J. Plant Production, Mansoura Univ., Vol. 3 (9): 2465 - 2478, 2012

RESPONSE OF SWEET PEPPER PLANTS (VEGETATIVE GROWTH AND LEAF CHEMICAL CONSTITUENTS) TO ORGANIC, BIOFERTILIZERS AND SOME FOLIAR APPLICATION TREATMENTS.

Dawa, K. K. ; H. M. E. Abd El - Nabi and W. M. E. Swelam
Veget. and Flori. Dept. Fac. Agric., Mans. Univ., Egypt.

ABSTRACT

This investigation was conducted in the two successive summer seasons of 2010 and 2011 on sweet pepper plants "Madir" hybride at a private farm at Sahragt El-Soghra near Mansoura, Dakahlia Governorate, Egypt to study the effect of two sources of organic fertilizers (chicken manure and compost), biofertilizers (a mixture of *Azotobacter chroococcum* and *Bacillus circulans* bacteria and Mycorrhiza fungi), some foliar application treatments (seaweed extract, yeast extract and humic acid) and their interaction on vegetative characteristics and chemical constituents of leaves. Results indicated that the highest values of vegetative parameters, i.e., plant height, number of leaves, number of branches, leaf area, fresh and dry weights as well as chemical constituents of leaves, i.e., chlorophylls (Chl. a, Chl. b and total Chl. a+b), N, P and K percentages were recorded when plants supplied with chicken manure at 2.43 ton/fed. as compared with compost in the two seasons. Plants in the presence of biofertilizers recorded better growth performance and higher values of chemical composition in leaves than untreated plants in the two seasons.

Comparing the effect of foliar applications, seaweed extract at 2.5 ml/L or yeast extract at 5 g/L recorded the highest significant values of most formentioned parameters compared with the control in both seasons. in addition, spraying humic acid at 1.5 ml/L came in the second order and significantly increased number of branches, fresh and dry weights in both seasons and leaf area in the second season as compared with the check treatment.

The best results of both vegetative parameters and chemical constituents were recorded when plants fertilized with chicken manure at 2.43 ton/fed. and sprayed with either seaweed extract at 2.5 ml/L or yeast extract at 5 g/L in the presence of biofertilizers in both seasons. Therefore, this treatment could be recommended for improving sweet pepper performance under similar conditions of this study.

Keywords: Sweet pepper, chicken manure, compost, biofertilizers, foliar application, seaweed extract, yeast extract, humic acid, vegetative growth, chemical composition.

INTRODUCTION

Capsicum (*Capsicum annuum* L.) commonly known as sweet pepper belongs to family Solanaceae and it is a high value crop and its fruits are highly nutritious, rich in vitamins particularly pro-vitamin A, vitamin B, vitamin C and minerals such as Ca, P, K and Fe. The fruits are non-pungent and have widely used in immature or green stage as vegetable for stuffing or for salads. With the increase in population, the demand for the crop has been increasing day by day and the traditional varieties due to their inherent low yield potential would not be fulfilling the demand.

At the present time, a great attention has been given to organic and bio-fertilization as a management tool for increasing the quality of vegetable crops. Egyptian soils are low in organic matter about 2% (Balba, 1976). Organic manure such as chicken manure and compost contribute to plant growth through its effect on physical, chemical and biological properties of the soil. In addition, organic fertilizers provide soil with essential nutrients such as N, P, S and some micro nutrients after its mineralization under soil conditions (Meshref *et al.,* 1995 and El-Nagar, 1996). Regarding the effect of chicken manure on sweet pepper growth, Alabi (2006) and Odebode and Fajinmi (2009) indicated that plant height, number of leaves, number of branches, leaf area, fresh and dry weights significantly enhanced in response to application of chicken manure fertilization. Also, Abd El-Aty (1997) and Alabi (2006**)** reported that chlorophylls as well as N, P and K% increased in sweet pepper leaves when plants supplied with chicken manure.

In addition, there is a great debate among scientists about the role played by microorganisms in promoting plant growth, while some other investigators directed their contribution to N-fixing, P or K solubilization and cellulose decomposition. Others went to production of plant growth modifying substances by such biofertilizers. Many investigators reported that Biofertilizer affected plant growth and chemical composition of leaves (Supanjani *et al.*, 2006; Kaya *et al.,* 2009 and Khan *et al.,* 2012) of pepper plants.

