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EFFECT OF FOLIAR SPRAY WITH FOLIC ACID AND SOME AMINO ACIDS ON FLOWERING, YIELD AND QUALITY OF SWEET PEPPER

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ABSTRACT

Two field experiments were carried out at Kafer El-Wekala Sherbin, Dakahlia governorate, Egypt, during the two successive seasons of 2004 and 2005 to study the effect of foliar spray with folic acid and some amino acids *i.e.,* methionine, lysine and cysteine and their combinations on chemical composition, flowering, fruit setting, yield and quality of sweet pepper.

The main findings obtained from this investigation showed that:

- Foliar spray of pepper plants with 50 or 100 ppm of folic acid with methionine, lysine and Cysteine mixture resulted in the highest significant total protein and total sugars in leaves dry weigh.
- Foliar spray with the mixture of 50 ppm of folic acid with lysine and cysteine amino acids enhanced significantly number of flowers and decreased fruit sheding of pepper plants to 17.2%, on the other hand, there was no significant differences could be detected with flowering time with all used foliar spray treatments compared with control.
- Foliar application of folic acid at 50 ppm with methionine, lysine and cysteine amino acids mixture led to the highest significant average fruit weight.
- Foliar spray with 50 or 100 ppm of folic acid with methionine, lysine and cysteine mixture resulted in the highest significant average fruit weight, fruit diameter, fruit dry weight, fruit total soluble solids, and fruit vitamin C. On the other hand fruit length did not significantly affected by all used interaction treatments.
- The lowest nitrate content in fruit fresh weight was resulted from foliar application of 50 ppm of folic acid with methionine, lysine and cysteine mixture.

INTRODUCTION

Sweet pepper (*Capsicum annuum* L.) is considered as one of the major and most important vegetable all over the world, due to the high nutritive value, *i.e.* minerals, antioxidants and vitamins. Stress such as high temperature and drought, during long growing summer season, became a problem not only affecting pepper growth but also extended to the disturbances of all physiological and metabolic pepper plant functions, this lead to low fruits setting with a corresponding reduction in crop quality and quantity. Recently, much work has been conducted on several natural compounds that include amino acids, to be applied as a foliar feeding to increase the growth and yield of economical crops as a biostimulant. Folic acid plays a decisive role in nucleic acids biosynthesis and in the cell division (Strove, 1986). Amino acids are the fundamental ingredients for the process of protein synthesis. The importance of amino acids came from their widely use for the biosynthesis of a large variety of nonproteinic nitrogenous materials, *i.e.,* pigments, vitamins, coenzymes, purine and pyrimidine bases. Studies have proved that amino acids can directly or indirectly influence the physiological activities in plant growth and development. Milad (1998) on

American Ocimum plants reported that foliar application of tryptophan and methionine caused an increase in the contents of photosynthetic pigments.

Therefore, this study was conducted to elucidate the effect of foliar spray with folic acid and some amino acids *i.e.,* methionine, lysine and cysteine and their interactions on chemical composition, flowering, fruit setting, yield and quality of sweet pepper.

MATERIALS AND METHODS

Two field experiments were conducted during the two successive summer seasons of 2004 and 2005 at Kafer EL-Wekala, Sherbin, Dakahlia, Egypt, to study the effect of foliar spray with folic acid, some amino acids and their interactions on chemical composition, flowering, fruit setting, yield and quality of sweet pepper.

This experiment included 24 treatments, which were the combinations between 3 folic acid levels; *i.e.,* 0, 50 and 100 ppm and 8 amino acids treatments:

1- Control (tap water).
2- Methionine 25 ppm.
3- Lysine 50 ppm.
4- Cysteine 50 ppm.
5- Methionine 25 ppm + lysine 50 ppm.
6- Methionine 25 ppm + cysteine 50 ppm.
7- Lysine 50 ppm + cysteine 50 ppm.
8- Methionine 25 ppm + lysine 50 ppm + cysteine 50 pm.

