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Effect of Organic, Bio Fertilization and Foliar Spraying Treatments on Artichoke

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ABSTRACT

Two field experiments were carried out at a private Farm in El-Madany Village, Abo El-Matamir Region, El-Behira Governorate, Egypt, during seasons of 2014/2015 and 2015/2016 in order to determine the influence of organic, biological fertilization and foliar spraying treatments in addition their interactions on growth, yield and yield attributes and chemical composition of artichoke Balady cultivar. The experiment was carried out in a strip-split plot design with four replications. The vertical-plots were allocated to organic fertilization treatments *i.e.* farmyard manure "FYM" (30 m^3 per fed) and chicken manure (20 m^3 per fed). The horizontal-plots were included biological fertilization treatments *i.e.* without biological fertilization (control treatment), treated soil with Mycorrhiza at the rate of 1 L/20 L water and Phosphorin (as a source of phosphorus) at the rate of 450 g/fed. The sub-plots were faithful to treatments of foliar spraying *i.e.* without (control treatment), yeast extract (100 ml/liter water), algae (1.0 g/liter water) and humic acid "HA" (1.5 ml/liter water). The obtained results could be summarized as follows:Artichoke plants which fertilized with chicken manure (20 m^3 per fed) recorded the highest values of all studied characters, with exception nitrate content in receptacles in both seasons. Biological fertilizing soil with Mycorrhiza at the rate of 1 L/20 L water gave highest values of every studied traits, except nitrate content in artichoke receptacles in both seasons. Foliar spraying artichoke plants with HA (1.5 ml/liter water) exceeded other spraying treatments and gave maximum values of all studied traits, except nitrate content in receptacles in both seasons.It can be concluded that when added to soil organic fertilizer as chicken manure (20 m^3 per fed) and treated soil with Mycorrhiza at the rate of 1 L/20 L water in addition to foliar spraying three times after 60, 75 and 90 days from planting date with HA (1.5 ml/liter water) in order to obtain high productivity and chemical composition of artichoke Balady cultivar under the environmental conditions of Abo El-Matamir Region, El-Behira Governorate, Egypt.

Keywords: Artichoke, farmyard manure, chicken manure, Mycorrhiza, Phosphorin, foliar spraying treatments, Yeast extract, algae, humic acid, growth, yield, chemical composition.

INTRODUCTION

The artichoke (*Cynara scolymus* L.) is a herbaceous plant grown all over the world for its large and fleshy heads. Most of the farming areas in the Mediterranean countries. Artichoke is an important vegetable crop in Egypt because of its nutritive and medical values. The immature flower bud (head) is the edible part of the crop which includes the fleshy receptacle and fleshy tender basis of bracts. Artichoke is widely used in human diet, characterized by low protein and fat, high content of minerals, fibers, vitamins, inulin, carbohydrates and polyphenolic compounds. The edible flower buds and other artichoke plant extracts are rich in polyphenols and have high levels of antioxidant activity (Liorach *et al.*, 2002). Moreover, it gained a highly exportable importance to the European markets.

It is well known that high productivity of any crop is the final goal of many factors and operations. In addition, the pronounced role of the agronomical processes such as organic and biological fertilization and foliar spraying treatments has very important effect on productivity and quality of artichoke crop.

Farmyard manure (FYM) is considered the most important organic manures, which contains many nutrients required to crop growth such as macro and micronutrents. Sheng Mao *et al.* (2006) showed that FYM provides with sufficient amounts of many nutrients (N and K), which requaied fro balance crop supplies and lead to improve of onion bulb yield. Huosman *et al.* (2016) concluded that for sustainable production of garlic, it can be application of 10 ton per hectare of farmyard manure will enhanced yield and profitability of garlic.

Chicken manure is natural, locally available and relatively cheap material that the organic vegetable growers can obtain. While, inorganic fertilizers are relatively expensive and can potentially contaminate the environment. The efficiency of manure utilization by a crop is determined by the method of application, time to incorporation and the rate of decomposition in the soil. Shiyam and Binang (2013) indicated that significant increases in vine length, leaf proliferation, fresh leaf weight/plant and dry matter production of fluted pumpkin were obtained by applying chicken manure at the rate of 24 t/ha. Habimana *et al.* (2014) found that the geatest values of plant and leaves lengths and marketable root yield of carrot were obtained in the combination of chicken manure and NPK fertilizer and the lowest were in the absolute control.

