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Physiological Response of Gladiolus Plants to Amino Acid Tryptophan and Mineral Fertilization in the New Reclaimed Lands

A. H. El-Naggar[1], Z.A.Abd El-Hafez[2]

ABSTRACT

Two field experiments were carried out during two successive seasons of 2008/09 and 2009/10 for evaluating the response of gladiolus plant (*Gladiolus gandavensis cv.*Rosesupreme) to four concentrations of amino acid "tryptophan" at 0.00, 50, 100 and 200 ppm as pre-soaking of corms for 24 hr and four rates of mineral fertilization NPK (19:19:19) at 0.00, 0.25, 0.50 and1.0% at three times as foliar spray. The obtained data showed that pre-soaking of gladiolus corms with tryptophan alone and/or in combination with different rates of mineral NPK, stimulated the vegetative growth characteristics, flowering parameters and production of corms and cormels. The best results of studied parameters were obtained by using 200 ppm of tryptophan treatment with 0.50 and/or l.0% foliar fertilization NPK (19:19:19). Moreover, the results indicated that amino acid "tryptophan" at 200 ppm with mineral fertilization at 1.0% gave the highest values of chemical composition parameters(the total chlorophyll (a+b), mineral contents of leaves and total carbohydrates in the new corms).

Key word: flowering bulbs, amino acid, tryptophan, foliar fertilizers, mineral fertilizer, *Gladiolus.*

INTRODUCTION

The genus gladiolus of the Iridaceae family is represented by 180 species (Lewis et al.,1972). It is found throughout Africa and the Mediterranean area, with the greatest concentration in southern Africa. *Gladiolus gandavensis* Van Houtte. is one of the most preferable flowering bulbs all over the world. It is grown mainly for production of cut flowers, which are required for local and foreign markets. gladioli is herbaceous plants that develops from axillary buds on a corm. The inflorescence is a spike and originates as a terminal axis. The commercial production of Gladiolus are grown from corms in fields for use in cut flower arrangements due to its excellent keeping quality, wide range of forms and sizes. In addition the widespread production may attribute to the short growth period that taken until flowering ability to withstand long distance transportation. Therefore, paying a great attention to improve both qualitative and quantitative characteristics of gladiolus.

The role of amino acid i.e. (tryptophan) in stimulating the growth and activating plants were studied by Phillips (1971) suggested several alternative roles of IAA synthesis exist in plants all starting from amino acids also function in the synthesis of other organic compound, such as protein, amines, purine and primidines, alkaloids, enzymes, terpenoids and others (Goss,1973). The beneficial effect of amino acids on new cell production through restoring the specific enzymes for protein synthesis has been stated by Levitt (1980).

Mineral fertilization is considered as an essential element of photosynthesis respiration, sugar translocation and enzyme activation, this element is also so abundant that is a major contributor to the osmotic potential of cells and therefore to their turgor pressure (Frank and Cleam 1985). Foliar application of nutrients is gaining more importance in fertilization of various field and floricultural crops. The advantages of foliar fertilizers were more obvious under growing conditions restricting the absorption of nutrients from the soil, as reported by Hamdi (1979). The nutrients supplied by macro are necessary for the various biochemical processes that occur within the plant, and that are essential for normal plant growth and development (Darling, 1975). foliar fertilization technique may also be a good alternative to the conventional soil application to avoid the loss of fertilizers by leaching and thereby minimizing the ground water pollution (Paparozzi and Tukey, 1979).

Many researcher pointed out to the importance of amino acid and foliar fertilization in increasing growth, flowering and chemical composition of some economic plants. Hassan (1997) indicated that foliar spraying of

[1]Floriculture, Ornamental Horticulture and landscape Gardening Dept., Faculty of Agric., (EL-Shatby), Alexandria Univ. Egypt.
[2]Medicinal and Aromatic Plants Res.Dept.Hort.Res.Inst.A.R.C., Alexandria, Egypt.

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tryptophan at 50,100 and150 ppm on *Narcissus tazetta* plant resulted in improving vegetative growth measurements and caused significant increase in the parameters of peduncle (number, length, fresh and dry weights). Also, the different concentrations caused early flowering and significant increase in number of florets, diameter and fresh weight of florets per plant. The best results in this concern were obtained with the higher concentrations .Wahba *et al.*, (2002) on *Antholyza aethiopica*, showed that tryptophan and aspartic acid at 25,50 and 75 ppm for each increased number of leaves, leaf width, number of flower/ spike ,fresh weight of spike, number of corm/ plant, diameter, fresh and dry weights of corms /plant. The highest value was obtained by tryptophan at 75 ppm. In addition, the effective role of amino acid Tryptophane on the growth and flowering was assured with *Alpinia nutans* (Mohamed *et al.*, 1992) *Antholyza aethiopica* (Hend *et al*., 2002) *Polianthus tuberose* (Taha 2005). Furthermre, supplying the plants with suitable foliar fertilizer rate is an essential element for photosynthesis respiration, and carbohydrates transformation, for better growth and flowering, especially for bulbous plants. Foliar fertilization is recommended by several investigators to improve the growth, flowering and corms production of *Gladiolus hybrida* plants (El-Naggar 2005), *Polianthus tuberose* (Parthiban and Khader1991 and Amarjeet and Godara 1996), *Chrysanthemum morifolium* (Mazrou *et al.*,1988) Therefore, this study was conducted to determine the suitable rate of foliar fertilizer and its synergistic effect with amino acid "tryptophan" on the vegetative growth, flowering characteristic, corms production and some chemical analysis of gladiolus plants.

MATERIALS AND METHODS

The present work was carried out during two successive seasons (2008/09 and 2009/10) at the new reclaimed lands of Noubaria region, West of Alexandria City, Egypt.

Corms of *Gladiolus gandavensis cv.*Rosesupreme 10-12 cm in circumference, were imported from Holand for both seasons(2008/09 and 2009/10). The corms planted on the 5th October in each experimental seasans, using 20× 50 cm. inter and intra row spacing and depth of 7 cm (Potti and Arora 1986, and El-Naggar 2005). The chemecial and physical analysis of the soil samples at beginning of the experimental sites are presented in the Following table.

