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EFFECTS OF N-FERTILIZER SOURCE, BIOFERTILIZER AND FOLIAR SPRAY WITH DELFAN (AMINO ACIDS) OR GARLIC EXTRACT ON GROWTH, YIELD AND FRUIT QUALITY OF SWEET PEPPER PLANTS.

BY

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ABSTRACT

Field experiments were carried out on sweet pepper, *Capsicum annuum L., cv.* California Wonder, at the Experimental Farm of the Faculty of Agriculture, Moshtohor, Egypt, during the summer seasons of 2004 and 2005. Transplanting took place on 24 th March in both seasons. Studies aimed to investigate the effect of organic manure and/or mineral N-fertilizer with or without biofertilizer inoculation on growth, yield and quality of plants. The treatments used were 60 kg/feddan organic-N as biogas manure, 60 kg/feddan mineral-N as ammonium sulfate (20.5% N) or 30 kg organic-N + 30 kg mineral-N with or without Microbin as biofertilizer and foliar application with Delfan as amino acids, garlic extract or without foliar application.

Results show that using 30 kg organic-N + 30 kg mineral-N, improved plant growth, yield and fruit quality than those received nitrogen doses (60kg N/fed.) either in the organic or in the mineral form. Inoculating seeds and transplant's roots with Microbin gave good results than when no biofertilizer was added. Also, the treatments sprayed with Delfan (amino acids) gave good results as compared with garlic extract or without foliar application. Therefore, using 30 kg organic-N + 30 kg mineral-N/feddan combined with Microbin and spray with Delfan gave the best growth and increased early and total yield with the best fruit quality as compared with all other used treatments.

This increase reached 37.20 and 16.05 % as an average in both seasons for early and total yield respectively, as compared with plants supplied with 60 kg mineral-N without biofertilizer or spraying treatments.

Key words: N-source, biogas, Delfan (amino acids), Garlic extract, Microbin.

INTRODUCTION

Egypt like several countries is facing many critical food problems unless concentrated efforts are directed to maximize the agricultural production. The production of the high yields requires that the soil must have favorable physical, chemical nutritional and biological conditions. It is worth to mention that, good effect of organic nitrogen treatment as well as biofertilizer inoculation led to improve root and plant growth parameters. In addition, adding organic nitrogen and biofertilizer have beneficial return to increase population of soil microorganisms, especially in the surface layer at root rhizosphere, that produce substances, which stimulate plant growth (Awad, *et al.*, 1993). Many investigators emphasized the beneficial role of organic manures incorporated with biofertilizer to stimulate plant growth, yield of vegetables among them Abdalla, *et al.* (2001) on pepper; Abou-Hussein, *et al.* (2002) on potatoes; Adam, *et al.* (2002) on cantaloupe; Rizk, *et al.* (2003) on squash and Shams (2003) on sweet pepper.

Proteins are formed by sequence of amino acids. Many studies found that foliar application of amino acids can improve the vegetative growth and fruit quality of chilli pepper (Maheswari *et al.*, 2004). The fresh extracts of *Allium sativum* can be used to improve the vegetative growth of many plants such as squash (Abou-Hussein, *et al.*, 1975 and Shafshak *et al.*, 2004).

The aim of the present study is to investigate the effects of organic manure application combined with mineral fertilizer with or without inoculation with the bio-fertilizer i.e. Microbin and foliar application with amino acids i.e. Delfan or garlic extract on growth, yield and quality of sweet pepper plants.

MATERIALS AND METHODS

Field experiments were carried out during the two summer seasons of 2004 and 2005 at the Experimental Farm of the Faculty of Agriculture, Moshtohor, Benha University, Egypt on sweet pepper, *Capsicum annuum L.*, cv. California Wonder. Sowing seeds took place in the nursery on 15th January and transplanting took place on 24 th March in both seasons.

This experiment included 18 treatments which were the combination among three factors; three N sources, two biofertilizer treatments and three foliar spray treatments.

The N-fertilizer sources were biogas at 60 kg N/fed., mineral fertilizer at 60 kg N as $(NH_4)_2SO_4$/fed. (20.5%N) and biogas at 30 kg N/fed. + 30 kg N as $(NH_4)_2SO_4$/fed.

Biogas manure was obtained from the Agric. Res. Centre, Soil and Water Res. Inst., Biogas training center at Moshtohor village. The total amount of organic manure was calculated on the basis of total nitrogen percentage of organic fertilizer. The chemical composition and density of biogas fertilizer used is presented in Table (1).

Table (1): Chemical composition and density of biogas fertilizer used for growing sweet pepper plants.