Arbuscular mycorrhizal fungi be able to also benefit from plants by stimulating the production of regulated substances for growth, increase photosynthesis, improve osmotic adjustment under drought and salinity pressure and increase resistance to soil-borne pests and diseases (Al-Karaki, 2006). Mycorrhiza is one of the promising bio-techniques that can be used effectively for increasing P-availability in soil and improving its uptake by plants, particularly the perennial crops like artichokes (Ezz El-Din *et al.*, 2010). Shams (2014) revealed that vessicular arbuscular mycorrhizas recorded the highest plant growth and total yield beside of improving the quality of heads of artichoke.

Phosphorin is a bio-fertilizer product containing active micro-organisms hydrolyzing the insoluble phosphate into soluble form under high soil pH. Therefore, the utilization of bio-fertilizers may be dissolve the unavailable form of phosphate to available form as indicated by Gmaa (2015) who showed that nitrobin biofertilizer enhanced tomato growth traits and

yield (plant height, leaves number/plant, plant fresh weight) especially when combined with phosphorin and potassumage as compared to control.

The foliar application with biostimulants such as yeast extract, algae and humic acid have very important role in improving fruit set, productivity and quality of vegetables. It has also beneficial role in recovery of nutritional and physiological disorders in vegetables.

Eid (2013) suggested that using yeast as a bioagents and safety chemicals to increase the activity of all assessed enzymes, which commercially used for controlling stem rot disease for Jerusalem artichokes plants. Hafez (2013) revealed that foliar spraying with yeast gave the highest values of vegetative growth, yield and its components and quality parameters of Jerusalem artichoke as a result of its elevated auxin and cytokinins contents and augmentation carbohydrates content. Its stimulatory effects on cell division and enlargement, protein and nucleic acid synthesis and chlorophyll formation, in addition to its content of dry protective agent *i.e.* sugars, protein , amino acids and also several vitamins (Mahmoued, 2001)..

Shalaby and El-Ramady (2014) found that foliar applications with seaweed extract (Alga 600) effectively increased plant height, number of leaves/plant and bulb weight of garlic plants. Arafa *et al.* (2013) studied the effect of foliar spraying with seaweed extract on growth, carbohydrates concentration and ion percentage in the shoots of potato plants. They showed that foliar spraying with seaweed extract significantly increased carbohydrate concentration of potato.

Humic acid is a commercial product recognized as a plant growth promoter contains many elements which improve the soil fertility, increase the availability of nutrients, enhancing roots, plant growth, development and plant tolerance against both biotic and a biotic stresses and quality of crop, and consequently increase plant growth and yield (Abd El-Al *et al.*, 2005). Samy *et al.* (2015) showed that application of humic acid at the rate of 1 g/L increased number of leaves/plant, dry weight of foliage, number of tubers, yield per plant and total yield per feddan of Jerusalem artichoke. Said-Al Ahl *et al.* (2016) revealed that humic acid foliar application at the rate of 400 ppm gave the best results of survival %, plant height, number of branches, number of umbles and seed oil yield of dill.

Therefore, this investigation aimed to find out the impact of organic, biological fertilization and foliar spraying treatments desides their interactions on growth traits, yield and yield components and chemical composition of artichoke under the environmental conditions of Abu El-Matamir Region, Al-Buhayrah Governorate, Egypt.

MATERIALS AND METHODS

Two field experiments were carried out at a private Farm in El-Madany Village, Abu El-Matamir Region, El-Behira Governorate, Egypt, during seasons of 2014/2015 and to find out the impact of organic, biological fertilization and foliar spraying treatments as well as their interactions on growth parameter, yield and yield attributes in addition chemical composition of artichoke Balady cultivar.