Treatments and Expermimental layout

The corms were soaked before planting for 24 hr. with amino acid "tryptophan" at concentration of 0.00, 50, 100 and 200 ppm. The plants were sprayed with the mineral fertilizer Kristalon™ (19:19:19) at concentrations of 0.00 (control), 0.25, 0.50 and 1.0%. The foliar spray treatments were done early in the morning on the leaves till run – off point. Foliar spray were done three times, the first foliar spray addition was applied at 2 – leaf stage, the second one was applied at 4 – leaf stage, and the third application was applied at 6 – leaf stage. The control plants were sprayed with distilled water. The available commercially mineral fertilizer Kristalon™ (19:19:19) produced by Phayzen Company, Holland; EC= 0.9 dS/m at1 g/L, total N 19% (5.5% NO_3-N, 3.8% NH_4-N, 9.7% urea), P_2O_5 soluble in ammonium citrate 19% (8.3% P) and potassium oxide (K_2O) soluble in water 19% (16.8% K).

Experimental design:

The experiments were designed to provide a randomized complete block with three replicated on the open field. Each experimental unites consisted of 10 plants as a plot. For commercial insect and diseases agricultural practices were applied as needed.

Growth parameters:

Conventional methods were used to record the data on plant height (cm) at flowering time, leaf length and width/ plant (cm), fresh and dry weight of leaves / spike. Spikes were cut after leaving three leaves on each plant and when the basal floret was opened, the numbers of days from planting to flowering was account, number of florets /spike, inflorescences duration (day) in plastic vases (1000 ml, containing 3.0% sugar dissolved in deionized water) and dry weights of spike. Also, the data recorded for corms size (diameter), fresh and dry weight of corms, number of cormels and their fresh weight / plant.

Chemical properties

Variable	Available dissolved salts (ppm)								Available N mg Kg^{-1} soil	Available P mg Kg^{-1} soil	Available K mg Kg^{-1} soil	E.C** (ds/m)
	pH*	Na^+	K^+	Ca^{++}	Mg^{++}	Ho_3^-	So_4^-	Cl^-				
Value	8.00	11.3	0.15	1.65	1.30	1.80	1.92	5.6	31.22	2.88	1.18	1.07

Physical properties

Variable	Sand (%)	Silt (%)	Clay (%)	Organic mattr (%)	Texture
Value	79.00	13.90	7.10	0.17	Sandy loam

*In1: 2.5 soil water ratio - **In water saturated soil paste extracted.

The chemical analysis of leaves i.e. leaf total chlorophylls (a+b) content (mg/100 g L. F.W.) were carried out according to the methods described by Moran and Porath(1980). leaf Nitrogen(%), Phosphorus (%) and Potassium (%) were also recorded for both seasons. The nitrogen content and phosphorus percentage of the dried and fine leaves were determined according to methods described by Chapman and Pratt (1961) and Bringham (1982). The potassium percentage was determined by using Flame Photometer according to Brown and Lilleland (1946) and Chapman and Pratt (1961).The total carbohydrate contents(mg/g D.W.) in dried the new corms samples were determined according to Herbert, *et al*., (1971).

Statistical analysis:

The data on the growth characteristics were subjected to statistical analysis of variance and the means were compared using the "Least Significant Difference (L.S.D)" test at the 5% level, as described by Snedecor and Cochran, (1981).

RESULTS AND DISCUSSION

A-The effect of tryptophan, foliar fertilizer and their combination treatments on vegetative growth:

1- plant height (cm)

The data illustrated in Table (1), showed that all the different concentrations of amino acid "tryptophan" as pre-soaking had significant effect on plant height of *Gladiolus gandavensis cv.Rosesupreme* as compared with the control treatment in both seasons. Whereas the concentration level of tryptophan 200 ppm gave the highest significant increases of plant height, compared with the other treatments. with the mean of 131.10 and 130.63 cm in the first and second seasons ,respectively. These results might be due to the effect of tryptophan on inducing indole -3- acetic acid formation which induces cell divisons, combial division (Thimann,1972), increases cell wall deposition and maintains the cell wall in a chemical and /or physical state to allow continued cell elongation, consequently the plant height would be increased. Besides, tryptophan affects on gene expression for the production of specific macromolecules required for permanent cell elongation. These results are in agreement with those of Shoala(2000) on *Lavendula multifida* plants and Wahba *et al.,* (2002) on *Antholyza aethiopica,* bulbs.

Foliar fertilizer treatments significantly increased plant height, it increased with increasing fertilizer rate for both growing seasons. the highest increase was recorded with 1.0% fertilizer rate with the means of 124.70 and 125.42 cm in the first and second seasons, respectively. These results may be attributed to the influence of N at specific concentration on the growth of plant which led to new cells formation, consequently, increased plant height. Similar results were obtained by Amarjeet and Godaro (1995) who mentioned that, increasing rates of N,P and K increased plant height of *Polianthus tuberose*.

Concerning the interaction between amino acid "tryptophan" in combination with fertilizer treatment, highly significant differences were observed. The highest value of plant height was observed with tryptophane at200 ppm and 1.0% fertilizer rate in the first and second seasons. These treatment increased plant height 147.64 and 147.96 cm against to 74.18 and 75.94 cm resulted from the control treatment in the first and second seasons, respectively. While the followed values were obtained by 200 ppm tryptophan and 0.50% foliar fertilizer. It increased the values to 145.36 and 143.89 cm in the two growing seasons, respectively. There is no significant effect between treatment 200 ppm tryptophan with 0.50 and 1.0% fertilizer rate.

2- Leaf length and width (cm):

The results in Table(1) showed that, the tryptophan treatments gave significant effects on Leaf length and width compared with the control treatment. Whereas tryptophan 200 ppm for the two seasons gave the highest value of Leaf length and width. The relative increases in Leaf length and width were 36.17%, 34.60% and 81.91%, 82.01% in the first and second seasons, respectively. These results might be due to that pre-soaking the corms in the amino acid "tryptophan" at suitable concentration led to absorb them within epidermal surface of corms and led to activating the growth, thus enhanced the biosynthesis. Also, tryptophan provides plant cell with an immediately available source of nitrogen, which generally can be taken by the cells more rapidly than inorganic nitrogen (Thorn *et al.,* 1981), consequently the Leaf length and width/plant could be increased This data coincided with Taha (2005) on *Polianthus tuberosa*.

Fertilizer treatments were very effective on increasing leaf length and width/plant. Using 0.50 % or 1.0% foliar fertilizer rates significantly increased Leaf length and width/plant compared to control, Meanwhile, spraying the highest concentration 1.0% of foliar fertilizer recorded the maximum values in this respect as they reached the leaf length to 45.52 and 45.78 cm and width to 3.23 and 3.25 cm in both seasons, respectively. This result could be attributed to the efficiency of available nitrogen of the high rate of fertilization which is balanced with other nutrients and affected leaf length and width. Similar results are observed by Pal and Biswas (2005) with *Polianthes tuberosa*.