Parameters \ Seasons	1st season	2nd season
Total nitrogen (N%)	1.74	1.56
Total phosphate (P%)	0.86	0.92
Total potassium (K%)	1.21	0.70
Organic matter (%)	56.2	54.6
Density kg/m^3	285	275

The biofertilizer treatments were without biofertilizer (Control) and inoculation with biofertilizer (Microbin)

The treated biofertilizer containing N-free living bacteria (*Azotobacter* and *Azospirillium*) and a phosphate dissolving bacteria (Bacillus megatherium), under the trade name of Microbin.The source of Microbin was the Egyptian Ministry of Agriculture, Unit of Biofertilizer Production, General Organization for Agriculture Equalization Fund (G.O.A.E.F.). Inoculation with biofertilizer took place two times; at seed sowing and at transplanting stage. Seeds were sown in the nursery in rows at 10 cm apart and then the biofertilizer carrying bacteria was drilled on seeds (Microbin package 400g/fed.) and then covered with the nursery soil. Once again after nursery period; roots of transplants were inoculated by dipping in a solution of biofertilizer Microbin package 400g + 30g arabic gum + 2 liters of tap water for about 10 minutes and then transplanting took place in the permanent field.

The foliar spray treatments were without foliar application (Control), foliar application by Delfan (amino acids) and foliar application by garlic extract

Plants were sprayed with Delfan (3ml/l) or garlic extract (100 g/l) as foliar application seven times at 14 day intervals, starting 21 days after transplanting. Foliar applications were at the rate of 200 l per feddan.

DELFAN is a brown liquid with pH of 5-5.5 and specific gravity of 1.12 g/ml. Also it contains 18.4% w/w organic matter content, 10% w/w free amino acids, 3% w/w total nitrogen and 3% w/w organic nitrogen. It is produced by Trade Corporation International Company Madrid and imported by Tecnogreen Co.

Garlic extract:

According to EL-Desouky *et al.*, (1998), the garlic extract was prepared, hence, fresh mature garlic cloves were blended in distilled water 100g cloves/l liter distilled water. Frozen and thawed two times then filtered. Main contents of garlic extract have been analyzed by Arid Land Agricultural Research Unit Fac. of Agric. Ain Shams Univ. in Table (2).

Table (2): Some chemical constituents of garlic cloves according to Arid Land Agricultural Research Unit.

Components	Concentration
GA_3	1.633 mg/100gm F.W
IAA	Trace amount
ABA	Trace amount
Ca	1.363%
Mg	1.230%
$S0_4$	0.181 %
Zn	66.5 ppm
Mn	94.4 ppm

Experimental design:

The experimental treatments were arranged in a split-split plot design with 3 replicates. Each experimental plot included 4-ridges each of 70 cm wide and 3.75 long with plot area of 10.5 m^2. Transplanting took place in one side of the ridge in the presence of water at 30 cm apart and each plot contained 48 plants.

The required organic manure (biogas) fertilizer was added to soil plots before transplanting and then incorporated with soil particles.

The source of mineral-N fertilizer was ammonium sulphate (20.5 % N). All experimental units received equal amounts of calcium superphosphate (16% P_2O_5) at the rate of 64 kg P_2O_5 and potassium sulphate (48 % K_2O) at the rate of 96 kg K_2O /fed. Ammonium sulphate was applied four times; 21, 40, 60 and 80 days after transplanting as 20, 40, 20 and 20% of the required N-dose at each time, respectively. Super phosphate was added 3 times, 50% at soil management, 25% each at 21 and 80 days after transplanting. Potassium sulphate was added 4 times; 21, 40, 60 and 80 days after transplanting as 25% of the required K_2O dose at each time.

Data Recorded:

a) Five plants from each plot were taken at the 3rd picking stage (100 days after transplanting):

Plant height (cm), leaf area (cm^2) per plant and total fresh and dry weight per plant were determined.

b) Early and total fruit yield:

1. Early yield, as kg/plot and then calculated as ton/fed. (The sum of the first three pickings).
2. Total yield, as kg/plot harvested allover the season and then calculated as ton/fed.

c) Chemical constituents of fruits

1. Reducing, non reducing and total sugars were determined according to the method of Shaffer and Hartman (1921). Sugar content was expressed as mg/100g fresh weight of fruit.
2. Ascorbic acid (Vitamin C) was estimated as mg/100g fresh weight of fruit by using the 2,6 dichlorophenolindophenol method described in A.O.A.C. (1975).

Statistical analysis:

All obtained data were recorded on plot basis and statistically analyzed according to a split-split plot design. Duncan's Multiple Range Test at 5% level was used to compare between significant treatment means. All the obtained data were subjected to statistical analysis of variance according to the procedure outlined by Gomez and Gomez (1984). MSTAT-C program (1988) was used for statistical computations.