This trial was carried out in a strip-split plot design with . replications. The vertical-plots owed to two organic fertilization treatments as following:

1- FYM (30 m^3/fed).
2- Chicken manure (20 m^3/fed.

FYM and chicken manure were added at the aforementioned rates after determining the experimental units on soil surface and then turned over via hack. Chemical analysis of used FYM and chicken manure in both years are showed in Table 1.

The horizontal-plots were included three treatments of bio-fertilization as follows:

1- Without biological fertilization (control treatment).
2- Treated soil with Mycorrhiza at the rate of 1 L/20 L water.
3- Treated soil with Phosphorin (as a source of phosphorus) at the rate of 450 g/fed.

Table 1. Mean values of chemical analysis of FYM and chicken manure used in this study during the two seasons of 2014/2015 and 2015/2016.

Properties	Farmyard manure (FYM)	Chicken manure (CM)
Moisture (%)	12.96	11.40
OM (%)	39.16	50.97
C/N ratio	26 / 1	11 / 1
N (%)	1.65	2.24
P (%)	0.45	0.50
K (%)	1.40	1.69
Mg (%)	1.95	2.75
pH	7.91	7.83
EC m.mohs/cm	1.82	1.81
Fe (ppm)	710.2	740.5
Mn (ppm)	808.3	805.6
Zn (ppm)	365.4	385.7

Phosphorin as commercial products of biofertilizers was produced by Biofertilizer Unit, Agriculture Research Region (ARC), Giza, Egypt, which included free-living bacteria able to fix atmospheric phosphorus in the rhizosphere of soil. Mycorrhiza was obtained from Biofertilizer Unit, Microbiology Department, Faculty of Agriculture, Ein Shams University.

The biofertilizers were added to soil at three times at the aforesaid levels after 60, 75 and 90 days from planting as side-dress near from artichoke plants. Sub-plots dedicated to 4 treatments of foliar spraying like this:

1- Without (control treatment).
2- Spraying with yeast extract (100 ml/liter water).
3- Spraying with algae (1.0 g/liter water).
4- Spraying with HA (1.5 ml/liter water).

Yeast extract as natural biostimulants was prepared by using Spencer *et al.* (1983) method.

HA in the form of Uni-humic which contains 18.5 % high purity humic acid in liquid form, 1.5% folic acid 0.5 % K_2O and 0.5-1.0 % micronutrients (Fe, Zn and Mn), was manufactured by United for Agricultural Development and distributed by Al-Hayah for Agricultural Projects.

The foliar solution (200 Liter/fed) was sprayed by hand sprayer to dissemination point. Foliar spraying with these treatments was carried out three times at the aforesaid levels after 60, 75 and 90 days of planting.

The experimental (sub – plot) incorporated 3 ridges, each of 1.0 m width and 4.0 m length (12.0 m^2).

The experimental field prepared through ploughing, leveling, compaction, ridging and then divided into the units (12.0 m^2).

Artichoke seedlings produced when divided mother plants (parts) were immediately planted in the moderately moist soil on 15th and 25th August in the first and second seasons, respectively. Seedlings were cultivated in hills (1 part/hill) by hand at 70 cm apart on one side of the ridge.

Calcium super phosphate "15.5 % P_2O_5" at the recommended rate (62.0 kg P_2O_5/fed) was applied during soil preparation. K fertilizer (potassium sulphate, 48.0 % K_2O) at the recommended rate (48.0 kg K_2O/fed) and nitrogen fertilizer (ammonium nitrate, 33.5 % N) at the recommended rate (167.5 kg N/fed) were used in two equal doses, the first one was added before the first irrigation and the second one was before the following irrigation.

According to the recommendations of Ministry of Agriculture and Land Reclamation, other agricultural practices for growing artichoke were done in the two seasons, except the factors under study.

Data recorded:

A. Vegetative growth traits:

At approximately 120 days after planting date, samples of 5 plants were randomly taken from each experimental unit to decide the next parameters:

1. Chlorophylls content: It was measured using spectrophotometer (Ouzounidou and Strasser, 1997) to determine chlorophyll a and chlorophyll b.
2. Dry matter percentage (%): The plants sample were weighed as fresh weight and oven dried at 70 °C until stable weight and weighted, then calculated dry matter %.