For the interaction between amino acid “tryptophan” and fertilizer rates the highest value of Leaf length and width/plant were observed with 200 ppm tryptophan and combined with 1.0 % fertilizer rate, whereas this treatment gave leaf length of 48.92 and 49.28 cm, in the first and second season, respectively. Also, this treatment gave highest values for leaf width 3.81and 3.84 cm, for the growing seasons.

3- Total leaf fresh and dry weights / spike (g):

Data presented in Table (2) reveal significant increase in total leaf fresh and dry weights as a result of amino acid "tryptophan" traetment, it was found that pre-soaking corms either the concentration of 100 or 200 ppm tryptophan resulted in the greatest total leaf fresh and dry weights compared with the control in both seasons. However, the highest concentration of 200 ppm tryptophan was more effective than 100 ppm tryptophan. The suitable concentrations of tryptophan led to increase the activity of growing regions of the plant by increasing the leaves development and the size of photosynthesizing surface, thus total leaf fresh and dry weights could be increased. These results are in accordance with those obtained by Hassan (1997) on *Narcissus tazetta*, Gomaa (2003) on *Crinum asiaticum* bulbs and Taha (2005) on *Polianthus tuberosa*.

The results indicated that, all fertilizer treatments, significantly increased total leaf fresh and dry weights compared to control. These results may be related to the accumulation of dry matter in the leaves and their relation with plant height, leaf area and the rate of NPK in the foliar fertilizer used. These results are in parallel line with those Mahgoub *et al.,* (2006) on iris bulbs.

The interaction between amino acid "tryptophan" concentrations and foliar fertilizer treatment significantly affected total leaf fresh and dry weights .whereas the highest weights was obtained by using tryptophan at 200 ppm cmbined with 1.0% foliar fertilizer as compared with the other treatment in the two growing seasons . Such treatment increased leaf fresh

Table 1. Effect of tryptophan, foliar fertilizer and their interaction on plant height (cm), leaf length (cm) and leaf width (cm) of *Gladiolus gandavensis cv.Rosesupreme.* during the two seasons of 2008/09 and 2009/10

Plant height (cm)

Tryptophan ppm (B)	First season: Foliar fertilizer%(A) 0.00	0.25	0.50	1.00	Mean	Tryptophan ppm (B)	Second season: Foliar fertilizer%(A) 0.00	0.25	0.50	1.00	Mean
0.00	74.18	81.93	94.86	104.65	88.90	**0.00**	75.94	83.95	94.99	103.86	89.68
50	82.76	93.87	107.39	111.23	98.81	**50**	85.03	94.87	107.38	112.65	99.98
100	97.75	103.67	129.84	135.29	116.68	**100**	96.86	105.53	131.14	137.20	117.63
200	102.84	128.57	145.36	147.64	131.10	**200**	104.37	126.31	143.89	147.96	130.63
Mean	89.38	102.01	119.86	124.70		**Mean**	90.55	102.66	119.35	125.42	
L.S.D$_{(0.05)}$	**(A) = 4.77**	**(B) =2.59**	**(A× B)=6.11**			**L.S.D$_{(0.05)}$**	**(A) = 4.25**	**(B) =2.18**	**(A× B)=5.29**		

Leaf length (cm)

Tryptophan ppm (B)	First season: Foliar fertilizer%(A) 0.00	0.25	0.50	1.00	Mean	Tryptophan ppm (B)	Second season: Foliar fertilizer%(A) 0.00	0.25	0.50	1.00	Mean
0.00	34.28	36.73	39.17	41.92	38.02	**0.00**	34.91	36.79	40.53	42.12	38.59
50	39.11	42.27	43.71	44.10	42.30	**50**	39.70	41.81	43.52	44.25	42.32
100	42.90	44.14	46.96	47.13	45.28	**100**	43.10	44.32	47.03	47.46	45.48
200	43.98	46.29	47.52	48.92	46.68	**200**	44.17	46.36	48.15	49.28	46.99
Mean	40.07	42.36	44.34	45.52		**Mean**	40.47	42.32	44.80	45.78	
L.S.D$_{(0.05)}$	**(A) = 1.77**	**(B) = 1.18**	**(A× B)=2.95**			**L.S.D$_{(0.05)}$**	**(A) = 1.48**	**(B) =1.27**	**(A× B)= 2.87**		

Leaf width (cm)

Ta	First season: Foliar fertilizer%(A) 0.00	0.25	0.50	1.00	Mean	Tryptophan ppm (B)	Second season: Foliar fertilizer%(A) 0.00	0.25	0.50	1.00	Mean
0.0	1.88	2.28	2.49	2.63	2.32	**0.0**	1.89	2.30	2.52	2.64	2.38
50	2.30	2.39	2.87	2.96	2.63	**100**	2.32	2.39	2.89	2.99	2.65
100	2. 51	3.15	3.47	3.51	3.16	**100**	2.51	3.18	3.50	3.54	3.18
200	2.67	3.41	3.79	3.81	3.42	**200**	2.69	3.44	3.80	3.84	3.44
Mean	2.34	2.81	3.16	3.23		**Mean**	2.35	2.82	3.18	3.25	
L.S.D$_{(0.05)}$	**(A) = 0.22**	**(B) =0.15**	**(A× B)=0.37**			**L.S.D$_{(0.05)}$**	**(A) =0.17**	**(B) =0.13**	**(A× B)= 0.30**		

Table 2. Effect of tryptophan, foliar fertilizer and their interaction on total leaf fresh weights/ spike (g) and total leaf dry weights / spike of *Gladiolus gandavensis cv.Rosesupreme.* during the two seasons of 2008/09 and 2009/10

Total leaf fresh weights / spike (g)

First season						Second season					
Tryptophan ppm (B)	**Foliar fertilizer%(A) 0.00**	**0.25**	**0.50**	**1.00**	**Mean**	**Tryptophan ppm (B)**	**Foliar fertilizer%(A) 0.00**	**0.25**	**0.50**	**1.00**	**Mean**
0.00	26.38	32.39	36.90	39.29	33.74	**0.00**	26.58	33.36	36.83	39.75	34.13
50	33.78	39.26	40.10	42.52	38.91	**50**	34.17	39.71	40.55	43.29	39.43
100	36.92	42.66	48.37	48.00	45.98	**100**	37.02	42.78	49.26	48.98	44.51
200	39.59	45.13	50.32	51.88	46.73	**200**	39.92	45.98	50.17	52.40	47.11
Mean	34.16	39.86	43.92	45.42		**Mean**	34.42	40.46	44.38	46.10	
L.S.D$_{(0.05)}$	**(A) = 1.32**	**(B) =0.96**	**(A× B)=2.23**			**L.S.D$_{(0.05)}$**	**(A) = 1.25**	**(B) = 0.91**	**(A× B)=2.20**		