The used amino acids are, L-Amino acids forms and from a cheap source (used as a poultry fodder addition). The treatments were arranged in a split plot design with three replicates, folic acid levels were randomly arranged in the main plots and amino acids treatments were randomly distributed in the sub plots. The monthly average maximum and minimum temperature during seasonal growth 2004 and 2005 summer seasons at Dakahlia area, Egypt are tabulated in Table (1), recorded by Shawa weather station.

Table 1: The monthly average maximum and minimum temperature during seasonal growth 2004 and 2005 summer seasons at Dakahlia area, Egypt.

Month	2004		2005	
	Max.	Min.	Max.	Min.
May	28.2	17.1	29.2	16.4
June	31.3	20.7	32.2	19.6
July	33.4	19.4	32.7	20.4
August	34.1	24.4	33.2	23.5
September	30.4	22.4	31.3	21.4

Sweet pepper transplants (cv. California Wander), 45 day old were transplanted in the open field 1st of March in 2004 and 2005 seasons on one side of ridges (4 m x 0.7 m) at 30 cm apart, the plot area was 9.6 m^2. Normal cultural practices were carried out as recommended for the conventional pepper planting according to instructions of Egyptian Ministry of Agriculture. Pepper plants were treated with above mentioned treatments as foliar spray

6 times at 15 day intervals during the season beginning at 45 days after transplanting using spreading agent (Super Film 1 ml/ Liter). The untreated plants (control) were sprayed with tap water using the same spreading agent.

At full bloom stage, samples of representative leaves (from the forth upper leaves) of each plot were collected to determinate total nitrogen in dried leaves by using the modified micro Kjeldahl apparatus according to A.O.A.C. (1990) and then the obtained values were multiplied by 6.25 as used by Tripathi *et al*. (1971). Total sugars in dried leaves were determined according to Michel *et al*. (1956). Five uniform plants of each sub plot were randomly chosen, labeled to determinate the following parameters; flowering time (days after transplanting), number of flowers per plant, fruit setting % and fruit sheding %. All harvested fruits from each sub plot were used to determinate early marketable yield and total marketable yield ton per feddan. Early marketable yield was determined from the first three harvestings. Average fruit weight was calculated from all harvested fruits from each sub plot during the whole season. Ten representative marketable fruits from each treatment at the middle of harvesting season were collected and used for determination of fruit length (cm), fruit diameter, fruit dry matter (%), total soluble solids (TSS %), determined in juice by Carle Zeis refracotometer, and vitamin C in Juice of fruits using 2, 6-dichlorophenol indophenols (mg/100g FW) according to the methods of A.O.A.C. (1990). Nitrate content mg/kg of fresh fruit weight was determined according to methods of Sen and Donaldson (1978).

The obtained data were subjected to the analysis of variance according to Snedecor and Cochran (1980). Mean separation was done by LSD at 0.05 level of probability.

RESULTS AND DISCUSSION

1. Chemical components, flowering characters and yield components:

1.1. Effect of folic acid:

Data in Table (2) show the effect of foliar spray of folic acid on chemical components, flowering characters and yield components of sweet pepper. The results indicate that all used foliar folic acid treatments did not enhanced significantly total protein or total sugars in leaves dry weight, flowering time, number and fruit setting as well as fruit sheding. The same data reveal that foliar spray with 100 ppm of folic acid increased early marketable yield and total marketable yield; however the increments did not reach the level of significant.

1.2. Effect of amino acids:

Data presented in table (2) reveal that foliar spray with methionine, lysine and cysteine mixture resulted in the highest significant total protein and total sugars in leaves dry weight. Similar results were found by Wahba *et al*. (2002) on aethiopica plants who reported that application of the amino acids as a foliar spray caused a significant increase in the contents of total soluble sugars in the leaves. Regarding the effect of foliar spray of amino acids on flowering characters of sweet pepper, data in table (2) indicate that there is no significant differences could be detected with flowering time with all used foliar spray of amino acids compared with control. The same data

show that using a mixture of lysine and cysteine significantly increased number of flowers per plant, the lowest value in this respect was obtained from foliar spray with methionine amino acid. It is clear from such data that fruit sheding percentage significantly decreased with foliar spray of the same mixture of lysine and cysteine compared with other treatments and control. The increase in fruit setting as a result of application of amino acids may be due to their conversion into IAA (Phillips, 1971 and Russell, 1982).