Engaging in vegetable production the chemicals of regulatory effect on plant growth and development (biostimulators) are one of means for obtaining the increase in plant performance. However, plant biostimulation has recently become an increasingly more common treatment in modern agricultural production, among such substances are seaweed extract, yeast extract and humic acid. The application of seaweed extract for different crops was a great importance due to containing high levels of organic matter, macro and micro elements, vitamins and fatty acids and also rich in growth regulators such as auxins, cytokinins and gibberellins (Crouch and Van Staden, 1994).However, application of seaweed extract increased vegetative growth (El-Aidy *et al*., 2002 on sweet pepper and Nour *et al.,* 2010 on tomato), El-Aidy *et al.* (2002**)** on sweet pepper observed increases in leaves chemical compositions.

The positive effects of dry yeast application may be due to that it is considered as a natural source of cytokinins that stimulates cell division and enlargement as well as the synthesis of protein, nucleic acid and chlorophyll (Fathy and Farid, 1996). It also contains sugar, proteins, amino acids and vitamins (Shady, 1978). Many investigators reported that spraying yeast extract significantly enhanced vegetative growth performance (El-Tohamy *et al.,* 2008 on eggplant; Ghoname *et al.,* 2010 on sweet pepper) and chemical composition of leaves (Shokr and Abd El-Hamid, 2009 on pea plants).

Humic acid as a foliar treatment enhanced plant growth (Ertan, 2007 on tomato and Azarpour *et al*., 2012 on eggplant) and increases chemical composition of leaves (Hanafy *et al*., 2010 on snap bean and Unlu *et al.,* 2011 on cucumber) through increasing nutrient uptake such as N, Ca, P, K, Mg, Fe, Zn and Cu, serving as a source of mineral plant nutrient and regulator of their release which decrease pollution and costs (Atiyeh *et al.,* 2002; Neri *et al*., 2002 and El- Desouki, 2004). Also, enhancement of photosynthesis, chlorophyll density and plant root respiration has resulted in greater plant growth with humate application (Chen and Aviad 1990).

Therefore, this work aimed to evaluate the effect of organic manure, biofertilizers and foliar applications on sweet pepper performance (vegetative growth and chemical constituents of leaves).

MATERIALS AND METHODS

Two field experiments were conducted in the two successive summer seasons of 2010 and 2011 on sweet pepper plants "Madir" hybride at a private farm at Sahragt El-Soghra near Mansoura, Dakahlia Governorate, Egypt to study the effect of two sources of organic fertilizers, biofertilizers, some foliar application treatments and their interaction on vegetative characteristics and chemical constituents of leaves.

The physical and chemical properties of the experimental soil are reviewed in Table 1. The experimental layout was split split plot system in a randomized complete block design with three replicates. Organic manure sources were presented in the main plots, which were subdivided to two sub plots presented biofertilizers treatments. The biostimulators were randomly assigned in the sub sub plots. The experimental unit area was 11.25 m^2 and it contained three ridges, 5 m long and 0.75 m wide. Forty five days old seedlings were transplanted into the open field at the beginning of June in the two seasons. The seedlings were transplanted on one side of ridge at 50 cm apart. The experiment included 16 treatments.

Table 1: Physical and chemical properties of experimental soil in 2010 and 2011 seasons:

Seasons	O.M (%)	Clay (%)	Silt (%)	Sand (%)	Texture class	E.C (dSm^{-1})	pH	Available (%)		
								N	P	K
1st	1.45	40.5	33.65	25.95	Clay loam	1.12	8.11	0.2	11.72	5.33
2nd	1.45	40.3	33.45	26.25	Clay loam	1.130	8.10	0.2	11.70	5.33

In this investigation, plants were supplied with chicken manure at 2.43 ton/fed. which compared with rice straw compost application at 3.1 and 3.4 ton/fed. in the first and second seasons respectively (containing the same units of nitrogen in chicken manure). The chemical analysis of chicken manure and compost is presented in Table 2. Biofertilizers treatment involved a mixture of beneficial microorganisms including *Azotobacter chroococcum* bacteria which fixes nitrogen by a free manner; *Bacillus circulans* bacteria which make potassium more available and Mycorrhiza fungi which increases phosphorus and many nutrients absorption. All inoculans were provided by Biofertilizer Unit, Fac. Agric., Ain Shams University. Biofertilizer solution was added to the wet soil twice to the root absorption zone of each plant at the recommended rate (5 ml/plant), the first one was after a week from transplanting. The second one was added three weeks later.