Total leaf dry weights / spike (g)

First season						Second season					
Tryptophan ppm (B)	**Foliar fertilizer%(A) 0.00**	**0.25**	**0.50**	**1.00**	**Mean**	**Tryptophan ppm (B)**	**Foliar fertilizer%(A) 0.00**	**0.25**	**0.50**	**1.00**	**Mean**
0.00	3.02	3.56	3.91	3.98	3.62	**0.00**	3.08	3.55	3.92	4.00	3.64
50	3.60	3.93	4.22	4.39	4.03	**50**	3.61	3.95	4.20	4.38	4.03
100	3.98	4.39	4.68	4.63	4.42	**100**	3.99	4.41	4.70	4.65	4.44
200	4.03	4.66	4.70	4.79	4.54	**200**	4.04	4.68	4.73	4.81	4.57
Mean	3.66	4.13	4.38	4.45		**Mean**	3.68	4.15	4. 39	4.46	
L.S.D$_{(0.05)}$	**(A) = 0.22**	**(B) =0.15**	**(A× B)=0.36**			**L.S.D$_{(0.05)}$**	**(A) =0.17**	**(B) =0.13**	**(A× B)=0.30**		

L.S.D $_{(0.05)}$ = Least significant differences at 0.05 level of probability.

weight to 51.88 and 52.40 g and increased total leaf dry weight to 4.79 and4.81 g in the first and second seasons, respectively.

B-The effect of amino acid “tryptophan”, foliar fertilizer and their combination treatments on Flowering characteristics:

1-Number of days to flowering:

Data of the experimintal seasons in Table (3) indicated that soaking the corms of *Gladiolus gandavensis cv.Rosesupreme* before planting in amino acid “tryptophan” at 200 ppm during the two seasons gave the shortest period for flowering, compared with the other treatments. This result was due to that using tryptophan at suitable concentration had a positive effect on the syntheses of IAA and other vital organic materials such as RAN and DNA (Goss,1973), leading to stimulation florets to initiate and develop early. These results are in agreement with those reported with Safaa and Khalil (1992) on *Antrrhinum majus,Delphinum grandiflorum,Mathiola incana* and *Callistiphus chinensis.*

Fertilizer rates had a great effect on number of days to flowering. The earliest flowering was observed with those plants which received 1.0% fertilizer rate, (Table 3). The results may be related to the enhancing effect of high rate of fertilizer application on vegetative growth and produced enough hormones to initiate flower buds earlier than unfertilizerd plants and those which were treated with low level of fertilizer application. These results agree with those of El- Naggar (2005) on gladiolus.

As shown in Table (3) it is clear that flowering times were significantly decreased with application of amino acid “tryptophan” in combination with mineral NPK. The earliest reduction in the period from planting until appearance of color, was obtained by using 200 ppm combined with 1.0% mineral fertilizer, as compared with the control in the first and second seasons, respectively.

2- Number of florets / spike:

Data presented in Table (3) showed a significant effect of amino acid “tryptophan” treatments on the number of florets/spike of *Gladiolus gandavensis cv.Rosesupreme*. Generally, the highest number of florets / spike were obtained by using tryptophan at 200 ppm in the two seasons(16.02 and 16.07) respectively. These result may be due to that pre-soaking the corms in the suitable concentration of tryptophan, led to absorp them wthin the corms and led to activated the growth and enhanced the biosynthesis, consequently leading to stimulate the thus initiation and development of more florets per spike. The results agree with those obtained by Shoala (2000) on *Lavendula multifida*.

Table 3. Effect of tryptophan, foliar fertilizer and their interaction on number of days to flowering, number of florets / spike , inflorescences (flowers) duration (day) and spike dry weight (g) of *Gladiolus gandavensis cv.Rosesupreme.* during the two seasons of 2008/09 and 2009/10

Number of days to flowering

First season						Second season					
Tryptophan ppm (B)	Foliar fertilizer%(A)				Mean	Tryptophan ppm (B)	Foliar fertilizer%(A)				Mean
	0.00	0.25	0.50	1.00			0.00	0.25	0.50	1.00	
0.0	95.63	91.35	84.15	84.93	89.01	**0.0**	95.24	91.15	83.00	84.28	88.42
50	88.32	85.25	79.00	81.19	83.44	**100**	88.18	86.07	77.92	82.00	83.54
100	80.72	77.37	73.78	73.96	76.46	**100**	81.27	77.16	73.24	74.19	76.46
200	76.38	73.78	71.20	72.05	73.35	**200**	77.01	73.55	70.83	72.43	73.45
Mean	85.26	81.94	77.03	78.03		**Mean**	85.42	81.98	76.25	78.22	
L.S.D$_{(0.05)}$	**(A) =1.22**	**(B)= 0.91**	**(A× B)= 2.29**			**L.S.D$_{(0.05)}$**	**(A) =1.24**	**(B) =0.88**	**(A× B)= 2.22**		

Number of florets / spike

First season						Second season					
Tryptophan ppm (B)	Foliar fertilizer%(A)				Mean	Tryptophan ppm (B)	Foliar fertilizer%(A)				Mean
	0.00	0.25	0.50	1.00			0.00	0.25	0.50	1.00	
0.00	7.12	8.27	10.96	12.18	9.63	**0.00**	7.23	8.36	11.03	11.96	9.64
50	9.67	12.78	15.28	15.11	13.21	**50**	9.71	12.82	15.76	15.23	13.38
100	11.06	14.69	16.30	15.58	14.41	**100**	11.13	15.32	16.76	16.00	14.80
200	13.86	15.76	17.57	16.89	16.02	**200**	13.92	15.90	17.54	16.91	16.07
Mean	10.43	12.87	15.02	14.94		**Mean**	10.50	13.10	15.27	15.02	
L.S.D$_{(0.05)}$	**(A) = 0.77**	**(B) =0.61**	**(A× B)=1.47**			**L.S.D$_{(0.05)}$**	**(A) =0.72**	**(B) =0.57**	**(A× B)=1.39**		

Inflorescences duration (day)