Table 2: Effect of folic acid and amino acids on chemical components, flowering characters and yield components of sweet pepper, combined analysis of 2004 and 2005 seasons.

Characters / Treatments	Total protein mg/g dry leaves weight	Total sugars mg/g dry leaves weight	Flowering time (days)	No. of flowers / plant	Fruit setting %	Fruit sheding %	Early marketable yield ton/fed	Total marketable yield ton/fed
Folic acid (ppm):								
0 ppm	22.4	33.7	57.5	54.5	44.9	22.3	1.58	11.66
50 ppm	22.9	33.6	56.3	55.8	46.7	21.0	1.61	11.84
100 ppm	22.6	36.3	56.7	55.6	47.1	20.9	1.66	11.94
LSD 5%	NS	NS	NS	NS	NS	NS	NS	NS
Amino acids								
Control (tap water)	21.5	32.0	57.9	55.6	43.9	21.8	1.56	11.20
Methionine(M)	21.8	33.0	55.7	49.4	42.6	22.4	1.56	11.22
Lysine (L)	21.7	34.2	56.7	53.9	43.6	20.5	1.63	11.52
Cystine(C)	23.6	33.4	57.0	53.6	44.7	21.8	1.56	11.77
M+ L	22.7	33.6	57.5	50.8	47.7	22.6	1.57	11.87
M+ C	22.1	34.9	57.2	57.1	47.5	22.4	1.61	12.01
L+ C	23.1	35.3	55.8	62.2	47.9	18.4	1.66	12.15
M+ L+ C	24.3	40.1	56.6	58.6	51.8	21.3	1.76	12.71
LSD 5%	2.10	4.54	NS	5.02	5.24	2.21	0.132	0.451

With respect to the effect of foliar spray of amino acids on yield components of sweet pepper data illustrated in table (2) clear that all used amino acids mixtures significantly increased average fruit weight, early marketable yield and total marketable yield per feddan. It is also evident that the most effective treatment was that of methionine, lysine and cysteine mixture. Those results were in harmony with those obtained by Sharma and Kothari (1993) who reported that foliar spray of cereal proteins hydrolysate, which contained all the amino acids increased yield of mungbean by 25% compared with the control, and in conformity with those obtained by Reda *et al*. (1999) who showed that sprayed *Hyoscyamus muticus* plants with amino acid cysteine at 100 mg gave significant increases of total yield over the control by 13.96 %, and by the results of El-Shabasi *et al*. (2003) who found that foliar spray of garlic plants with the mixture of glycine, alanine, cysteine and arginine (each at 100 ppm) scored the highest significant garlic yield over the control.

The pronounced promotional effect of amino acids on plant development and yield of sweet pepper plants may be due to the regulatory effects of certain amino acids on plant development are through their

influence on enhancing production of gibberellins in plant tissues (Waller and Nowaki, 1978). Moreover, amino acids are the starting materials for the synthesis of alkaloids and various products of secondary metabolisms (Strove, 1986). Abd El-Kader (1962) showed that methionine is essential amino acids and important in the metabolism of phospholipids. El-Nabarawy (2001) illustrated the importance and role of amino acid cysteine in synthesizing processes of chlorophyll and enzymes that are very important for growth and protein synthesis of cucumber. The role of the amino acids in stimulating growth and chemical composition was studied by several investigators on a number of plant species, Salonen (1980) on *Atropa belladomna*, Moursy *et al*., (1988), El-Bahar *et al*. (1990) on Datura, Gamal El-Din (1992) on *Hyoscyamus muticus* and Talaat and Youssef (2002) who indicated that foliar application of amino acids lysine, ornithine and tryptophan significantly promoted plant growth and chemical composition of basil plant.