RESULTS AND DISCUSSION

1. Vegetative growth:

1.1. Effect of N-fertilizer source

Data presented in Table (3) show that plants supplied with 30 kg organic-N + 30 kg mineral-N, improved plant growth (plant height, leaf area, fresh and dry weight) than those received all nitrogen dose (60kg N/fed.) either in the organic or in the mineral forms. This trend was true in both seasons. Data also show that the treatments which received 60kg mineral-N came in the second rank followed by the treatments which received 60kg organic-N with significant differences in all vegetative growth characteristics as a general trend in both seasons.

Table (3): Effect of N-fertilizer sources, biofertilizer and foliar spray treatments on vegetative growth of sweet pepper plants during the summer seasons of 2004 & 2005.

Characters / Treatments	First Season (2004)				Second Season (2005)			
	Plant height cm	Leaf area cm^2/ plant	Fresh weight g/plant	Dry weight g/plant	Plant height cm	Leaf area cm^2/ plant	Fresh weight g/plant	Dry weight g/plant
	N-fertilizer sources							
60 kg organic-N/fed.	40.75C	3371C	324.9C	126.8C	41.92C	3423C	336.0C	118.5C
60 kg mineral-N/fed.	46.86B	4346B	403.1B	159.5B	48.13B	4397B	420.2B	150.0B
30 kg organic-N/fed. +30 kg mineral-N/fed.	50.13A	4863A	426.6A	179.3A	50.75A	4966A	437.0A	171.2A
	Biofertilizer							
Without biofertilizer	44.81B	3885B	363.7B	146.7B	46.08B	3937B	378.3B	137.5B
Biofertilizer (Microbin)	47.01A	4501A	406.1A	163.7A	47.78A	4588A	417.1A	155.6A
	Foliar application							
Without foliar application	45.28B	4068B	374.0C	149.1C	46.08B	4120B	385.1C	140.0C
Amino acids	47.28A	4466A	397.4A	163.7A	48.50A	4569A	413.9A	156.0A
garlic extract	45.19B	4045C	383.3B	152.9B	46.21B	4097C	394.2B	143.7B

Means of the same column followed by the same letter were not significantly differed due to Duncan MRT at 5%.

In this connection, Abd-El-Aty (1997) and Shams (2003) found that the addition of organic manure combined with chemical fertilizers improved vegetative growth of sweet pepper plants.

The superiority of using 50% of the required N in the organic form and 50% in the mineral form on vegetative growth may be due to the favorable effect of the mineral nitrogen on the activity of micro organisms responsible for organic fertilizer analysis in the soil (Follett *et al.*, 1981).

1.2. Effect of biofertilizer

Biofertilizer inoculation (Table, 3) significantly increased vegetative growth characteristics i.e., plant height, leaf area, fresh and dry weight over the treatments with no biofertilizer in both seasons.

This superiority in plant growth by inoculating soil and seeds with Microbin (N-free living bacteria + Phosphorus dissolving bacteria) is in agreement with the results obtained by Moustafa *et al.* (1993) using *Bacillus* and *Azospirillum*, Saber (1993) using Microbin and Gomaa (1995) using *Azospirillum, Azotobacter* and *Bacillus*.

The role of N-free living bacteria in production of phytohormones and/or improving the availability and acquisition of nutriaents or by both, may explain the encouraged growth of plants inoculated with these non – symbiotic N-fixing bacteria (Barakat and Gabr, 1998). Furthermore, *Azotobacter* and *Azospirillum* could produce IAA and cytokinins which increased the surface area per unit root length and were responsible for root hair branching with an eventual increase in acquisition of nutrients from the soil (Jain and Patriquin, 1985).

Many organic acids which are produced by rhizosphere microorganisms are effective in solubilizing soil phosphates (Marschner, 1997). When phosphate dissolving bacteria (PDB) are inoculated to neutral or alkaline soils, the acid production decreases the rhizosphere pH and consequently favoring the solubility of calcium phosphates and micronutrients (Follett *et al.*, 1981).

1.3. Effect of foliar application

From Table (3) data show that treatments sprayed by Delfan as a source of amino acids gave the highest values regarding plant height, leaf area, fresh and dry weight with a significant increase in both seasons.

Data Table (3) also show that the treatments sprayed by garlic extract came in the second rank and the treatments with no spray came in the third rank as to their effects on fresh and dry weight in both seasons. These results are in harmony with those of Shafshak *et al.* (2004) on squash and Mohamed (2008) on strawberry.

1.4. Effect of the interaction between N-fertilizer source, biofertilizer and foliar spray treatments

From data Tables (4 and 5) it could be concluded that, the treatment fertilized with 30kg organic-N + 30kg mineral-N, inoculated with biofertilizer and foliar sprayed with Delfan (amino acids) gave the highest plant growth; leaf area, fresh and dry weight with significant increase as compared with all other treatments in both seasons. Regarding with plant height results show that plant height was increased in plants supplied with amino acids and biofertilizer especially when N was added as 60 kg organic or 60 kg mineral-N. However, plants received 30 kg organic-N + 30 kg mineral-N did no differ in plant height when sprayed with amino acids other wise treated or not with biofertilizer.