First season						Second season					
Tryptophan ppm (B)	Foliar fertilizer%(A)				Mean	Tryptophan ppm (B)	Foliar fertilizer%(A)				Mean
	0.00	0.25	0.50	1.00			0.00	0.25	0.50	1.00	
0.00	8.67	9.15	10.51	11.21	9.88	**0.00**	8.69	9.15	10.57	11.23	9.91
50	9.44	10.43	12.50	12.10	11.11	**50**	9.46	10.46	12.51	12.23	11.16
100	11.61	13.00	14.79	14.22	13.40	**100**	11.65	13.06	14.83	14.16	13.43
200	11.99	14.63	16.21	15.54	14.59	**200**	12.08	14.68	16.44	15.59	14.70
Mean	10.43	11.80	13.50	13.27		**Mean**	10.47	11.84	13.59	13.30	
L.S.D$_{(0.05)}$	**(A) =0.98**	**(B) =0.72**	**(A× B)=1.72**			**L.S.D$_{(0.05)}$**	**(A) =0.89**	**(B) = 0.68**	**(A× B)= 1.62**		

Spike dry weight (g)

First season						Second season					
Tryptophan ppm (B)	Foliar fertilizer%(A)				Mean	Tryptophan ppm (B)	Foliar fertilizer%(A)				Mean
	0.00	0.25	0.50	1.00			0.00	0.25	0.50	1.00	
0.00	2.97	3.28	3.81	3.87	3.48	**0.00**	2.97	3.28	3.84	3.89	3.55
50	3.42	3.68	4.12	4.09	3.83	**50**	3.43	3.67	4.14	4.10	3.83
100	3.87	4.19	4.39	4.22	4.17	**100**	3.90	4.20	4.42	4.23	4.19
200	4.09	4.31	4.55	4.37	4.33	**200**	4.11	4.32	4.59	4.39	4.35
Mean	3.59	3.86	4.22	4.14		**Mean**	3.60	3.87	4.25	4.15	
L.S.D$_{(0.05)}$	**(A) =0.22**	**(B) =0.11**	**(A× B)=0.31**			**L.S.D$_{(0.05)}$**	**(A) = 0.19**	**(B) =0.10**	**(A× B)= 0.25**		

L.S.D $_{(0.05)}$ = Least significant differences at 0.05 level of probability.

Data in Table (3) reveal a gradual increase in the number of florets / spike with increasing the fertilizer rate in both seasons. This result may be related to the increase of the available nutrients which led to increase in number of florets / spike . This result agrees with that obtained by Parthiban and Khader (1991) on *Polianthus tuberosa*.

The interaction between amino acid "tryptophan" and fertilizer rates show significant differences in the number of florets/spike. The highest values were recorded with 200 ppm tryptophan with high rate of foliar fertilizer in the two growing seasons. The values reached to 16.89 and 16.91 against to 7.12 and 7.23 florets/ spike resulted from untreated plants (control) in the first and second seasons, respectively.

3-Inflorescences duration (day) and Spike dry weight (g) :

The data reported in Table (3) clearly show a pronounced improvement in the inflorescences duration (keeping quality) and spike dry weight as a result of pre-soaking the corms with amino acid "tryptophan" compared to the control. The treatment of 200 ppm gave the maximum inflorescences duration (14.95 and 14.70 day) and heaviest spike dry weight (4.33 and 4.35g) in the first and second seasons, respectively. These results may be due to the effect of amino acid "tryptophan" at specific concentration on encouragement the vegetative growth of gladiolus plant , consequently the flowering quality increased. Similar trend was cleared by Hend *et al*., (2002) on *Antholyza aethiopica*

Significant increments in inflorescence durations and spike dry weight due to all fertilizer rates were recorded compared to the control as indicated in Table (4). With the increase in fertilizer rates an increase in the efficiency of available nutrients and photosynthetic products may occurred which affect inflorescence durations and dry weight of spike. These results are in accordance with those of El- Naggar (1999) on gladiolus.

Concerning the interaction between amino acid "tryptophan" and fertilizer rates, the highest value of inflorescence durations and spike dry weight was obtained by 200 ppm tryptophan in combination with 1.0% fertilizer rate compared with the other treatments throught the two growing seasons.

C- effect of amino acid "tryptophan", foliar fertilizer and their combination treatments new corms and cormels production:

Data in Table (4 and 5) show significant increases in new corms and cormels production as a result of treating to amino acid "tryptophan" compared to the control plants. The highest values were obtained by the application of amino acid "tryptophan" at 200 ppm for corms and cormels characteristics, such as corms diameter (cm), fresh and dry weight of corms (g), number of cormels/plant and fresh weight of cormels/plant (g) (3.59 cm, 9.06 g, 2,42 g, 17.04 and 20.21 g, respectively in the first season, and 3.57 cm, 9.11 g, 2.43 g, 17.11 and 20.12 g, respectively, in the second season. These results may be due to the role of tryptophan which had a positive effect on phothsynthetic and respiration rates and leaf carbohydrates and this reflect on the nutrient uptake and transport, consequently produced good vegetative growth which could be storage large amount of foods in the corms ,thus the new corms and cormels parameters could be increased. These results are in accordance with those of Hend *et al*.,(2002) on *Antholyza aethiopica*. They found that the application of amino acid "tryptophan" increased the yield of corms compared to the untreated plants.

Regarding the fertilizing rates, gave significantly increased of corms and cormels characteristics compared to the control. The high concentration of foliar fertilizer (1.0%) fertilizer gave the highest values of corms diameter, fresh and dry weight of corms and the number of cormels/plant compared to the other treatments for both seasons. This result could be attributed to the efficiency of available potassium of the high rate of foliar fertilization which is balanced with other nutrients and affected corms diameter, fresh and dry weight of corms and the number of cormels/plant.

The interaction between tryptophan concentrations and foliar fertilizer rates show significant differences in corms and cormels parameters. The highest values were recorded with 100 and 200ppm tryptophan concentrations combined with foliar fertilizer at 1.0% However, the control treatment gave the lowest values of corms diameter, fresh and dry weight of corms and the number of cormels/plant in both seasons.

D- Effect of amino acid "tryptophan", foliar fertilizer and their combination treatments on chemical constituents of leaves:

1-Total chlorophyll (mg/100 L. F.W.):

Chemical analysis of fresh leaf samples has revealed that the total chlorophyll (a+b) content in mg/100 g L. F.W. was considerably affected by the addition of amino acid "tryptophan" (Table 6) in both seasons. The untreated control plants had lower mean chlorophyll contents than plants receiving any concentrations of amino acid "tryptophan".The highest significant increases in the total chlorophyll contents were obtained from plants treated with amino acid "tryptophan" at either 100 or 200 ppm as compared with the control.