B. Yield and its components:

From 15th December to 30th April in each season (harvesting stage), samples of 5 receptacles were harvested from each experimental unit to determine the following parameters:

1. Fresh weight of heads (g).
2. Dry weight of heads (g).
3. Total yield of heads (t/fed.)

D. Quality parameters in the receptacles:

- **Total soluble solids percentage (TSS %)**: 10 random samples of artichoke receptacles from each plot were taken to determine the total soluble solids (TSS) by using Hand Refractometer.
- **Total sugars percentage (%):** It was determined according to the method of Forsee (1938).
- **Protein (%):** It was intended by multiplying the total nitrogen by 6.25.
- **Nitrate content (NO_3-N ppm):** It was determined according to the method described by Singh (1988).
- **total Inuline percentage (%):** It was estimated according to a simplified spectrophotometric method as described by Araya and Suporn (2011).

All recorded data were analyzed according to ANOVA method for strip-split plot design as described by Gomez and Gomez (1984) using "MSTAT-C". LSD method was used to compare the differences among treatment means (5 % level of probability) as described by Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

1- Effect of organic fertilization:

From obtained results in Tables 2, 4, 6 and 8, it could be state that artichoke plants were fertilized with chicken manure (20 m^3 per fed) recorded the highest significant means of vegetative growth characters, yield and yield components and chemical constituents in the receptacles in both seasons of this study, with exception nitrate content (NO_3-N) in artichoke receptacles, where the highest values were obtained by using FYM (30 m^3/fed) in both seasons.

These increases due to fertilized artichoke plants with chicken manure may be due to supply adequate amounts of organic matter and nutrients like N, P and K (Table 1), which lead to balance crop requirements and improving plant growth as well as dry matter accumulation in artichoke plant. Similar results were confirmed by Habimana *et al.* (2014).

2- Effect of bio-fertilization treatments:

Regarding the effect of biological fertilization treatments *i.e.* without biological fertilization (control treatment), treated soil with Mycorrhiza at the rate of 1 L/20 L water and Phosphorin at the rate of 450 g/fed on vegetative growth traits, yield and yield components and chemical constituents in the receptacles, the obtained results of this study apparently cleared that there were significant effects of studied biological fertilization treatments on all studied characters in both seasons as shown in Tables 2, 4, 6 and 8.

It could be notice that biological fertilizing soil with Mycorrhiza at the rate of 1 L/20 L water gave the highest means of vegetative growth characters, yield and yield components and chemical constituents in the artichoke receptacles, except nitrate content (NO_3-N) in artichoke receptacles in both seasons. Biological fertilizing artichoke soil with Phosphorin at the rate of 450 g/fed ranked secondly after treatment with Mycorrhiza concerning its effect on every one studied characters in the two seasons. Adversely, the lowest means were obtained from control treatment (without biological fertilization), excepting nitrate content (NO_3-N) in artichoke receptacles in both seasons. On the contrary of that, artichoke plants did not biological fertilizing (control treatment) produced the highest nitrate content (NO_3-N) in artichoke receptacles in both

seasons.

Such increments as a result of biological fertilization treatments may be certified to its successful roles in humanizing soil properties and increasing the status of minerals release in suitable form to be absorbed by plants. The superiority of Mycorrhiza may be due to symbiosis through greater and faster root structure development as well as through numerous mechanisms such as greater water absorption and a higher resistance to both parasite attacks on the root structure and different types of stress (Ezz El-Din *et al.*, 2010).These effect are in good accordance with those of Shams (2014), and Gmaa (2015).

3-EFFECT OF FOLIAR SPRAYING TREATMENTS:

The obtained results show that studied treatments of foliar spraying *i.e.* without (control treatment), yeast extract (100 ml/liter water), algae (1.0 g/liter water) and HA (1.5 ml/liter water) affected significantly vegetative growth traits, yield and yield attributes and chemical constituents in the receptacles in both seasons as shown in Tables 2, 4, 6 and 8.