Table (4): Effect of combination between N-fertilizer sources, biofertilizer and foliar spray treatments of amino acids and garlic extract on vegetative growth of sweet pepper plants during the summer season of 2004.

Treatments		Characters	Plant height (cm)	Leaf area cm^2/plant	Fresh weight g/plant	Dry weight g/plant
60 kg organic-N/fed. 60 kg mineral-N/fed.	Without biofertilizer	Without foliar application	38.6 G	3074 R	261.8 N	101.5 L
		Amino acids	39.0 G	3305 P	306.3 L	118.7 J
		garlic extract	39.5 G	3189 Q	282.8 M	110.1 K
	Biofertilizer (Microbin)	Without foliar application	39.0 G	3356 O	345.7 K	133.4 I
		Amino acids	44.1 F	3795 M	389.8 H	155.4 FG
		garlic extract	44.1 F	3506 N	363.2 J	141.7 H
	Without biofertilizer	Without foliar application	49.1 BCDE	4696 F	418.5 E	168.8 E
		Amino acids	46.0 EF	3832 L	372.0 I	145.7 H
		garlic extract	44.5 F	4035 I	402.0 G	155.8 FG
30 kg organic-N/fed. +30 kg mineral-N/fed.	Biofertilizer (Microbin)	Without foliar application	46.3 DEF	4186 H	391.3 H	152.4 G
		Amino acids	49.6 ABCD	4785 E	425.9 CD	175.6 CD
		garlic extract	45.5 F	4542 G	408.8 F	159.0 F
	Without biofertilizer	Without foliar application	46.6 DEF	3864 K	393.7 H	159.4 F
		Amino acids	52.6 A	5079 D	424.3 D	187.2 B
		garlic extract	47.1 CDEF	3891 J	411.8 F	173.1 DE
	Biofertilizer (Microbin)	Without foliar application	51.8 AB	5232 B	433.2 B	178.9 C
		Amino acids	52.1 AB	6002 A	465.8 A	199.4 A
		garlic extract	50.3 ABC	5110 C	430.8BC	177.8 CD

Means of the same column followed by the same letter were not significantly differed due to Duncan MRT at 5%.

Table (5): Effect of combination between N-fertilizer sources, biofertilizer and foliar spray treatments of amino acids and garlic extract on vegetative growth of sweet pepper plants during the summer season of 2005.

Treatments		Characters	Plant height (cm)	Leaf area cm^2/plant	Fresh weight g/plant	Dry weight g/plant
60 kg organic-N/fed. 60 kg mineral-N/fed.	Without biofertilizer	Without foliar application	40.0 F	3126 R	272.5 H	93.9 M
		Amino acids	40.5 F	3357 P	318.5 F	108.6 K
		garlic extract	40.2 F	3241 Q	295.5 G	101.5 L
	Biofertilizer (Microbin)	Without foliar application	40.7 F	3408 O	357.5 E	124.9 J
		Amino acids	45.5 DE	3848 M	398.5 D	148.2 FG
		garlic extract	44.5 E	3558 N	373.3 E	133.8 I
	Without biofertilizer	Without foliar application	50.0 BC	4748 F	431.5 BC	158.0 E
		Amino acids	47.5 BCDE	3885 L	417.3 CD	137.9 HI
		garlic extract	46.5 DE	4085 I	413.0 CD	145.2 FG
30 kg organic-N/fed. +30 kg mineral-N/fed.	Biofertilizer (Microbin)	Without foliar application	47.2 BCDE	4240 H	401.8 D	143.3 GH
		Amino acids	50.5 AB	4833 E	438.0 BC	165.9 CD
		garlic extract	47.0 CDE	4596 G	419.5 BCD	150.0 F
	Without biofertilizer	Without foliar application	48.0 BCD	3914 K	402.8 D	149.1 FG
		Amino acids	53.5 A	5133 D	432.5 BC	180.3 B
		garlic extract	48.5 BCD	3944 J	421.5 BCD	163.2 DE
	Biofertilizer (Microbin)	Without foliar application	50.5 AB	5284 B	444.5 B	170.6 C
		Amino acids	53.5 A	6363 A	478.5 A	195.6 A
		garlic extract	50.5 AB	5162 C	442.5 B	168.8 CD

Means of the same column followed by the same letter were not significantly differed due to Duncan MRT at 5%.

Regarding to the treatment of 60kg organic-N, the addition of biofertilizer significantly increased leaf area, fresh and dry weight in both seasons compared to non addition of biofertilizer. Also, foliar application with amino acids in this case (60kg organic-N) gave the best vegetative growth i.e. leaf area, fresh and dry weight with significant increase compared to foliar application with garlic extract or without foliar application, this trend was true in both seasons.