1.3. Effect of interaction between folic acid and amino acids:

Data concerned with the effect of interaction between folic acid and amino acids on chemical components, flowering characters and yield components of sweet pepper are shown in Table (3).

It is clear that foliar spray with 50 or 100 ppm of folic acid with methionine, lysine and cysteine mixture resulted in the highest significant total protein and total sugars in leaves dry weight of pepper. Moreover, it is evident clear from such data that flowering time did not affected significantly by all used interaction treatments. On the other hand, foliar spray with the mixture of 50 ppm of folic acid with lysine and cysteine amino acids enhanced significantly number of flowers and decreased fruit sheding of pepper plants to 17.2%. Concerning the effect on sweet pepper yield components, it is clear from data illustrated in Table (3) that foliar application of folic acid at 50 ppm with methionine, lysine and cysteine amino acids mixture led to the highest significant early marketable yield and total marketable yield as ton per feddan followed by foliar application of folic acid at 100 ppm with methionine, lysine and cysteine amino acids mixture. The results were in agreement with those obtained by Tallarico (1983) who found that Ergostim, a biostimulant containing 5% L-cysteine and 0.1 % folic acid, increased the dry weight content of spinach leaves and reduced the total number of flowers per plant similar results were reported by Thakur *et al*. (1991) on strawberry plants.

Moreover, Somasundaram *et al*. (1995) studied the effect of foliar spray of Ergostim, he found that two aqueous sprays of Ergostim at 0.05, 0.075 and 0.1 % significantly increased total yield of mulberry plants. Meanwhile, Siviero *et al*. (2001) reported that foliar spray of 5% L–cysteine and 0.1 % folic acid resulted in fewer flowers, fewer bud losses and higher tomato yield.

The beneficial effect of folic acid and amino acids on chemical components, flowering characters and yield components of sweet pepper are expected since folic acid stimulates the synthesis and utilization of methyl groups; meanwhile, methionine is important in biological methylation which is important for metabolic reactions in plant tissue (Abd El-Kader, 1962).

Table (3): Effect of interaction between folic acid and amino acids on chemical components, flowering characters and yield components of sweet pepper, combined analysis of 2004 and 2005 seasons.

Folic acid	Amino acids	Total protein mg/ leaves dry weight	Total sugars mg/ leaves dry weight	Flowering time (days)	No. flowers / plant	Fruit setting %	Fruit sheding %	Early yield ton/fed	Total yield ton/fed
0 ppm	Control	21.7	32.45	57.7	52.1	41.2	23.4	1.46	11.12
	Methionine (M)	22.4	33.2	53.5	49.5	42.5	24.6	1.50	11.07
	Lysine (L)	21.6	35.7	58.6	54.6	41.7	21.6	1.55	11.39
	Cysteine (C)	23.2	34.7	59.3	52.6	43.1	22.0	1.47	11.47
	M+ L	23.4	32.1	57.5	50.9	46.0	23.1	1.64	12.04
	M+ C	21.4	34.1	57.4	54.5	46.7	22.4	1.59	11.98
	L+ C	22.7	31.7	57.2	59.5	47.4	19.4	1.71	11.84
	M+ L+ C	22.7	35.8	58.6	58.7	50.4	21.9	1.70	12.33
50 ppm	Control	20.8	30.4	58.6	56.3	44.2	21.2	1.59	11.21
	Methionine (M)	21.4	31.4	57.4	48.6	41.6	22.5	1.58	11.24
	Lysine (L)	22.4	30.7	56.6	55.4	43.5	20.8	1.66	11.54
	Cysteine (C)	23.8	32.7	54.7	55.6	46.6	21.8	1.54	12.01
	M+ L	22.7	33.9	57.8	52.3	48.4	21.5	1.50	11.79
	M+ C	22.4	33.1	55.9	53.4	48.1	22.4	1.55	11.94
	L+ C	23.4	35.7	55.4	64.9	47.8	17.2	1.64	12.01
	M+ L+ C	25.9	41.4	53.7	59.5	53.7	20.4	1.82	12.94
100 ppm	Control	22.1	33.1	57.3	58.4	46.4	20.7	1.63	11.28
	Methionine (M)	21.6	34.4	56.3	50.0	43.8	20.1	1.61	11.35
	Lysine (L)	21.1	36.3	54.9	51.8	45.7	19.0	1.67	11.64
	Cysteine (C)	23.7	32.7	56.9	52.7	44.5	21.7	1.68	11.84
	M+ L	21.9	34.7	57.3	49.1	48.7	23.4	1.57	11.79
	M+ C	22.4	37.4	58.3	63.4	47.8	22.3	1.69	12.11
	L+ C	23.4	38.4	54.8	62.1	48.6	18.7	1.64	12.61
	M+ L+ C	24.3	43.1	57.6	57.5	51.3	21.7	1.77	12.86
LSD 5%		2.13	4.12	NS	3.41	2.43	1.24	0.110	0.351