Concerning foliar fertilizer treatments, a gradual increase was observed in total chlorophylls(a+b) content with increasing foliar fertilizer concentration from low (0.25%) to high (1.0%) concentrations compared to the control. These results may be due to the role of nitrogen, phosphorus and potassium in synthesis of phospholipids of membranes, sugar phosphates various nucleotides and co-enzymes.This in turn increased the total chlorophyll (a+b) contents.This could be also attributed to the physiological role of N,P and K in enhancing the plastid pigments content (total chlorophyll).

Table 4. Effect of tryptophan, foliar fertilizer and their interaction on corms diameter (cm) ,fresh and dry weight of corms (g) of *Gladiolus gandavensis cv.Rosesupreme.* during the two seasons of 2008/09 and 2009/10

Corms diameter (cm)

Tryptophan ppm (B)	First season: Foliar fertilizer%(A) 0.00	0.25	0.50	1.00	Mean	Tryptophan ppm (B)	Second season: Foliar fertilizer%(A) 0.00	0.25	0.50	1.00	Mean
0.00	2.46	2.72	3.13	3.39	2.92	**0.00**	2.49	2.79	3.10	3.41	2.95
50	2.84	3.15	3.55	3.86	3.35	**50**	2.82	3.17	3.57	3.88	3.36
100	2.98	3.36	3.90	4.22	3.63	**100**	2.97	3.37	3.93	4.29	3.64
200	3.11	3.24	3.80	4.28	3.59	**200**	3.09	3.22	3.78	4.20	3.57
Mean	2.85	3.12	3.59	3.94		**Mean**	2.84	3.14	3.59	3.94	
L.S.D$_{(0.05)}$	**(A) = 0.24**	**(B) = 0.11**	**(A× B)= 0.33**			**L.S.D$_{(0.05)}$**	**(A) =0.12**	**(B) =0.10**	**(A× B)= 0.27**		

Fresh weight of corms (g)

Tryptophan ppm (B)	First season: Foliar fertilizer%(A) 0.00	0.25	0.50	1.00	Mean	Tryptophan ppm (B)	Second season: Foliar fertilizer%(A) 0.00	0.25	0.50	1.00	Mean
0.00	6.46	6.89	7.76	7.93	7.26	**0.00**	6.50	6.88	7.80	7.94	7.28
50	6.97	7.52	8.11	8.71	7.83	**50**	6.82	7.54	8.08	8.73	7.79
100	7.25	8.25	9.14	9.52	8.58	**100**	7.29	8.33	9.17	9.56	8.62
200	8.13	8.90	9.49	9.74	9.06	**200**	8.16	8.97	9.51	9.79	9.11
Mean	7.20	7.89	8.62	8.97		**Mean**	7.19	7.93	8.64	9.00	
L.S.D$_{(0.05)}$	**(A) = 0.37**	**(B) =0.25**	**(A× B)=0.46**			**L.S.D$_{(0.05)}$**	**(A) = 0.37**	**(B) =0.23**	**(A× B)=0.44**		

Dry weight of corms (g)

Tryptophan ppm (B)	First season: Foliar fertilizer%(A) 0.00	0.25	0.50	1.00	Mean	Tryptophan ppm (B)	Second season: Foliar fertilizer%(A) 0.00	0.25	0.50	1.00	Mean
0.00	1.37	1.64	1.98	2.15	1.78	**0.00**	1.36	1.68	1.96	2.17	1.79
50	1.69	1.86	2.28	2.43	2.06	**50**	1.71	1.88	2.27	2.44	2.07
100	2.07	2.19	2.75	2.68	2.42	**100**	2.09	2.21	2.76	2.68	2.43
200	2.11	2.21	2.72	2.64	2.42	**200**	2.12	2.22	2.73	2.65	2.43
Mean	1.81	1.97	2.43	2.47		**Mean**	1.82	1.98	2.43	2.48	
L.S.D$_{(0.05)}$	**(A) =0.20**	**(B) = 0.13**	**(A× B)=0.32**			**L.S.D$_{(0.05)}$**	**(A) = 0.22**	**(B) =0.14**	**(A× B)=0.37**		

L.S.D $_{(0.05)}$ = Least significant differences at 0.05 level of probability.

Table 5. Effect of tryptophan, foliar fertilizer and their interaction on number of cormels/plant and fresh weight of cormels/plant (g) of *Gladiolus gandavensis cv.Rosesupreme.* during the two seasons of 2008/09 and 2009/10

Number of cormels/plant

Tryptophan ppm (B)	First season: Foliar fertilizer%(A) 0.00	0.25	0.50	1.00	Mean	Tryptophan ppm(B)	Second season: Foliar fertilizer%(A) 0.00	0.25	0.50	1.00	Mean
0.00	8.34	9.72	12.89	14.21	11.29	**0.00**	8.90	9.89	12.87	14.29	11.49
50	9.19	10.23	14.67	15.66	12.44	**50**	9.45	10.50	14.74	15.58	12.57
100	12.17	15.45	17.69	19.03	16.08	**100**	12.34	15.76	17.71	19.23	16.26
200	13.87	16.37	17.78	20.15	17.04	**200**	13.88	16.50	17.85	20.20	17.11
Mean	10.89	12.94	15.77	17.26		**Mean**	11.14	13.16	15.79	17.32	
L.S.D$_{(0.05)}$	**(A) = 0.45**	**(B) =0.37**	**(A× B)= 0.80**			**L.S.D$_{(0.05)}$**	**(A) =0.37**	**(B) =0.33**	**(A× B)= 0.81**		

Fresh weight of cormels / plant (g)

Tryptophan ppm(B)	First season: Foliar fertilizer%(A) 0.00	0.25	0.50	1.00	Mean	Tryptophan ppm (B)	Second season: Foliar fertilizer%(A) 0.00	0.25	0.50	1.00	Mean
0.00	12.59	13.67	15.97	16.13	14.59	**0.00**	12.69	13.73	16.07	16.20	14.67
50	13.76	14.17	15.72	17.01	15.16	**50**	13.79	14.21	15.76	17.00	15.19
100	15.28	16.92	18.23	21.87	18.07	**100**	15.33	16.98	18.52	21.91	18.18
200	16.95	18.67	21.58	23.28	20.12	**200**	17.16	18.75	21.61	23.31	20.21
Mean	14.64	15.58	17.87	19.58		**Mean**	14.74	15.92	17.99	19.60	
L.S.D$_{(0.05)}$	**(A) = 0.39**	**(B) = 0.30**	**(A× B)= 0.71**			**L.S.D$_{(0.05)}$**	**(A) =0.37**	**(B) = 0.29**	**(A× B)= 0.68**		

L.S.D $_{(0.05)}$ = Least significant differences at 0.05 level of probability.