While by using 60kg organic-N without both biofertilizer and foliar application gave the lowest plant growth i.e., leaf area, fresh and dry weight per plant as compared with all other treatments in both seasons.

2. Early and total yield:

2.1. Effect of N-fertilizer source

Data tabulated in Table (6) show that treatments supplied with (30kg organic-N + 30kg mineral-N) gave the highest early and total yield per feddan. This increase reached 37.20 and 16.05 % as an average in both seasons for early and total yield respectively, followed by treatment which received 60kg N in the mineral form with significant increase as compared with this received all nitrogen dose (60kg N/fed.) in the organic form. The same trend was clear in both seasons. These results are in harmony with those of Shams (2003) on sweet pepper and Mohamed (2008) on strawberry.

The superiority of adding 50% of N in the organic form (30 kg organic-N) + 30 kg N in the mineral form over adding all N-fertilizer in the organic or mineral form (60 kg N/fed.) may be referred to the increase in microorganisms activity and adsorbing essential nutrients against leaching (Follett *et al.*, 1981).

Table (6): Effect of N-fertilizer sources, biofertilizer and foliar spray treatments on early and total yield of sweet pepper plants during the summer seasons of 2004 & 2005.

Characters / Treatments	First Season (2004)		Second Season (2005)	
	Early yield (ton/fed.)	Total yield (ton/fed.)	Early yield (ton/fed.)	Total yield (ton/fed.)
	N-fertilizer sources			
60 kg organic-N/fed.	0.279C	6.999C	0.488C	7.277C
60 kg mineral-N/fed.	0.355B	8.316B	0.576B	8.570B
30 kg organic-N/fed. +30 kg mineral-N/fed.	0.435A	9.049A	0.654A	9.579A
	Biofertilizer			
Without biofertilizer	0.337B	7.796B	0.551B	8.244B
Biofertilizer (Microbin)	0.375A	8.447A	0.595A	8.707A
	Foliar application			
Without foliar application	0.338B	7.982B	0.561B	8.336B
Amino acids	0.393A	8.377A	0.609A	8.753A
garlic extract	0.338B	8.005B	0.548C	8.337B

Means of the same column followed by the same letter were not significantly differed due to Duncan MRT at 5%.

2.2. Effect of biofertilizer

Data (Table, 6) show that inoculation with Microbin gave higher early and total yield per feddan than when no biofertilizer was added, as shown in both seasons. The enhancing effect of biofertilizer application could be referred to the role of free living bacteria on N-fixation in the soil and the role of PDB on increasing the available-P in the soil (Rai, 2006). Moreover, the mechanism of microorganisms on plant growth and fruit yield depends on producing growth promoting substances (El-Hadad *et al.*, 1986) and enhancing nutrients uptake (Sarig *et al.*, 1984).

Results on the favourable effect of biofertilizer application on early and total yield have been mentioned by Moustafa *et al.* (1993) and Gomaa (1995) on tomato and Shams (2003) working on sweet pepper inoculated with Nitrobin and Phosphorin.

2.3. Effect of foliar application

Data Table (6) show that treatments sprayed by Delfan as a source of amino acids gave the highest early and total yield per feddan with a significant increase as compared with foliar application by garlic extract or without foliar application, as shown in both seasons.

The superiority of foliar application by Delfan (amino acids) may be referred to the role of Delfan (amino acids) content required to proteins synthesis. Moreover, data show that garlic extract application did not increase early or total yield than the control (without foliar application). Furthermore, garlic extract application decreased early fruit yield per feddan only in one season of this experiment, but had a similar effect on total fruit yield as compared with the control, as shown in both seasons.

2.4. Effect of the interaction between N-fertilizer source, biofertilizer and foliar spray treatments

Data presented in Table (7) show that, the treatment fertilized with 30kg organic-N + 30kg mineral-N and inoculated with microbin biofertilizer and foliar sprayed with Delfan (amino acids) gave the highest early and total yield per feddan with a significant increase in comparing to all other treatments, in both seasons. Moreover, the plants received 30kg organic-N + 30kg mineral-N + biofertilizer without foliar application or with garlic extract came in the second rank.

While by adding 60kg mineral-N and spraying with amino acids without biofertilizer inoculation significantly increased total yield per feddan in both seasons compared

with other treatments under the same N-fertilizer source. It could be clearly observed that using the foliar application of Delfan (amino acids) had a useful effect for increasing total yield, while supplying with biofertilizer in the presence of full dose of mineral-N had no effect on the total yield. This result may be due to the addition of mineral-N with full dose inhibit the activation of biofertilizer's microorganisms (Rai, 2006).

The treatment of 60kg organic-N without biofertilizer without foliar application gave the lowest total yield per feddan with a significant difference as compared with all treatments in both seasons. Regarding to the treatment of 60kg organic-N, the addition of biofertilizer significantly increased total yield per feddan in both seasons compared to non addition of biofertilizer. The positive effect of biofertilizer in this case indicated that there were no competition between plants and microorganisms for mineral-N uptake, hence, biogas the source of organic-N was well decomposed, this explanation is in harmony with Rai (2006).