2. Physical and chemical characters of fruits:

2.1. Effect of Folic acid:

Data tabulated in table (4) clear the effect of folic acid and amino acids on physical and chemical fruits characters of sweet pepper, combined analysis of 2004 and 2005 seasons. It is clear that foliar treatments of folic acid under investigation did not show any significant difference in relation to average fruit weight, fruit length, fruit diameter, fruit dry weight, fruit TSS and vitamin C as well as nitrate content in fruit fresh weight.

2.2. Effect of Amino acids:

Data in Table (4) show a significant effect of amino acid foliar treatments on the physical and chemical fruits characters of sweet pepper, such data revealed that the addition of individual amino acid methionine, lysine or cysteine did not significantly influence all studied characters when compared with control. Meanwhile, all used amino acids mixtures significantly increased average fruit weight, fruit length, fruit diameter, fruit dry weight, fruit TSS and vitamin C, the highest values in this respect were resulted from foliar application of methionine, lysine and cysteine mixture.

The same data illustrated also that the lowest nitrate content in fruit fresh weight was resulted from the same treatment. The present data are in agreement with the findings of Lancaster *et al*. (1988) who reported that cysteine is useful in improving and increasing the quality characters of garlic. Similar results were found by El-Shabasi *et al*. (2003) who found that spraying garlic plants with 100 ppm of cysteine was the most effective treatment for producing better garlic bulbs quality and cloves.

Table (4): Effect of folic acid and amino acids on physical and chemical fruits characters of sweet pepper, combined analysis of 2004 and 2005 seasons.

Treatments	Average fruit weight (g)	Fruit length (cm)	Fruit diameter (cm)	Fruit DW (%)	Fruit TSS (%)	Vitamin C mg/100 g fruit fresh weight	Nitrate content mg/kg fresh weight
Folic acid (ppm):							
0 ppm	46.9	9.32	4.89	8.38	4.47	140.5	10.2
50 ppm	47.5	9.53	5.25	8.37	4.40	166.2	9.8
100 ppm	48.0	9.12	5.23	8.66	4.56	148.1	10.7
LSD 5%	NS	NS	NS	NS	NS	NS	NS
Amino acids:							
Control	45.2	8.51	5.07	7.53	4.32	119.7	12.3
Methionine(M)	43.8	8.87	4.38	7.93	4.28	145.1	11.3
Lysine (L)	46.3	9.16	4.69	8.15	4.16	146.8	11.4
Cystine(C)	44.4	9.41	5.36	8.11	4.41	144.0	9.8
M+ L	47.9	8.93	5.43	8.84	4.24	146.5	10.1
M+ C	46.6	9.57	5.29	8.58	4.41	149.3	9.7
L+ C	49.2	9.68	5.13	9.06	4.86	151.2	9.5
M+ L+ C	56.3	10.66	5.62	9.58	5.12	158.2	7.0
LSD 5%	7.95	1.64	0.31	0.87	0.42	20.4	1.05

2.3. Effect of interaction between folic acid and amino acids:

Data in table (5) showed the effect of interaction between folic acid and amino acids on physical and chemical fruits characters of sweet pepper, combined analysis of 2004 and 2005 seasons. Such data revealed that that foliar spray with 50 or 100 ppm of folic acid with methionine, lysine and cysteine mixture resulted in the highest significant fruit weight, fruit diameter, fruit dry weight, fruit TSS, and fruit vitamin C. On the other hand, fruit length did not significantly affected by all used interaction treatments.