For the interaction, amino acid “tryptophan” in combination with different concentrations of foliar fertilizer treatments resulted in the highest content of the total chlorophylls content in mg/100 g L. F.W. compared with the control treatment in both seasons. Furthermore, the highest significant increase in the total chlorophylls content were obtained from treatment of 200 ppm amino acid “tryptophan” combined with spraying of mineral fertilizer at 1.0% as compared with the control. These results may be attributed to the enhancing effect of amino acid with mineral fertilizer at suitable concentrations on the absorption of the essential elements specially nitrogen phosphorus and potassium, which are found in many metabolically active compounds, including chlorophylls and these elements are necessary for enzymes activation and formation of chloroplasts and chlorophyll. Besides, using the two factors (amino acid with mineral fertilizer) led to increase the green pigments in the plants by stimulating the production of chlorophyll in leaves. Similar trend of results was obtained by Taha (2005) on *Polianthus tuberosa*.

2-Mineral content:

Data of N, P and K content and uptake in the various concentration of amino acid “tryptophan” presoaking treatments in the two successive seasons are presented in Table (6). Generally, the present results indicated that, with increasing amino acid “tryptophan” concentrations increased the content of N, P and K in leaves. Moreover, these increases were enhanced gradually by increasing amino acid “tryptophan” concentrations up to 200 ppm. These results may be due to that amino acid “tryptophan” led to increase N, P and K content through increasing nucleic acid especially RNA. Beside it also influenced the synthesis of enzymes. These results are in agreement with those obtained by Hend *et al.*,(2002) on *Antholyza aethiopica* and Taha (2005) with *Polianthus tuberosa* plant.

Concerning the effect of foliar fertilizer application on N, P and K content, in the dry leaves, it is evident from data that the previous minerals in leaves in the two growing seasons, were increased by using foliar fertilizer, especially by adding the high level (1.0 %). These results reflect the positive relationship between the concentration of foliar fertilizer and the mineral content of the leaves. This could be attributed to the rapaid absorption of these elements by the plant surface, especially the leaves, and their translocation within the plant. Similar results were obtained by El- Naggar and Swedan (2009) on *Hippeastrum vittatum*.

In general, the interaction between amino acid “tryptophan” and foliar fertilizer treatments gave significant increased of mineral content (N, P and K) in leaves. The height significant increase was found with 200 ppm amino acid “tryptophane” combined with 1.0% foliar fertilizer. This could be due to that foliar application led to more absorpition and accumulation in leaves. In addition amino acid “tryptophan” at optimum concentration (200 ppm) in presence foliar fertilizer application at 0.50 and/or 1% significantly increased the amount of N, P and K in leaves compared with the other amino acid “tryptophan” concentrations. Similar result was obtained by Wahba et al., (2002) on *Antholyza aethiopica* and Taha (2005) on *Polianthus tuberosa* plants.

3-Total carbohydrate in dried new corms (mg/g D.W.) :

The results of the chemical analysis indicated that the total carbohydrate (mg/g D.W.) in the dried new corms of plants were significantly increased with pre-soaking of corms with amino acid “tryptophan” as compared with untreated (Table7). The highest significant increase in the total carbohydrates (mg/g D.W.) was obtained from amino acid “tryptophan” at 200 ppm (290.77 and 290.60 mg/g D.W. in the first and second seasons, respectively) as compared with the other treatments. This result was probably due to that amino acid could be involved in the main metabolic processes with energy transfer co-enzymes carbohydrates metabolic and improved photosynthetic activity, consequently the amount of the stored carbohydrate in the new corms could be increased. These results agree with those obtained by Hend et al.,(2002) on *Antholyza aethiopica* .

Regarding the foliar fertilizer treatments had significantly affected total carbohydrates content. The highest value was recorded with spraying the foliar fertilizer at 1.0%, compared to the control in both seasons. This may be due to the mode of action of foliar nutrition in enhancing the photosynthetic activity and enzymes of carbohydrates transformation. These results are similar to those obtained by Haikal (1992) with *Gladiolus grandiflorus* plants. Concerning the interaction, it was found that applying 200 ppm of amino acid“tryptophan” combined with foliar fertilizer at high concentration (1.0%) gave the highest content of carbohydrates in produced corms(319.93 and 318.97 mg/g D.W.) for both seasons. While, 200 ppm amino acid with 0.50% foliar fertilizer treatment resulted in some increase in total carbohydrates content which led to 306.12 and 307.23 mg/g D.W. in the first and second seasons, respectively. This improvement in the total carbohydrate contents as a result of amino acid “tryptophan” with foliar application could be

Table 6. Effect of tryptophan, foliar fertilizer and their interaction on total chlorophyll (mg/100 g F.W.), nitrogen%, phosphorus (%) and potassium (%)content of leaf of *Gladiolus gandavensis cv.Rosesupreme.* during the two seasons of 2008/09 and 2009/10

Total chlorophyll (mg/100 g F.W.)

First season						Second season					
Tryptophan ppm(B)	Foliar fertilizer%(A)				Mean	Tryptophan ppm(B)	Foliar fertilizer%(A)				Mean
	0.00	0.25	0.50	1.00			0.00	0.25	0.50	1.00	
0.00	167.52	188.73	210.81	237.29	201.09	**0.00**	170.85	190.65	215.98	242.67	205.04
50	194.17	218.92	241.56	272.18	231.71	**50**	197.29	219.72	240.87	275.40	233.31
100	232.46	244.94	268.28	286.73	258.10	**100**	239.06	248.90	271.21	291.36	262.63
200	253.17	269.78	288.35	316.28	281.89	**200**	260.00	274.87	292.76	325.12	288.19
Mean	211.83	230.59	252.25	287.12		**Mean**	216.80	233.53	255.20	283.68	
L.S.D$_{(0.05)}$	**(A) = 3.15**	**(B) = 2.44**	**(A× B)=5.74**			**L.S.D$_{(0.05)}$**	**(A) = 2.86**	**(B) = 2.23**	**(A× B)= 7.25**		

N%

First season						Second season					
Tryptophan ppm (B)	Foliar fertilizer%(A)				Mean	Tryptophan ppm (B)	Foliar fertilizer%(A)				Mean
	0.00	0.25	0.50	1.00			0.00	0.25	0.50	1.00	
0.00	0.61	0.86	1.39	1.69	1.14	**0.00**	0.68	0.89	1.39	1.71	1.17
50	0.82	1.53	1.85	1.97	1.54	**50**	0.83	1.54	1.87	1.99	1.56
100	1.27	1.91	2.23	2.49	1.97	**100**	1.29	1.94	2.26	2.51	2.00
200	1.46	1.93	2.31	2.54	2.06	**200**	1.44	1.96	2.33	2.56	2.07
Mean	1.04	1.56	1.94	2.17		**Mean**	1.05	1.58	1.96	2.19	
L.S.D$_{(0.05)}$	**(A) =0.17**	**(B) =0.09**	**(A× B)=0.23**			**L.S.D$_{(0.05)}$**	**(A) =0.19**	**(B) =0.07**	**(A× B)=0.20**		