Table (7): Effect of combination between N-fertilizer sources, biofertilizer and foliar spray treatments of amino acids and garlic extract on early and total yield of sweet pepper plants during the summer seasons of 2004 & 2005.

Treatments		Characters	First season (2004)		Second season (2005)	
			Early yield ton/fed	Total yield ton/fed	Early yield ton/fed	Total yield ton/fed
60 kg organic-N/fed.	Without biofertilizer	Without foliar application	0.260 GH	6.273 J	0.450 M	6.680 K
		Amino acids	0.243 H	6.583 I	0.470 K	7.060 I
		garlic extract	0.250 H	6.470 IJ	0.460 L	6.870 J
	Biofertilizer (Microbin)	Without foliar application	0.256 GH	7.190 H	0.471 K	7.440 H
		Amino acids	0.386 BCDE	8.270 EFG	0.590 F	8.090 G
		garlic extract	0.280 GH	7.207 H	0.490 J	7.520 H
60 kg mineral-N/fed.	Without biofertilizer	Without foliar application	0.354 DEF	8.314 DEFG	0.592 F	8.511 EF
		Amino acids	0.372 CDE	8.643 C	0.592 F	8.859 D
		garlic extract	0.310 FG	8.217 FG	0.520 I	8.376 F
	Biofertilizer (Microbin)	Without foliar application	0.339 EF	8.284 EFG	0.578 G	8.665 E
		Amino acids	0.402 BCD	8.240 FG	0.612 E	8.539 EF
		garlic extract	0.352 DEF	8.197 G	0.564 H	8.471 EF
30 kg organic-N/fed. +30 kg mineral-N/fed.	Without biofertilizer	Without foliar application	0.388 BCDE	8.507 CDEF	0.611 E	8.969 CD
		Amino acids	0.441 B	8.589 CD	0.635 C	9.790 B
		garlic extract	0.418 BC	8.568 CDE	0.630 CD	9.080 C
	Biofertilizer (Microbin)	Without foliar application	0.429 BC	9.326 B	0.664 B	9.753 B
		Amino acids	0.517 A	9.935 A	0.760 A	10.18 A
		garlic extract	0.418 BC	9.372 B	0.628 D	9.702 B

Means of the same column followed by the same letter were not significantly differed due to Duncan MRT at 5%.

3. Fruit chemical constituents

3.1. Effect of N-fertilizer source

Concerning the effect of N-fertilizer source on fruit quality data Table (8) show that fruit of plants supplied with 60 kg N as organic biogas had the highest vitamin-C, reducing, non reducing and total sugars content as a general trend especially in the second season. On the other hand, plants received 60 kg N as ammonium sulphate had the lowest values of vitamin-C and sugars as compared with the other N-sources, in both

seasons. Meanwhile plants fertilized with 30 kg organic-N + 30 kg mineral-N had medium values of fruit chemical components, as shown in both seasons. These results are in harmony with those of Shafshak *et al.* (2007) on squash and Shams (2003) on sweet pepper.

3.2. Effect of biofertilizer

Biofertilizer inoculation gave higher values of fruit vitamin-C, reducing, non-reducing and total sugars over control without biofertilizer addition, as shown in both seasons. These results are in harmony with those of Abo El-Hamd *et al.* (2006) on strawberry.

3.3. Effect of foliar application

Treatments sprayed with Delfan (amino acids) had high values of reducing, non-reducing and total sugars content of fruits with a significant increase as compared with garlic extract or without any application in both seasons (Table, 8). Moreover, treatments sprayed by garlic extract or without foliar application come in the second rank with non significant difference in non-reducing and total sugars in both seasons.

3.4. Effect of the interaction between N-fertilizer source, biofertilizer and foliar spray treatments

Data Tables (9 and 10) show that the highest values of fruit's vitamin-C, reducing and total sugars were obtained by using 60kg organic-N with biofertilizer and foliar application with amino acids as compared with all other treatments. Adding 60kg organic-N with biofertilizer and without any foliar application or 60kg organic-N without biofertilizer and foliar sprayed with amino acids had no significant difference from each other with respect to total sugars content of fruits in both seasons.

Data also show that adding 60kg organic-N or 30kg organic-N + 30kg mineral-N with or without biofertilizer addition gave similar and higher vitamin-C content of sweet pepper fruits than all other treatments as a general trend in both seasons. However the treatments which supplied by 60kg mineral-N without biofertilizer addition gave the lowest values of fruit chemical constituents; vitamin-C, reducing and total sugars as a general trend in both seasons.