Four foliar applications including the check treatment (tap water spray only), seaweed extract (commercial name of Goemar BM 86). It contains total nitrogen 5.2%, Magnesium 6.2%, Boron 2.67%, Sulfur 12.3%

and molybdenum 0.25% and sprayed at 2.5 ml/L. Also, yeast extract was applied at 5 g/L. preparation of yeast solution was done according to El-Ghamriny *et al.* (1999). Humic acid (commercial name of Canada Humex) was sprayed at 1.5 ml/L. Plants were sprayed three times with the different assigned treatments starting after 30 days from transplanting and repeated after 15 days from the last one.

Table 2: Chemical analysis of chicken manure and compost during the two seasons:

Seasons	Organic manure	Macro-elements (%)			O.M. (%)
		N	P	K	
1st	Chicken manure	2.01	0.42	1.17	55.12
	Compost	1.57	0.41	0.62	36.24
2nd	Chicken manure	2.14	0.49	1.20	56.32
	Compost	1.52	0.37	0.60	35.11

During the growing seasons, all agricultural practices were performed according to the Ministry of Agriculture and Land Reclamation recommendations.

Data recorded

Growth parameters:

One sample of nine plants were taken from each plot after 70 days from transplanting in both seasons of the investigation for measuring growth characters of sweet pepper plants, i.e., plant height, number of leaves/plant, number of branches/plant, leaf area /plant according to Koller (1972), fresh and dry weights (leaves and branches).

Chemical constituents of leaves:

Chlorophyll a, b and total chlorophyll were colorimetrically determined in the leaves of sweet pepper plants at 70 days after transplanting during both seasons according to the methods described by Wettstein (1957) and calculated as mg/g fresh weight. In addition, nitrogen was determined in the dry matter of sweet pepper leaves according to piper (1947). Phosphorus was determined colorimtrically according to the method of Sandell (1950) and calculated as mg/g dry weight. Potassium was determined by the method described by Horneck and Hanson (1998).

Statistical analysis:

The obtained data were subjected to statistical analysis of variance according to Snedecor and Cochran (1967). The treatment means were compared using the LSD test as described by Gomez and Gomez (1984).

RESULTS AND DISSCUSSION

Growth parameters

Effect of organic manure sources:

Data presented in Table 3 showed growth performance of sweet pepper plants as influenced by different organic manure sources (chicken manure and compost) in the two growing seasons. Results showed that growth attributes like plant height, number of leaves and branches, fresh and dry weights and leaf area differed due to different sources of organic manure.

The applications of chicken manure at 2.43 ton/fed. gave the highest significant values of all formentioned parameters compared to compost.

Table 3: Effect of organic manure sources, biofertilizers and foliar applications on vegetative growth parameters of sweet pepper plants during 2010 and 2011 seasons.

Treatments	Plant height (cm)		No. of leaves		No. of branches		Fresh weight/plant (gm)		Dry weight/plant (gm)		Leaf area/plant (m^2)	
	2010	2011	2010	2011	2010	2011	2010	2011	2010	2011	2010	2011
Organic manure sources:												
Chicken manure	67.59	66.87	239.5	231.0	9.9	9.9	850.19	840.13	171.28	167.80	2.27	2.07
Compost	60.67	59.21	200.9	193.2	7.0	7.0	698.64	683.41	134.63	131.60	2.12	1.91
F. test	*	*	*	*	*	*	*	*	*	*	*	*
Biofertilizer: (*Az.+Bac.*+AMF):												
With	66.25	65.37	235.1	226.4	9.3	9.3	825.56	810.37	166.07	162.17	2.50	2.32
Without	62.01	60.70	205.3	197.7	7.5	7.5	723.27	713.17	139.83	137.23	1.89	1.66
F. test	*	*	*	*	*	*	*	*	*	*	*	*
Foliar applications												
Seaweed extract	66.05	65.38	234.1	224.6	9.3	9.3	819.66	808.57	163.65	160.35	2.37	2.23
Yeast extract	64.88	63.59	224.3	217.2	8. 5	8.5	795.85	786.16	156.30	154.12	2.27	2.02
Humic acid	63.60	61.99	216.1	208.0	8.2	8.2	761.80	742.96	151.90	147.88	2.16	1.89
Control	62.00	60.83	206.3	198.5	7.6	7.6	720.35	709.38	139.98	136.46	1.98	1.82
LSD at 5%	2.57	2.41	14.7	13.2	0.5	0.5	31.70	31.38	9.56	7.45	0.07	0.18