There were substantial differences in these characters among all foliar spraying treatments and control treatment in both seasons. Foliar spraying artichoke plants with HA (1.5 ml/liter water) surpassed other treatments of foliar spraying and resulted in the highest means of vegetative growth characters, yield and its components and chemical constituents in the artichoke receptacles, except nitrate content (NO_3-N) in artichoke receptacles in both seasons of this study. The second best foliar spraying treatment was foliar spraying with yeast extract (100 ml/liter water), and followed by spraying with algae (1.0 g/liter water) in both seasons. Whereas, the lowest values were obtained from control treatment (without foliar spraying), excluding nitrate content (NO_3-N) in artichoke receptacles in both seasons. Foliar spraying artichoke plants three times with HA (1.5 ml/liter water) produced the lowest nitrate content (NO_3-N) in artichoke receptacles in both seasons. On contrary, artichoke plants grown without spraying resulted in the greatest nitrate content (NO_3-N) in artichoke receptacles in both seasons.

The desirable effect of spraying artichoke plants three times with humic acid treatment might have been due to humic acid is a commercial product recognized as a plant growth promoter contains many elements which improve the soil fertility, increase the availability of nutrients, enhance plant tolerance against both biotic and biotic stresses (Abd El-Al *et al.*, 2005). In addition, improving early artichoke growth, more dry matter accumulation and stimulated the building of metabolic products which translocated to receptacles. These results are in partial compatible with those recorded by Hafez (2013), Samy *et al.* (2015) and Said-Al Ahl *et al.* (2016).

4- Effect of interactions:

As regards the interaction among organic × biological fertilization × foliar spraying treatments, it revealed that marketable effect on total sugars % in artichoke (in the first season), total chlorophylls in artichoke leaves (in the second season), chlorophyll b in artichoke leaves, dry matter percentage in artichoke plants, fresh and dry weights of heads, total yield of heads /fed, total soluble solids percentage in artichoke receptacles, crude protein percentage in artichoke receptacles and inuline percentages in artichoke receptacles (in both seasons) as presented in Tables 3, 5, 7 and 9.

Table 2. Chlorophyll a, b and total chlorophylls in artichoke leaves and dry matter percentage in artichoke plants as affected by organic, biological fertilization and foliar spraying treatments as well as their interactions during 2014/2015 and 2015/2016 seasons.

Characters Treatments	Chlorophyll a (mg/g FW)		Chlorophyll b (mg/g FW)		Total chlorophylls (mg/g FW)		Dry matter (%)	
	2014/2015	2015/2016	2014/2015	2015/2016	2014/2015	2015/2016	2014/2015	2015/2016
A- Organic fertilization treatments:								
Farmyard manure	0.491	0.523	0.374	0.386	0.865	0.929	14.43	14.70
Chicken manure	0.559	0.617	0.426	0.440	0.990	1.059	15.02	15.30
F. test	*	*	*	*	*	*	*	*
B- Biological fertilization treatments:								
Without	0.500	0.551	0.378	0.391	0.878	0.941	14.23	14.46
Microhiza	0.544	0.586	0.415	0.426	0.964	1.025	15.08	15.35
Phosphorin	0.532	0.574	0.408	0.422	0.941	1.016	14.87	15.18
LSD at 5 %	0.009	0.019	0.003	0.009	0.019	0.013	0.10	0.05
C- Foliar spraying treatments:								
Without	0.496	0.543	0.373	0.384	0.869	0.925	14.07	14.32
Yeast	0.534	0.570	0.409	0.426	0.943	1.017	14.99	15.25
Algae	0.524	0.563	0.394	0.403	0.924	0.980	14.60	14.85
Humic acid	0.548	0.605	0.424	0.439	0.975	1.054	15.24	15.56
LSD at 5 %	0.007	0.014	0.003	0.008	0.011	0.010	0.08	0.06
D- Interactions:								
A × B	NS	NS	NS	NS	NS	NS	NS	NS
A × C	NS	NS	NS	NS	NS	*	NS	NS
B × C	*	NS	*	*	*	*	*	*
A × B × C	NS	NS	*	*	NS	*	*	*

Table 3. Chlorophyll a, b and total chlorophylls in artichoke leaves and dry matter percentage in artichoke plants as affected by the interaction among organic, biological fertilization and foliar spraying treatments during 2014/2015 and 2015/2016 seasons.