Table (8): Effect of N-fertilizer sources, biofertilizer and foliar spray treatments on fruit chemical constituents of sweet pepper plants during the summer seasons of 2004 & 2005.

Characters / Treatments	First Season (2004)				Second Season (2005)			
	Vitamin C mg/100g	Sugars mg/100g (F.W.)			Vitamin C mg/100g	Sugars mg/100g (F.W.)		
		Reducing	Non-Reducing	Total		Reducing	Non-Reducing	Total
	N-fertilizer sources							
60 kg organic-N/fed.	174.4A	103.0A	146.4B	249.4A	180.3A	104.5A	154.1A	253.1A
60 kg mineral-N/fed.	171.0B	70.83C	127.3C	198.2C	175.9C	72.33C	127.5C	199.8C
30 kg organic-N/fed. +30 kg mineral-N/fed.	173.8A	85.83B	149.7A	235.6B	178.8B	88.42B	150.9B	239.3B
	Biofertilizer							
Without biofertilizer	172.4B	82.78B	139.6B	222.4B	177.8B	85.44B	140.4B	222.1B
Biofertilizer (Microbin)	173.8A	90.33A	142.7A	233.1A	178.8A	91.41A	148.0A	239.4A
	Foliarapplication							
Without foliarapplication	172.6A	83.00C	139.9B	222.9B	178.1A	84.78C	141.4B	220.6B
Amino acids	173.5A	91.50A	145.2A	236.7A	178.8A	93.50A	148.7A	242.2A
garlic extract	173.1A	85.17B	138.3B	223.5B	178.1A	87.00B	142.6B	229.6B

Means of the same column followed by the same letter were not significantly differed due to Duncan MRT at 5%.

Table (9): Effect of combination between N-fertilizer sources, biofertilizer and foliar spray treatments of amino acids and garlic extract on fruit chemical constituents of sweet pepper plants during the summer season of 2004.

Treatments		Characters	Vitamin C mg/100g	Sugars mg/100g (F.W.)		
				Reducing	Non-reducing	Total
60 kg organic-N/fed	Without biofertilizer	Without foliar application	173.1 ABC	99.33C	142.7CD	242.0BCD
		Amino acids	175.1A	106.3A	144.7CD	251.0AB
		garlic extract	174.4 AB	105.3AB	141.0 DE	246.3BC
	Biofertilizer (Microbin)	Without foliar application	174.1AB	100.3BC	160.7A	261.0A
		Amino acids	175.2A	105.3 AB	155.3 AB	260.7 A
		garlic extract	174.6 AB	101.3 ABC	134.3 EF	235.7 CD
60 kg mineral-N/fed	Without biofertilizer	Without foliar application	169.2D	54.33K	130.7FG	185.0G
		Amino acids	170.3CD	64.33I	124.0G	188.3G
		garlic extract	169.5 D	59.33J	127.7 FG	187.0G
	Biofertilizer (Microbin)	Without foliar application	171.8ABCD	76.33H	114.7H	191.0FG
		Amino acids	173.8AB	92.33 DE	143.3 CD	235.7CD
		garlic extract	171.5BCD	78.33 GH	123.7G	202.0F
30 kg organic-N/fed. + 30 kg mineral-N/fed.	Without biofertilizer	Without foliar application	173.9AB	79.33 GH	141.7CD	221.0E
		Amino acids	172.0ABCD	93.33 D	148.7BCD	242.0BCD
		garlic extract	173.8 AB	83.33 FG	155.3 AB	238.7BCD
	Biofertilizer (Microbin)	Without foliar application	173.4ABC	88.33 DEF	149.3 BC	237.7CD
		Amino acids	174.7AB	87.33 EF	155.3 AB	242.7BCD
		garlic extract	174.8 AB	83.33 FG	148.0BCD	231.3DE

Table (10): Effect of combination between N-fertilizer sources, biofertilizer and foliar spray treatments of amino acids and garlic extract on fruit chemical constituents of sweet pepper plants during the summer season of 2005