Az: Azotobacter chroococcum, Bac: Bacillus circulans **and AMF: Arbuscular Mycorrhizal Fungi.**

The variation in results between the two sources of organic manure may be due to the differences in the management of soil fertility under organic practices that affect soil dynamics and plant metabolism, which result in differences in plant composition and nutrient quality (Worthington, 2001). The increment in plant growth due to chicken manure application might be attributed to the favorable effect on soil texture, water holding capacity and it creates good aeration in soils. In addition to the slow release of the nutrients resulted from it by the biodegrading soil microorganisms creates better conditions of nutrient uptake to root growth and proliferation there by, creating more absorptive surface for nutrient uptake and reflect better to photosynthetic activity which in turn resulted in higher vegetative growth. Also, Shashidhara (2000) and Bidari (2000) reported that improved nutrient uptake especially nitrogen, phosphorus and potassium in the organics (Table 2) applied treatments may be responsible for the improved vegetative growth. These results are in conformity with the findings of Alabi (2006) and Odebode and Fajinmi (2009) who reported that different growth parameters of sweet pepper plants were increased in response to the addition of chicken manure.

Effect of biofertilizers:

With respect to the effect of biofertilizers on sweet pepper growth performance, data reviewed in Table 3 clarified that plants in the presence of biofertilizers (*Azotobacter chroococcum, Basillus circulans* and Mycorrhiza fungi) achieved the best records of plant height, number of leaves and branches, fresh and dry weights and leaf area in the two successive seasons as compared with those in the absence of biofertilizers.

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The significant effect of biofertilizers may be due to the effect of different strain groups such as nitrogen fixers (*Azotobacter chroococcum*), phosphate solubilizing microorganisms (Arbuscular Mycorrhizal Fungi) and potassium solubilizing bacteria (*Bacillus circulans*) which help in availability of minerals and their forms in the composted materials and increased levels of extractable N, P, K, Fe, Zn and Mn (El-Karamany *et al*., 2000). Also, Rajaee *et al.* (2007) reported that free-living microorganisms enhance root development, increase water and mineral uptake and produce plant hormones that might be responsible for growth of pepper plants. These results are in agreement with those of Supanjani *et al.* (2006); Kaya *et al.* (2009) and Khan *et al.* (2012) on pepper plants.

Effect of foliar application treatments:

Comparing the effect of foliar application treatments (seaweed extract, yeast extract and humic acid), it was found that all growth parameters including plant height, number of leaves and branches, fresh and dry weights and leaf area were increased in the two growing seasons compared to the check treatment (sprayed with tap water) (Table 3). Data clearly showed that the highest significant values of the formentioned parameters were recorded by spraying plants with seaweed extract (2.5 ml/L) followed by spraying yeast extract (5g/L) (without significant differences between the two treatments except for number of branches and leaf area). Foliar application with humic acid came in the third order, while the control treatment (sprayed with tap water) recorded the lowest values of the mentioned vegetative parameters in both seasons.

Regarding the growth enhancing potential of seaweed extract might be attributed to the presence of macro and micronutrients, i.e., N, Mg, B, S and Mo as mentioned previously. Also, the presence of some growth promoting substances present in the seaweed extracts (Blunden, 1991). Exogenous application of seaweed extract has already shown to enhance plant growth by El-Aidy *et al.* (2002) on sweet pepper and Nour *et al.* (2010) on tomato.

Also, the beneficial effect of yeast extract might be due to that it is considered as a natural source of cytokinins which stimulate cell division and enlargement as well as the synthesis of protein, nucleic acid and chlorophyll (Fathy and Farid, 1996). In addition, yeast is a natural source of many growth substances and it contains protective agent, i.e., sugars, proteins, amino acids, several vitamins as well as most of nutritional elements (Na, Ca, Fe, Mg, K, P, S, Zn and Si) and organic compounds (Nagodawithana, 1991) .