Treatments			Chlorophyll a (mg/g FW)		Chlorophyll b (mg/g FW)		Total chlorophylls (mg/g FW)		Dry matter (%)	
Organic	**Biological**	**Spraying treatments**	2014/ 2015	2015/ 2016	2014/ 2015	2015/ 2016	2014/ 2015	2015/ 2016	2014/ 2015	2015/ 2016
Farmyard manure	Without	Without	0.450	0.489	0.333	0.342	0.783	0.829	13.52	13.81
		Yeast	0.478	0.523	0.364	0.375	0.842	0.898	14.17	14.42
		Algae	0.457	0.498	0.340	0.352	0.797	0.847	13.69	13.94
		Humic acid	0.482	0.533	0.374	0.382	0.856	0.917	14.42	14.60
	Microhiza	Without	0.471	0.514	0.354	0.367	0.825	0.880	13.98	14.25
		Yeast	0.513	0.397	0.397	0.413	0.911	0.978	15.05	15.27
		Algae	0.532	0.552	0.389	0.399	0.921	0.953	14.75	14.93
		Humic acid	0.533	0.586	0.412	0.431	0.945	1.012	15.36	15.69
	Phosphorin	Without	0.463	0.506	0.352	0.357	0.814	0.861	13.82	14.09
		Yeast	0.502	0.563	0.393	0.404	0.895	0.968	14.88	15.09
		Algae	0.494	0.539	0.376	0.392	0.870	0.935	14.57	14.75
		Humic acid	0.523	0.578	0.404	0.421	0.926	1.071	14.92	15.52
Chicken manure	Without	Without	0.517	0.567	0.388	0.399	0.905	0.964	14.04	14.31
		Yeast	0.543	0.604	0.412	0.431	0.956	1.035	14.77	14.98
		Algae	0.526	0.578	0.392	0.408	0.917	0.987	14.24	14.48
		Humic acid	0.551	0.614	0.421	0.437	0.971	1.051	14.95	15.16
	Microhiza	Without	0.540	0.596	0.411	0.422	0.951	1.016	14.64	14.85
		Yeast	0.587	0.649	0.449	0.471	1.037	1.119	15.62	15.95
		Algae	0.572	0.633	0.435	0.421	1.044	1.087	15.25	15.61
		Humic acid	0.606	0.669	0.469	0.487	1.076	1.157	15.98	16.29
	Phosphorin	Without	0.534	0.587	0.400	0.415	0.934	0.999	14.43	14.63
		Yeast	0.578	0.641	0.440	0.462	1.018	1.103	15.45	15.78
		Algae	0.563	0.623	0.431	0.447	0.994	1.070	15.10	15.43
		Humic acid	0.597	0.649	0.466	0.477	1.075	1.117	15.81	16.12
LSD at 5 %			NS	NS	0.007	0.015	NS	0.024	0.20	0.15

Table 4. Fresh and dry weights and total yield/fed of artichoke heads as affected by organic, biological fertilization and foliar spraying treatments as well as their interactions during 2014/2015 and 2015/2016 seasons.

