.082 g.

Table (2): Effect of soaking with the amino acid tryptophan on Floral characteristics (number of flowers flower .plant-1, dry weight of stigmas g) of saffron plant *Crocus sativus* L .

The amino acid tryptophan Mg.l^{-1}	Number of flowers flower.plant-^{1}	The dry weight Of the stigma (g)
0	1.5 a	0.072 c
150	1.3 b	0.073 b
300	1.5 a	0.082 a

*** Averages with similar letters are not significantly different among themselves at the 5% probability level, according to Dunkin's multiple range test.**

3-Number of corms, wet weight of corms(g):

The results presented in Table (3) showed that soaking with the amino acid tryptophan led to a significant decrease in the number of corms when the concentration was increased to 300 mg.l^{-1} and reached 3.18 corms, and the highest number of corms reached 3.45 corms when soaking with the amino acid tryptophan at a concentration of 150 mg.l^{-1}. And to a significant increase when soaking with the amino acid tryptophan at a concentration of 300 mg L^{-1} in reducing the fresh weight of the chromate and reached 18.20 gm, while the highest increase in fresh weight was 19.08 gm at a concentration of 150 mg L^{-1}.

Table (3) Effect of soaking with the amino acid tryptophan on yield characteristics (number of corms Corm.plant-1, wet weight of corms) of saffron plant.

The amino acid tryptophan Mg.l^{-1}	number of corms Corm. plant $^{-1}$	The wet weight of the corms g
0	2.75 c	16.16 c
150	3.45 a	19.08 a
300	3.18 b	18.20 b

***Averages with similar letters are not significantly different among themselves at the 5% probability level, according to Dunkin's multiple range test.**

DISCUSSION

Statistical analysis data and references appear in tables that represent vegetative traits (number of leaves. plant^{-1}, length of the longest leaf), floral traits (number of flowers, dry weight of stigmas) and corms yield characteristics (average number of corms and their fresh weight), to the significant effect of soaking with the amino acid tryptophan at different concentrations, as soaking with the amino acid tryptophan led to significant differences in the characteristics of vegetative growth, as it led to an increase in the number of buds, As for the concentration of 150 mg.L^{-1}, it increased the average number of leaves and gave the longest leaf. This positive effect may be due to the effective role of the amino acid tryptophan in increasing the growth regulator auxin. 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 , Wahba *et al.,* (2002) and Muhand and Al-saad (2020) of Gladiolus plants(*Gladiolus hybrida),* Khattab *et al.,* (2016) showed that tryptophan with a concentration of 300 mg.L-1 significantly affected most of the studied traits of *Gladiolus* This result agrees with the results of Al-Obeidi and Al-Saad (2020) in improving the vegetative growth characteristics with concentration. 300 mg.L^{-1} of Gladiolus hybrida L. Soaking with the amino acid tryptophan led to a significant increase in the average number of flowers, and gave the highest dry weight of the