Regarding the effect of foliar sprays of folic acid and amino acids on nitrate content mg/kg fresh fruit weight the same data showed significant effect of interaction between folic acid and amino acids in reducing nitrate content of pepper fruits, the most effective treatments in this respect was that of spraying pepper plants with 50 ppm of folic acid with methionine, lysine and cysteine mixture. Similar results were reported by Thakur *et al*. (1991) who reported that foliar spray with Ergostim; containing 5% L–cysteine and 0.1 % folic acid increased fruit length, diameter, weight and volume of strawberry. Moreover, Siviero *et al*. (2001) reported that Ergostim enhanced tomato fruit quality.

Finally, from the previous mentioned results and discussion, it could be concluded that spraying sweet pepper plants 6 times with 50 ppm of folic

acid with methionine (25 ppm), lysine (50 ppm) and cysteine (50 ppm) mixture resulted in the highest significant total protein, total sugars in leaves dry weigh, early marketable yield, total marketable yield, average fruit weight, fruit diameter, fruit dry weight, fruit total soluble solids, and fruit vitamin C as well as the lowest nitrate content in fruit fresh weight.

Table (5): Effect of interaction between folic acid and amino acids on physical and chemical fruits characters of sweet pepper, combined analysis of 2004 and 2005 seasons.

Folic acid	Amino acids	Average fruit weight (g)	Fruit length (cm)	Fruit diameter (cm)	Fruit DW (%)	Fruit TSS (%)	Vitamin C mg/100 g fruit fresh weight	Nitrate content mg/kg fresh weight
0 ppm	Control	44.4	8.11	4.14	7.34	4.44	119.3	12.3
	Methionine (M)	43.7	9.02	4.23	7.64	4.37	138.3	11.7
	Lysine (L)	47.9	9.57	4.13	8.24	4.15	140.5	10.1
	Cystine (C)	44.7	9.66	5.41	8.14	4.71	135.3	9.7
	M+ L	49.0	9.34	5.22	8.67	4.32	141.5	10.0
	M+ C	44.6	8.5 9	5.27	8.65	4.47	149.4	9.8
	L+ C	47.4	9.77	5.08	9.08	4.45	151.7	9.2
	M+ L+ C	53.7	10.52	5.61	9.31	4.86	148.3	7.8
50 ppm	Control	44.8	8.90	5.51	7.28	4.07	115.7	11.7
	Methionine (M)	44.8	9.37	4.44	7.54	4.12	146.7	11.2
	Lysine (L)	45.1	10.9	4.90	7.98	4.26	155.3	11.0
	Cystine (C)	43.7	9.67	5.37	8.09	4.15	144.4	9.1
	M+ L	49.1	8.99	5.60	8.87	4.04	148.0	10.7
	M+ C	45.7	10.8	5.32	8.45	4.20	150.1	9.1
	L+ C	48.6	9.64	5.11	8.97	5.04	149.6	9.3
	M+ L+ C	58.9	10.44	5.71	9.81	5.29	164.0	6.2
100 ppm	Control	46.4	8.51	5.55	7.97	4.44	124.1	12.8
	Methionine (M)	43.4	8.24	4.46	8.61	4.35	150.3	10.9
	Lysine (L)	45.8	8.01	5.04	8.24	4.07	144.6	12.1
	Cystine (C)	44.8	8.40	5.29	8.11	4.36	152.3	10.4
	M+ L	45.5	8.51	5.46	8.97	4.37	150.0	9.5
	M+ C	49.6	10.32	5.27	8.65	4.55	148.4	10.3
	L+ C	51.7	9.64	5.21	9.12	5.09	152.3	9.9
	M+ L+ C	56.4	11.01	5.54	9.61	5.22	162.4	7.1
LSD 5%		3.08	NS	0.187	0.521	0.21	10.01	1.01

REFERENCES

A.O.A.C. (1990). Official Method of Analysis. 10th Association of Official Analytical Chemists. Inc. USA.