Characters	Fresh weight of heads (g)		Dry weight of heads (g)		Total yield of heads (t/fed)	
Treatments	**2014/ 2015**	**2015/ 2016**	**2014/ 2015**	**2015/ 2016**	**2014/ 2015**	**2015/ 2016**
A- Organic fertilization treatments:						
Farmyard manure	59.25	66.16	14.18	16.47	9.539	10.282
Chicken manure	62.68	70.72	15.91	17.93	9.744	10.396
F. test	*	*	*	*	*	*
B- Biological fertilization treatments:						
Without	59.46	67.14	14.37	14.77	9.058	9.938
Microhiza	61.93	69.33	15.39	21.13	10.002	10.681
Phosphorin	61.52	68.85	15.38	15.70	9.864	10.398
LSD at 5 %	0.34	0.47	0.21	0.32	0.157	0.163
C- Foliar spraying treatments:						
Without	59.58	66.82	14.66	14.60	9.235	9.823
Yeast	61.41	69.05	15.13	23.08	9.560	10.226
Algae	60.50	68.07	14.83	15.18	9.540	10.201
Humic acid	62.39	69.81	15.57	15.93	10.230	11.107
LSD at 5 %	0.45	0.32	0.17	0.29	0.140	0.144
D- Interactions:						
A × B	NS	NS	*	*	*	*
A × C	NS	NS	NS	NS	*	*
B × C	*	*	*	NS	*	*
A × B × C	*	*	*	*	*	*

Table 5. Fresh and dry weights and total yield/fed of artichoke heads as affected by the interaction among organic, biological fertilization and foliar spraying treatments during 2014/2015 and 2015/2016 seasons.

Treatments			Fresh weight of heads (g)		Dry weight of heads (g)		Total yield of heads (t/fed)	
Organic	Biological	Spraying treatments	2014/ 2015	2015/ 2016	2014/ 2015	2015/ 2016	2014/ 2015	2015/ 2016
Farmyard manure	Without	Without	13.35	63.90	13.06	13.35	8.137	9 .370
		Yeast	14.04	65.46	13.42	14.04	8.527	9.461
		Algae	13.45	64.30	13.23	13.45	9.008	9.855
		Humic acid	14.26	65.83	14.01	14.26	9.652	10.544
	Microhiza	Without	13.85	65.16	13.75	13.85	9.575	9.980
		Yeast	58.37	67.63	14.68	58.37	9.915	10.570
		Algae	14.63	66.80	14.33	14.63	9.827	10.481
		Humic acid	15.20	68.63	15.12	15.20	10.383	11.257
	Phosphorin	Without	13.63	64.60	14.92	13.63	9.502	9.757
		Yeast	14.82	67.06	14.53	14.82	9.882	10.522
		Algae	14.46	66.33	14.18	14.46	9.787	10.418
		Humic acid	15.12	68.23	14.94	15.12	10.272	11.167
Chicken manure	Without	Without	15.27	68.33	15.03	15.27	8.789	9.760
		Yeast	16.05	70.06	15.36	16.05	9.194	9.924
		Algae	15.47	68.76	15.18	15.47	9.179	9.937
		Humic acid	16.26	70.46	15.68	16.26	9.976	10.655
	Microhiza	Without	15.85	69.76	15.70	15.85	9.786	10.322
		Yeast	17.05	72.23	16.44	17.05	9.992	10.782
		Algae	16.66	71.36	16.18	16.66	9.885	10.415
		Humic acid	17.46	73.10	16.94	17.46	10.657	11.640
	Phosphorin	Without	15.65	69.20	15.53	15.65	9.623	9.747
		Yeast	18.18	71.83	16.33	18.18	9.733	10.098
		Algae	16.45	70.90	15.89	16.45	9.672	10.097
		Humic acid	17.27	72.63	16.71	17.27	10.439	11.377
LSD at 5 %			1.10	0.80	0.42	0.67	0.242	0.252

Table 6. Total soluble solids, total sugars and crude protein percentages in artichoke receptacles as affected by organic, biological fertilization and foliar spraying treatments as well as their interactions during 2014/2015 and 2015/2016 seasons.