stigmas. This may be due to the positive effect of the amino acid in increasing the total chlorophyll content in the leaves and in increasing the outputs of photosynthesis, which was positively reflected in the improvement of growth. These results are consistent with what Al-Obaidi and Al-Saad (2020) reached for the gladiolus plant, who indicated that early flowering and an increase in the number of florets on the pink spirea of Gladiolus plants when spraying with a concentration of 300 mg.L^{-1}, and soaking with the amino acid tryptophan had a significant positive effect on increasing the corms yield at the two concentrations (150,300) mg.L^{-1}, as the average number of corms increased And its weight when soaking at a concentration of 150 mg.L^{-1}, and this is due to the positive role of the amino acid tryptophan and its physiological role in building the growth regulator auxin, which was reflected positively in improving and stimulating growth and photosynthesis products and improving the physiological characteristics of the plant shown above, and the statistical analysis data shows the role. The effective soaking of the amino acid tryptophan, which led to the improvement of most of the vegetative and flowering characteristics and the yield of corms. These results are due to the fact that the amino acid tryptophan represents the initial expression of the plant hormone auxin, which has an effective role in regulating growth and development in plants (Abbas et al., 2013), and adding it leads to an increase in In the production of auxin in plant tissues, this acid is the main material in the process of biosynthesis of auxin (IAA), And that the increase in plant hormones leads to an increase in the process of cell division, elongation and increase in size, which has a positive role in increasing plant height and improving most traits, and this result is referred to by many researchers who confirmed that the amino acid tryptophan leads to an increase in photosynthesis outputs and an increase in The level of amino and nucleic acids, and the manufacture of basic and stimulating proteins for the process of cell division and growth, which is a positive increase that increases with the increase in the concentration of the amino acid. For its effective role in increasing the percentage of nitrogen in the leaves through the compositions of the porphyrins groups included in the synthesis of chlorophyll and the enzyme Nitrite Reductase and Hydroxyiamin R. Its availability in large quantities of the element nitrogen, which is the main component of chlorophyll (Guillioni et al., 2003), and its role in increasing the activity of many enzymes, especially enzymes Responsible for building and forming the chlorophyll molecule and increasing the plant's ability to photosynthesize and thus increasing the chlorophyll content in the leaves (Dorayeera and Mokashi, 2012) and as a result of increasing the components of vegetative growth, including plant height, leafy area of the plant, number of lateral buds, and similar results reached by (Sharawy et al., 2018) If they show that increasing the concentration of the amino acid tryptophan has increased the concentration of nutrients in the leaves, as the amino acids are a source of the macro and micro elements necessary for plant growth and increase its ability to absorb water and nutrients by the root and transfer it to the shoot system, especially the leaves, as well as increase the vital activity of microorganisms, which It increased the components of vegetative growth and improved growth indicators. Many researchers indicated that the increase in vegetative growth indicators may be due to the role of amino acids in increasing plant growth and its efficiency in absorbing nutrients. As the amino acid ions are easily liberated for the plant to benefit from quickly and easily enter the cytoplasm of the cells, which leads to an increase in the process of photosynthesis as a result of its entry into the synthesis of many enzymes of this process and as a result of its rapid processing of the nitrogen element and its activation of the carbon metabolism process, especially if it is sprayed on the plant in the form of nutrient solutions. Which leads to an increase in the manufacture of carbohydrates and is exploited in turn in the growth of the vegetative system (Oksal et al., 1999), and similar results reached by Muhand and ALsaad (2020) when spraying Gladiolus varieties with different concentrations of the amino acid tryptophan, in which the concentration exceeded 300 mg.L-1 significantly in improving the characteristics of Growth, flowering, and corm yield, If the rate of the number of leaves, plant height, leaf area of the plant, early flowering and the diameter of the new shoot increased significantly, agreeing with the results of Khattab et al.(2016), the effect of spraying with the amino acid tryptophan on watercress plant, Erauca sativa, as well as the results of Sabreen and Abdul Karee (2019), with superiority of the amino acid tryptophan at a concentration of 150 mg.l-1 in the characteristics of early flowering and leaf chlorophyll content of *Gerbera jamesonii* L.

CONCLUSIONS

1- The effect of soaking with the amino acid tryptophan at concentrations (0, 150, 300) mg. L^{-1} 24 hours before planting, significantly increased the growth, flowering and yield characteristics, as the soaking treatment with a concentration of 300 mg was superior. L^{-1} improved most of the studied traits compared to plants of comparison treatment, while soaking at a concentration of 150 mg was superior. L^{-1} in improving some characteristics, including the characteristics of the yield of corms (the average number of corms, their wet weight, and their diameter).

2- The flowering of some treatments was affected and led to the growth of some plants vegetatively, and this may be a result of the plant being affected by climatic fluctuations, and what the country is witnessing in terms of temperature fluctuations ..... etc.

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