Abd El-Kader, M. M. (1962). Basic biochemistry. Volume 1, Third Edition. Published, 195-200.

El-Bahar, K. M.; A. S. Ghanem and E. A. Omer, (1990). Responses of *Datura metel L.* cell cultures to some amino acids. Egypt. J. Appl. Sci., 5: 192-199.

El-Nabarawy, M. A. (2001). Mitigation of dark induced senescence 1-By some amino acids. Annals of Agric. Sc. Moshtohor, 39(1): 225-232.

El-Shabasi, M. S. S.; S. M. A. Mohamed and Sanaa, A. Mahfouz (2003). The effect of some amino acids on plant growth yield and chemical compounds of garlic plants. The 6th Arabian Conference for Horticulture, Ismailia, Egypt, 16-24.

Gamal El-Din, K. M. (1992). Growth response of *Hyoscyamus muticus* L. to temperature hardening in hardening in relation to alkaloidal pattern. Ph.D. Thesis, Fac. Agric., Ain Shams Univ.

Lancaster, J. E.; E. M. Dommisse and M.L. Shaw (1988). Production of flavour precursors (S-alk (en) yl-L-cysteine sulphoxides) in photomixotrophic callus of garlic. Phytochemistry, 27(7).2123-2124.

Michel, K. A.; J. K. Gilles; R. P. A. Ramilton and F.Smith (1956). Colorimetric method for determination of sugars and related substances. Annal Chem., 28(3): 350-356.

Milad, S. M. N. (1998). Effect of tryptophan and methionine on the productivity of two Mentha species and American Ocimum plants. M.Sc. Thesis, Fac. Agric., Cairo Univ.

Moursy, H. A.; S. M. Hussein and K. M. El-Bahar (1988). Effect of some alkaloid precursors on the growth and alkaliod production of *Datura stramonium L.* cultured in vitro. Egypt. J. Bot., 31:153-165.

Phillips, L. D. J. (1971). Introduction to the Biochemistry and Physiology of Plant Growth Hormones. Mc.Graw-Hill Book Co.

Reda, F.; M. R. Shedeed; A. El-Moursi; K. M. El-Gamassy and K. M. G. El-Din (1999). Effect of some amino acids on growth and alkaloidal pattern of *Hyoscyamus muticus* L. Arab-Universities-Journal-of-Agricultural Sciences, 7(2):631-647.

Russell, R. S. (1982). Plant Root Systems, 1st Ed. ELBS, UK. pp: 17-18.

Salonen, M. L. (1980). Glutamate and aspartate derived amino acids as nitrogen sources for the callus of Atropa belladomna L. Annals, Botan. Fenn. 17: 357-378.

Sen, N. P. and B. Donaldson (1978). Improved colorimetric methods for determining nitrate and nitrate in food.J.Assoc. Of Anal.Chem. 61(6): 1389-1395.

Sharma, R. K. and R. M. Kothari (1993). Recycled cereal proteins as foliar spray enhances quality and production of food crops. Resources, Conservation and Recycling, 9 (3): 213-221.

Siviero, P.; C. Zoni and B. Frullanti (2001). Efficiency of an antidrying growth regulator on industrial tomatoes. Informatore Agrario, 2001, 57(14): 73-75.

Snedecor, G. W. and W. G. Cochran (1980). Statistical Methods, 7th ed. Iowa State Univ. Press, Iowa, U.S.A.

Somasundaram, P.; R. Gururaj, D. S. Chandrashekar and A. K. Sikdar. (1995). Effect of foliar spray of Ergostim on growth and leaf production of mulberry. Madras Agricultural - Journal, 82(9-10): 508-509.

Strove, E. A. (1986). Biochemistry. MIR Publishers, Moscow, 281.

Talaat, I. M. and A. A. Youssef (2002). The role of the amino acids lysine and ornithine in growth and chemical constituents of basil plants. Egypt. J. Appl. Sci., 17: 83-95.