Effect of interaction among organic manure sources, biofertilizers and foliar application treatments:

Regarding the effect of interaction among organic manure sources, biofertilizers and foliar application treatments, it is evident from such data presented in Table 4 that there was significant response on all measured parameters as affected by the triple interaction in both seasons. Generally, it is clear that application of chicken manure in the presence of biofertilizers and all foliar treatments recorded the highest figures of all measured parameters as compared to compost treatments. The best records were obtained when plants fertilized with chicken manure and spraying with seaweed extract (2.5 ml/L) in the presence of biofertilizers in both seasons. The lowest values of all measured parameters were recorded by adding compost in the absence of biofertilizers or foliar application in both seasons.

Chemical constituents of leaves

Effect of organic manure sources:

The obtained results in Table 5 showed that chlorophylls (a, b, and a+b) as well as N, P and K in leaves differed due to different sources of organic manure. The applications of chicken manure at 2.43 ton/fed. gave the highest significant values of chlorophylls in both growing seasons as well as N, P and K percentages in leaves as compared with compost in the two successive seasons.

Table 5: Effect of organic manure sources, biofertilizers and foliar applications on chemical constituents of sweet pepper leaves during 2010 and 2011 seasons.

Treatments	Chl. a (mg/100gm)		Chl. b (mg/100gm)		Total (a+b) (mg/100gm)		N (%)		P (%)		K (%)	
	2010	2011	2010	2011	2010	2011	2010	2011	2010	2011	2010	2011
Organic manure sources:												
Chicken manure	1.15	1.14	0.84	0.84	1.99	1.97	3.29	3.17	0.82	0.82	1.79	1.70
Compost	1.03	1.02	0.75	0.75	1.78	1.77	1.85	1.77	0.51	0.51	1.56	1.46
F. test	*	*	*	*	*	*	*	*	*	*	*	*
Biofertilizer: *(Az.+Bac.*+AMF*)*:												
With	1.14	1.13	0.82	0.82	1.96	1.94	3.05	2.94	0.75	0.75	1.74	1.64
Without	1.05	1.04	0.77	0.77	1.82	1.80	2.10	2.00	0.58	0.58	1.61	1.51
F. test	*	*	*	*	*	*	*	*	*	*	*	*
Foliar applications												
Seaweed extract	1.14	1.13	0.82	0.81	1.96	1.94	2.96	2.84	0.72	0.72	1.73	1.64
Yeast extract	1.13	1.12	0.81	0.81	1.94	1.92	2.82	2.71	0.67	0.69	1.68	1.59
Humic acid	1.09	1.08	0.79	0.78	1.78	1.86	2.43	2.33	0.65	0.65	1.65	1.55
Control	1.02	1.01	0.76	0.76	1.78	1.77	2.09	1.99	0.61	0.61	1.63	1.53
LSD at 5%	0.04	0.04	0.02	0.02	0.06	0.06	0.39	0.38	0.07	0.08	0.04	0.03

Az: Azotobacter chroococcum, Bac: Bacillus circulans **and AMF: Arbuscular Mycorrhizal Fungi.**

The variation in results between the two sources of organic manure may be due to the differences in the chemical composition of the two sources, i.e., organic matter and elements ratio as shown in Table 2 which reflected positively on the mentioned parameters. The obtained results are in the same line with Alabi and Odubena (2001) who reported that poultry manure contains large contents of all mineral nutrients needed by cowpea plants. Also, Dibb *et al.* (1990) reported that application of N and P in crop fertilization is leading to increase absorption of both elements, hence increasing top growth, particularly as a result of N absorption. Nitrogenous compounds make up a significant part of the total weight of plants. Similarly increase in nitrogen supply leads to utilization of carbohydrates to form protoplasm and more cells to enhance growth. These confirm the ability of poultry manure to supply the required N contents needed by pepper plants to enhance their growth and general performance. This is in an agreement with similar observations made by Abd El-Aty (1997) and Alabi (2006) on sweet pepper, who reported that chlorophylls, N, P and K content in plant leaves significantly enhanced in response to fertilization with chicken manure.