Treatments		Characters	Vitamin C mg/100g	Sugars mg/100g (F.W.)		
				Reducing	Non-reducing	Total
60 kg organic-N/fed	Without biofertilizer	Without foliar application	179.0 ABC	102.0B	146.5EF	215.2DEF
		Amino acids	180.5 AB	110.5A	151.0D	261.5AB
		garlic extract	179.5 ABC	107.5A	143.0F	250.5 ABC
	Biofertilizer (Microbin)	Without foliar application	180.5 AB	100.2BC	163.0A	263.2A
		Amino acids	181.5A	107.5A	159.0B	266.5A
		garlic extract	180.5AB	99.50BC	162.3AB	261.8AB
60 kg mineral-N/fed	Without biofertilizer	Without foliar application	174.5E	58.50K	125.0G	183.5G
		Amino acids	175.5 DE	64.50J	125.0G	189.5FG
		garlic extract	175.0E	61.50JK	125.0G	186.5G
	Biofertilizer (Microbin)	Without foliar application	176.5CDE	75.50I	121.2G	196.5FG
		Amino acids	177.5BCDE	92.50DE	148.0DE	240.5ABCD
		garlic extract	176.5CDE	81.50H	121.0G	202.5EFG
30 kg organic-N/fed. +30 kg mineral-N/fed	Without biofertilizer	Without foliar application	179.5ABC	81.50H	143.2F	224.5CDE
		Amino acids	178.5ABCD	96.50CD	150.0DE	246.5 ABC
		garlic extract	178.5ABCD	86.50FG	155.0C	241.5ABCD
	Biofertilizer (Microbin)	Without foliar application	178.5ABCD	91.00EF	149.5DE	240.5ABCD
		Amino acids	179.5 ABC	89.50EFG	159.0B	248.5 ABC
		garlic extract	178.5ABCD	85.50GH	149.0DE	234.5 BCD

Means of the same column followed by the same letter were not significantly differed due to Duncan MRT at 5%.

CONCLUSION

As a general conclusion inoculating sweet pepper seeds at seed sowing and transplant roots at transplanting stage with the biofertilizer "Microbin" and fertilizing plants with 30 kg N in the organic form (Biogas manure) + 30 kg N in the mineral form (ammonium sulphate) and sprayed with amino acids compound "Delfan", gave the highest vegetative growth, early and total fruit yield with the best fruit quality of sweet pepper, cv. California Wonder when grown in clay loam soil. Therefore, this treatment could be recommended.

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تأثيرمصدر السماد النيتروجينى والتسميد الحيوى مع الرش بمركب الدلفان (أحماض أمينية) ومستخلص الثوم على النمو والمحصول والجودة لنباتات الفلفل

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أجريت تجربة حقلية على نبات الفلفل الحلو صنف كاليفورنيا وندر بمزرعة الخضر بكلية الزراعة بمشتهر أثناء الموسم الصيفى لعامى ٢٠٠٤ ، ٢٠٠٥. تم نقل الشتلات بالأرض المستديمة فى ٢٤ مارس فى كلا موسمى الزراعة. وذلك بهدف دراسة تأثير التفاعل بين مصدر التسميد النيتروجينى (عضوى أومعدنى أو كلاهما) والتسميد الحيوى (ميكروبين) مع الرش الورقي بالأحماض الأمينية (دلفان) أو الرش بمستخلص الثوم على النمو الخضرى والمحصول والجودة لنباتات الفلفل. وصممت التجربة بنظام القطع المنشقة مرتين فى ثلاث مكررات. وكانت المعاملات هى استخدام التسميد المعدنى بمعدل ٦٠ كجم N للفدان على صورة سلفات نشادر (N%٢٠,٥) أو أستخدام التسميد العضوى بمعدل ٦٠ كجم N للفدان على صورة سماد بيوجاز أو استخدام التسميد المعدنى ٣٠ كجم N للفدان مع التسميد العضوى ٣٠ كجم N للفدان مع أو بدون استخدام التسميد الحيوى (ميكروبين) مع الرش الورقى بالأحماض الأمينية (دلفان) أو الرش بإستخدام مستخلص الثوم أو بدون رش ورقى.

أظهرت النتائج من حيث النمو والمحصول المبكر والكلى أن التسميد بمعدل ٣٠ كجم نيتروجين عضوى + ٣٠ كجم نيتروجين معدنى كانت أفضل من إضافة السماد كله (٦٠ كجم ن/فدان) فى صورة عضوية أو معدنية. وكان تلقيح البذور وجذور الشتلات بالميكروبين أفضل من عدم التلقيح. وكان الرش بمخلوط الأحماض الأمينية (دلفان) أفضل من الرش بمستخلص الثوم أو عدم الرش. لذلك يوصى بمعاملة التفاعل وهى التسميد بمعدل ٣٠كجم نيتروجين عضوى على صورة سماد البيوجاز + ٣٠كجم نيتروجين معدنى (فى صورة سلفات النشادر)/فدان + معاملة البذور وجذور الشتلات بالسماد الحيوى (ميكروبين) + الرش الورقى بالأحماض الأمينية (دلفان) للحصول على أفضل نموخضرى وأعلى محصول مبكر وكلى مع تحسين جودة الثمار بالمقارنة بباقى المعاملات فى صنف الفلفل الحلو كاليفورنيا وندر عند الزراعة فى أرض طينية صفراء. وكانت الزيادة بمعدل ٣٧,٢٠ و١٦,٠٥ % لكل من المحصول المبكر والكلى على الترتيب كمتوسط للموسمين وذلك مقارنة بالمعاملة التى أخذت نباتاتها ٦٠ كجم نيتروجين معدنى وبدون تسميد حيوى وبدون رش ورقى.