Tallarico, R. (1983); Evaluations of the yield response of spinach to treatment with plant growth regulators and biostimulants. Notiziario di Ortoflorofrutticoltura, 9 (3): 130-135.

Thakur, A. S.; Jindal, K. K.; and A. Sud (1991). Effect of growth substances on vegetative growth, yield and quality parameters in strawberry. Indian Journal of Horticulture, 48 (4): 286-290.

Tripathi, R. D.; G. P. Srivastava; M. S. Misra and S. C. Panda (1971). Protein in some varieties of legumes. The Allah Abad Farmer, 16: 291 – 294.

Wahba, H., S. M. Mohamed, G. E. Attoa and A. A. Farahat (2002). Response of *Antholyza aethiopica* to foliar spray with some amino acids and mineral nutrition with sulphur. Annals Agric. Sci. Ain Shams Univ., 47: 929-944.

Waller, G. R. and E. K. Nowaki (1978). Alkaliod, Biology and Metabolism in Plants. Plenum Press, New York, 85-247.

تـأثير الـرش الـورقي بحمـض الفوليـك و بعـض الأحمـاض الأمينيـه علـي الإزهـار و المحصول و الجودة لنباتات الفلفل.

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أجريت تجربتان حقليتان في العروة الصيفية خلال الموسمين المتعاقبينِ ٢٠٠٤ و ٢٠٠٥ في منطقةِ شربين, محافظة الدقهلية و ذلك لدراسة تأثير الرش الورقي بحمض الفوليك و بعض الأحماض الأمينيه و التفاعل بينهم علي التركيبِ الكيميائيِ و الإزهار و المحصول و كذلك جوده ثمار الفلفل صنف كاليفورنيا وندر.

وكانت أهم النتائج ما يلي :

- أدّى الرش الورقي لنباتات الفلفل بحمض الفوليك بتركيز ٥٠ أو١٠٠ جزئ بالمليون مع مخلوط الأحماض الأمينيه المثيونين و الليسين و السيستين إلي زيادة البروتينِ الكليّ والسكّرياتِ الكليّةِ في الأوراقِ الجافة.
- أدّى الرش الورقي لنباتات الفلفل بحمض الفوليك بتركيز٥٠ جزئ بالمليون مع مخلوط الأحماض الأمينيه الليسين و السيستين إلي زيادة عدد الأزهار و خفض نسبه تساقط ثمار الفلفل بينما لم يكن للرش بأي من المعاملات تحت الدراسة تأثير علي وقت الإزهار.
- أدّى الرش الورقي لنباتات الفلفل بحمض الفوليك بتركيز٥٠ جزئ بالمليون مع مخلوط الأحماض الأمينيه المثيونين و الليسين و السيستين إلي أفضل محصول تسويقي مبكر وكذلك محصول تسويقي كلي للفدان.
- أدّى الرش الورقي لنباتات الفلفل بحمض الفوليك بتركيز٥٠ أو ١٠٠ جزئ بالمليون مع مخلوط الأحماض الأمينيه المثيونين و الليسين و السيستين إلي الحصول علي أفضل وزن و قطر للثمرة و أفضل وزن جاف و كذلك المواد الصلبة الذائبة و فيتامين ج.
- أدّى الرش الورقي لنباتات الفلفل بحمض الفوليك بتركيز٥٠ جزئ بالمليون مع مخلوط الأحماض الأمينيه المثيونين و الليسين و السيستين إلي الحصول علي اقل محتوي للثمار من النترات.

و علي ذلك توصي الدراسة برش نباتات الفلفل بالعروة الصيفية بحمض الفوليك بتركيز٥٠ جزئ بالمليون مع مخلوط الأحماض الأمينيه المثيونين (٢٥ جزء بالمليون) و الليسين (٥٠ جزء بالمليون) و السيستين (٥٠ جزء بالمليون) و ذلك للحصول علي أفضل نتائج فيما يخص التركيب الكيماوي و الإزهار والعقد و المحصول و كذلك الجودة للثمار.