Effect of biofertilizers:

Data presented in Table 5 illustrated the effect of inoculation of sweet pepper plants with biofertilizers on chlorophylls, N, P and K percentages in sweet pepper leaves. It was noticed that the highest significant values of the mentioned parameters were obtained by inoculation with biofertilizer in both seasons compared to the uninoculated plants.

The significant effect of biofertilizers may be due to the fact that biofertilizers have a positive effect on chemical composition in leaves by providing doses of nutrient to the plants and in some cases to provide plants with some promoting growth regulators. In addition, biofertilizer increase microorganisms living in the soil and these microorganisms working on the organic matter in the soil to convert organic N to mineral N (Lampkin, 1990).
Biofertilizers play a fundamental role in converting P and K fixed form to be ready soluble for plant nutrition and making the uptake of nutrients by plants more easy. These results are in conformity with the findings of Supangani *et al*. (2006); kaya *et al.* (2009) and Khan *et al.* (2012), who showed that application of biofertilizers (N-fixing bacteria, P-dissolving microorganisms and K-solubilizing bacteria) increased chemical constituents of sweet pepper leaves.

Effect of foliar application treatments:

The obtained results in Table 5 showed that spraying pepper plants with seaweed extract, yeast extract and humic acid significantly increased chlorophylls, N, P and K content in leaves in the two growing seasons as compared to the control treatment (sprayed with tap water). Data clearly showed that the highest significant values of the formentioned parameters were recorded by spraying plants with seaweed extract (2.5 ml/L) followed by spraying yeast extract (5g/L). No significant differences were detected between both seaweed extract and yeast treatments on all studied characters except for K content in leaves.

With respect to the enhancement of seaweed extract on chlorophylls, seaweed extracts have been found to contain significant amounts of cytokinins, auxins and betaines, which enhance chlorophyll concentration in the leaves (Schwab and Raab, 2004). Also, this increase in chlorophyll content may be due to a decrease in chlorophyll degradation (Whapham *et al.,* 1993). Our findings coincide with some earlier findings of El-Aidy *et al.* (2002), who observed that application of seaweed extract increased chlorophyll content in sweet pepper leaves.

Regarding the enhancement of seaweed extract to N, P and K, seaweed extracts have been found to improve root system which could be influenced by endogenous auxins as well as other compounds in the extracts (Crouch *et al.,* 1992). Seaweed extracts improve nutrient uptake by roots

(Crouch *et al.,* 1990), resulting in root systems with improved water and nutrient efficiency, thereby causing enhancement in general plant growth and vigor. Similar results were obtained by Hamed (1997) and El-Aidy *et al.* (2002). They indicated that foliar application of seaweed extract increased N, P and K contents in sweet pepper leaves.

Effect of interaction among organic manure sources, biofertilizers and foliar application treatments:

With respect of the effect of interaction among organic manure sources, biofertilizers and foliar application treatments on chemical constituents of sweet pepper leaves, it is evident from such data presented in Table 6 that the combination between the three factors had a significant marked effect on leaf content of chlorophylls (a, b and a+ b) as well as N, P and K content in sweet pepper plants in both seasons. It was clearly noticed that the best records in the mentioned characters were obtained by plants fertilized with chicken manure, inoculated with biofertilizers and sprayed with seaweed extract (2.5 ml/L) followed by yeast treatment (without significant differences between the two foliar treatments in all measured characters except for K content in the two seasons). The lowest values of all measured parameters were recorded by adding compost without biofertilizers and foliar application in both seasons.

Table 6: Effect of interaction among organic manure sources, biofertilizers and foliar applications on chemical constituents of sweet pepper leaves during 2010 and 2011 seasons.