P%

First season						Second season					
Tryptophan ppm(B)	Foliar fertilizer%(A)				Mean	Tryptophan ppm (B)	Foliar fertilizer%(A)				Mean
	0.00	0.25	0.50	1.00			0.00	0.25	0.50	1.00	
0.00	0.15	0.23	0.34	0.39	0.28	**0.00**	0.16	0.25	0.35	0.38	0.28
50	0.19	0.27	0.37	0.42	0.31	**50**	0.20	0.29	0.39	0.44	0.33
100	0.25	0.35	0.46	0.49	0.39	**100**	0.26	0.36	0.48	0.53	0.41
200	0.29	0.39	0.50	0.56	0.43	**200**	0.29	0.41	0.52	0.58	0.45
Mean	0.22	0.31	0.42	0.46		**Mean**	0.23	0.33	0.43	0.48	
L.S.D$_{(0.05)}$	**(A) =0.15**	**(B) =0.06**	**((A× B)=0.19**			**L.S.D$_{(0.05)}$**	**(A) = 0.14**	**(B) =0.06**	**(A× B)=0.18**		

K%

First season						Second season					
Tryptophan ppm (B)	Foliar fertilizer%(A)				Mean	Tryptophan ppm (B)	Foliar fertilizer%(A)				Mean
	0.00	0.25	0.50	1.00			0.00	0.25	0.50	1.00	
0.0	1.76	1.99	2.24	2.45	2.11	**0.0**	1.80	2.09	2.28	2.49	2.16
50	1.92	2.22	2.38	2.71	2.31	**50**	1.91	2.25	2.39	2.73	2.32
100	2.15	2.40	2.59	2.88	2.50	**100**	2.18	2.42	2.59	2.90	2.52
200	2.26	2.73	3.02	3.29	2.82	**200**	2.27	2.75	3.00	3.31	2.83
Mean	2.02	2.33	2.56	2.83		**Mean**	2.04	2.38	2.56	2.86	
L.S.D$_{(0.05)}$	**(A) = 0.24**	**(B) =0.11**	**(A× B)=0.23**			**L.S.D$_{(0.05)}$**	**(A) = 0.21**	**(B) = 0.09**	**(A× B)= 0.16**		

L.S.D $_{(0.05)}$ = Least significant differences at 0.05 level of probability.

attributed to physiological role of amino acid with mineral fertilizer in enhancing leaf production which probably had higher chlorophyll content and consequently more carbohydrates production, beside the mode of action of foliar fertilizer especially, K in the activation of enzymes of carbohydrates transformation or in the regulation of the consumption sugars and the promotion of water and Co_2 absorption, which can be led to increase the capacity of plants in building metabolites. These results agree with those reported by El- Naggar (1999) on gladiolus plants.

Table 7. Effect of tryptophan, foliar fertilizer and their interaction on total carbohydrates of new corms(mg/g D.W.) of *Gladiolus gandavensis cv.Rosesupreme.* during the two seasons of 2008/09 and 2009/10

Total carbohydrates (mg/g D.W.)											
First season						Second season					
Tryptophan ppm (B)	Foliar fertilizer%(A) 0.00	0.25	0.50	1.00	Mean	Tryptophan ppm (B)	Foliar fertilizer%(A) 0.00	0.25	0.50	1.00	Mean
0.00	222.18	231.36	250.00	263.82	241.84	**0.00**	225.17	230.98	253.18	266.01	243.83
50	229.46	257.28	274.93	282.81	261.11	**50**	223.87	257.92	275.23	283.28	260.07
100	241.18	269.39	290.28	302.53	275.84	**100**	241.55	268.97	291.11	302.82	276.11
200	261.83	274.72	306.62	319.93	290.77	**200**	261.08	275.13	307.23	318.97	290.60
Mean	238.66	258.19	280.45	292.27		**Mean**	237.92	258.25	281.69	292.77	
L.S.D$_{(0.05)}$	**(A) = 5.72**	**(B) = 3.97**	**(A× B)=8.19**			**L.S.D$_{(0.05)}$**	**(A) =5.53**	**(B) =3.26**	**(A× B)=7.54**		

L.S.D $_{(0.05)}$ = Least significant differences at 0.05 level of probability.

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الملخص العربي

الإستجابة الفسيولوجية لنباتات الجلاديولس للمعاملة بالحامض الأمينى تربتوفان والتسميد المعدنى فى الأراضى المستصلحة الجديدة

علي حسن النجار، زينب علي عبد الحافظ

أجريت تجربتان حقليتان خلال موسمي ٢٠٠٨/٢٠٠٩ و٢٠٠٩/٢٠١٠ لدراسة مدى إستجابة نبات الجلاديولس صنف" روزسبريم"لأربع تركيزات من الحمض الأميني تربتوفان (صفر ،٥٠ ،١٠٠،٢٠٠ جزء فى المليون) والرش ثلاث مرات بأربع معدلات من السماد المعدنى ١٩:١٩:١٩ (صفر، ٠,٢٥، ٠,٥٠، ١,٠ %) وأجرى عمل جميع التوافيق المحتملة بين كل من تركيزات التربتوفان والسماد المعدنى للحصول على ١٦ معاملة فى ثلاث مكررات.

وقد أوضحت النتائج اختلافا معنويا فى قياسات النمو الخضرى والزهرى وكذلك فى انتاج الكورمات والكوريمات بالمقارنة بالنباتات الغير معاملة (الكنترول) وقد تحققت أفضل النتائج عند معاملة النباتات بالحمض الأمينى تربتوفان بتركيز ٢٠٠ جزء فى المليون مع رش النباتات بالسماد المعدنى بتركيز٠,٥٠ و ١,٠% وذلك فى كلا الموسمين. وقد أشارت النتائج الى أن استخدام الحمض الأمينى تربتوفان بتركيز ٢٠٠ جزء فى المليون مع المعدل العالى من السماد المعدنى١,٠ % قد أعطى أعلى القيم فى نتائج التحليل الكيميائي(محتوى الأوراق من الكلوروفيل الكلى ومحتواها من النيتروجين والفوسفور والبوتاسيوم وكذلك محتوى الكورمات من الكربوهيدرات)