Treatments			Chl. a (mg/100gm)		Chl. b (mg/100gm)		Total (a+b) (mg/100gm)		N (%)		P (%)		K (%)	
			2010	2011	2010	2011	2010	2011	2010	2011	2010	2011	2010	2011
Chicken manure	With(*Az.*+*Bac.*+AMF)	Seaweed extract	1.25	1.24	0.87	0.86	2.12	2.10	4.20	4.03	0.97	0.98	1.97	1.87
		Yeast extract	1.19	1.18	0.86	0.86	2.04	2.03	4.03	3.88	0.96	0.95	1.85	1.75
		Humic acid	1.15	1.14	0.85	0.85	2.00	1.99	3.27	3.17	0.91	0.92	1.83	1.73
		Control	1.14	1.13	0.85	0.84	1.99	1.97	3.15	3.03	0.90	0.89	1.81	1.72
	Without	Seaweed extract	1.14	1.13	0.84	0.84	1.98	1.96	3.14	3.02	0.79	0.78	1.77	1.69
		Yeast extract	1.13	1.2	0.83	0.83	1.96	1.94	2.89	2.80	0.75	0.74	1.72	1.62
		Humic acid	1.12	1.11	0.82	0.81	1.94	1.92	2.89	2.77	0.66	0.65	1.70	1.61
		Control	1.12	1.11	0.80	0.80	1.92	1.90	2.76	2.66	0.64	0.65	1.70	1.60
Compost	With(*Az.*+*Bac.*+AMF)	Seaweed extract	1.10	1.09	0.79	0.78	1.90	1.88	2.59	2.48	0.62	0.61	1.69	1.59
		Yeast extract	1.10	1.09	0.79	0.78	1.89	1.87	2.54	2.45	0.57	0.57	1.66	1.57
		Humic acid	1.10	1.09	0.78	0.78	1.88	1.86	2.33	2.25	0.57	0.57	1.60	1.50
		Control	1.09	1.08	0.78	0.77	1.87	1.86	2.28	2.22	0.54	0.54	1.54	1.43
	Without	Seaweed extract	1.08	1.07	0.78	0.77	1.86	1.84	1.91	1.84	0.51	0.51	1.51	1.41
		Yeast extract	1.08	1.07	0.77	0.77	1.85	1.83	1.80	1.70	0.49	0.49	1.50	1.40
		Humic acid	0.97	0.96	0.70	0.70	1.68	1.66	1.23	1.14	0.46	0.46	1.49	1.39
		Control	0.74	0.73	0.62	0.61	1.36	1.34	0.16	0.06	0.36	0.35	1.46	1.36
LSD at 5%			0.09	0.09	0.05	0.05	0.13	0.13	0.79	0.77	0.15	0.16	0.08	0.07

***Az: Azotobacter chroococcum, Bac: Bacillus circulans* and AMF: Arbuscular Mycorrhizal Fungi.**

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استجابه نباتات الفلفل الحلو (النمو الخضري والمحتوى الكيماوي للأوراق) للتسميد العضوي والحيوي وبعض معاملات الرش الورقي

كوثر كامل ضوه ، حسام محمد السعيد عبد النبي و ولاء محمد السعيد سويلم
قسم الخضر والزينة- كلية الزراعة- جامعة المنصورة – مصر

أجريت هذه الدراسة خلال موسمي صيف 2010-2011 بمزرعة خاصة بقرية صهرجت الصغرى قرب مدينة المنصورة- محافظة الدقهلية بهدف دراسة تأثير مصدرين من التسميد العضوي (سماد الدواجن والكمبوست) والتسميد الحيوي (مخلوط من بكتريا الأزوتوباكتر والبكتريا االمذيبة للبوتاسيوم وفطر الميكروهيزا) وبعض معاملات الرش الورقي (مستخلص الطحالب، مستخلص الخميرة، الهيوميك أسيد) والتفاعل بينهم على النمو الخضري والمحتوى الكيماوي لأوراق نباتات الفلفل الحلو هجين مادير.

ويمكن تلخيص أهم النتائج المتحصل عليها كالتالي:-

١. أعطت معاملة تسميد النباتات بسماد الدواجن بمعدل 2.43 طن/فدان أعلى القيم لصفات النمو الخضري والممثلة في ارتفاع النبات، عدد الأوراق، عدد الأفرع، المساحة الورقية، الوزن الطازج والجاف وكذلك المحتوى الكيماوي للأوراق مثل كلوروفيل أ، كلوروفيل ب، الكلوروفيل الكلي أ + ب، النسبة المئوية للنيتروجين والفوسفور والبوتاسيوم عند المقارنة بمعاملة الكمبوست في موسمي الزراعة.
٢. أدى تلقيح النباتات بالسماد الحيوي الى زيادة معنوية في كل قياسات النمو الخضري وكذلك المحتوى الكيماوي للأوراق مقارنة بالنباتات غير المعاملة بالسماد الحيوي.
٣. أدت معاملة النباتات بمستخلص الطحالب بتركيز 2.5 مل/لتر أو مستخلص الخميرة بمعدل 5 جم/لتر الى زيادة معنوية في معظم الصفات المدروسة عند المقارنة بمعاملة الكنترول في موسمي الزراعة. بينما جاءت معاملة الرش بالهيوميك أسيد في المرتبة الثانية حيث أدت الى زيادة معنوية في صفات عدد الأفرع والوزن الطازج والجاف في موسمي الزراعة وكذلك المساحة الورقية في الموسم الثانية عند المقارنة بمعاملة الكنترول.
٤. كانت أفضل النتائج بالنسبة لصفات النمو الخضري وكذلك المحتوى الكيماوي ناتجة عن تسميد النباتات بسماد الدواجن بمعدل 2.43 طن/فدان والرش بمستخلص الطحالب بتركيز 2.5 مل/لتر أو مستخلص الخميرة بتركيز 5 جم/لتر في وجود السماد الحيوي حيث يمكن أن نوصي بها لتحسين أداء نباتات الفلفل تحت ظروف مشابهة لظروف التجربة.

قام بتحكيم البحث

أ.د / السيد طرطوره	**كلية الزراعة – جامعة المنصورة**
أ.د / سمير كامل الصيفى	**كلية الزراعة – جامعة قناة السويس**

Table 4: Effect of interaction among organic manure sources, biofertilizers and foliar applications on vegetative growth parameters of sweet pepper plants during 2010 and 2011 seasons.

Treatments			Plant height (cm)		No. of leaves		No. of branches		Fresh weight/plant (gm)		Dry weight/plant (gm)		Leaf area/plant (m^2)	
			2010	2011	2010	2011	2010	2011	2010	2011	2010	2011	2010	2011
Chicken manure	With(*Az.+Bac.*+AMF)	Seaweed extract	71.50	71.10	275.6	267.3	12.0	12.0	952.43	938.20	196.40	192.20	3.06	3.20
		Yeast	70.83	70.20	245.0	232.3	10.3	10.3	914.33	906.00	179.33	176.16	2.91	2.66
		Humic acid	68.83	67.90	240.0	230.6	10.3	10.3	870.66	857.76	176.00	172.93	2.68	2.33
		Control	68.16	67.86	239.0	229.3	10.0	10.0	832.76	821.76	168.43	163.63	2.32	2.10
	Without	Seaweed extract	67.93	67.13	231.0	223.0	9.6	9.6	819.46	811.33	165.20	162.76	1.88	1.83
		Yeast extract	65.50	64.53	230.6	226.6	9.3	9.3	812.00	803.43	164.03	159.66	1.80	1.58
		Humic acid	64.16	62.36	228.6	223.6	9.0	9.0	804.00	799.66	161.36	159.20	1.75	1.45
		Control	63.83	63.86	226.3	215.0	8.6	8.6	795.86	782.9	159.50	155.86	1.74	1.43
Compost	With(*Az.+Bac.*+AMF)	Seaweed extract	63.70	63.36	224.6	221.6	8.6	8.6	793.33	783.2	158.16	154.70	2.39	2.08
		Yeast extract	62.93	61.90	222.6	217.3	8.3	8.3	779.66	770.33	157.90	153.46	2.28	2.06
		Humic acid	62.16	60.70	219.0	210.0	7.6	7.6	733.90	688.20	148.50	143.83	2.09	1.99
		Control	61.93	59.96	215.0	212.0	7.3	7.3	727.43	717.53	143.90	140.46	2.25	2.16
	Without	Seaweed extract	61.06	59.93	205.3	195.6	7.0	7.0	713.43	701.56	134.83	131.73	2.14	1.79
		Yeast extract	60.26	59.20	199.0	192.6	6.3	6.3	677.43	664.90	123.93	127.20	2.11	1.78
		Humic acid	59.26	57.00	177.0	167.6	6.0	6.0	638.63	626.23	121.73	115.56	2.10	1.80
		Control	45.06	51.63	145.0	138.0	4.6	4.6	525.33	515.33	88.10	85.9	1.62	1.61
LSD at 5%			5.14	4.82	29.4	26.5	1.1	1.1	63.41	62.77	19.13	14.91	0.15	0.37

Az: Azotobacter chroococcum, Bac: Bacillus circulans **and AMF: Arbuscular Mycorrhizal Fungi.**

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