Characters Treatments	TSS (%)		Total sugars (%)		Crude protein (%)	
	2014/2015	2015/2016	2014/2015	2015/2016	2014/2015	2015/2016
A- Organic fertilization treatments:						
Farmyard manure	7.54	7.26	15.94	16.12	10.20	11.59
Chicken manure	7.86	7.63	18.04	17.60	12.43	13.67
F. test	*	*	*	*	*	*
B- Biological fertilization treatments:						
Without	7.19	7.02	15.80	15.96	10.05	10.96
Microhiza	8.03	7.73	17.78	17.47	12.19	13.70
Phosphorin	7.87	7.59	17.40	17.14	11.70	13.22
LSD at 5 %	0.02	0.03	0.10	0.15	0.68	0.33
C- Foliar spraying treatments:						
Without	7.25	6.90	15.92	15.67	9.88	10.52
Yeast	7.81	7.66	17.27	17.32	11.51	13.41
Algae	7.58	7.33	16.67	16.70	11.04	12.25
Humic acid	8.16	7.89	18.11	17.75	12.83	14.32
LSD at 5 %	0.03	0.04	0.09	0.11	0.49	0.26
D- Interactions:						
A × B	NS	*	*	*	NS	NS
A × C	NS	NS	*	NS	NS	NS
B × C	*	NS	*	*	NS	*
A × B × C	*	*	*	NS	*	*

Table 7. Total soluble solids, total sugars and crude protein percentages in artichoke receptacles as affected by the interaction among organic, biological fertilization and foliar spraying treatments during 2014/2015 and 2015/2016 seasons.

Treatments			TSS (%)		Total sugars (%)		Crude protein (%)	
Organic	Biological	Spraying treatments	2014/ 2015	2015/ 2016	2014/ 2015	2015/ 2016	2014/ 2015	2015/ 2016
Farmyard manure	Without	Without	6.74	6.47	14.39	14.32	8.10	8.70
		Yeast	7.04	7.07	14.78	15.66	8.74	10.90
		Algae	6.88	6.64	14.40	14.63	8.56	9.22
		Humic acid	7.49	7.22	15.73	15.35	10.41	11.31
	Microhiza	Without	7.33	6.92	15.37	15.29	9.81	10.36
		Yeast	8.02	7.71	17.04	17.39	12.36	13.32
		Algae	7.80	7.50	16.46	16.71	11.52	12.30
		Humic acid	8.32	7.98	17.84	18.02	9.56	14.43
	Phosphorin	Without	7.20	6.77	15.12	14.95	9.24	9.83
		Yeast	7.88	7.64	16.76	17.05	10.04	12.82
		Algae	7.58	7.35	16.06	16.34	10.98	11.86
		Humic acid	8.16	7.86	17.34	17.71	13.07	13.99
Chicken manure	Without	Without	7.08	6.82	16.11	16.58	10.12	9.85
		Yeast	7.32	7.41	16.82	16.95	11.27	12.76
		Algae	7.21	6.97	16.39	16.92	10.56	11.50
		Humic acid	7.81	7.55	17.79	17.28	12.69	13.44
	Microhiza	Without	7.68	7.27	17.43	16.61	10.27	12.42
		Yeast	8.37	8.16	19.34	18.59	12.59	15.62
		Algae	8.09	7.86	18.51	17.96	11.54	14.60
		Humic acid	8.62	8.46	20.22	19.21	15.96	16.58
	Phosphorin	Without	7.47	7.13	17.12	16.26	11.77	11.99
		Yeast	8.22	7.98	18.87	18.28	14.09	15.05
		Algae	7.93	7.70	18.21	17.62	13.07	14.01
		Humic acid	8.55	8.27	19.73	18.93	15.31	16.19
LSD at 5 %			0.08	0.10	0.21	NS	1.65	1.33

Table 8. Nitrate content (NO_3-N) and inuline percentages in artichoke receptacles as affected by organic, biological fertilization and foliar spraying treatments as well as their interactions during 2014/2015 and 2015/2016 seasons.

Characters Treatments	NO_3-N (ppm)		Inulin (%)	
	2014/2015	2015/2016	2014/2015	2015/2016
A- Organic fertilization treatments:				
Farmyard manure	7.80	8.09	13.34	13.62
Chicken manure	6.07	6.44	15.05	15.33
F. test	*	*	*	*
B- Biological fertilization treatments:				
Without	7.49	7.88	13.28	13.74
Microhiza	6.63	6.86	14.92	14.97
Phosphorin	6.70	7.04	14.37	14.73
LSD at 5 %	0.16	0.09	0.03	0.05
C- Foliar spraying treatments:				
Without	7.44	7.82	13.33	13.53
Yeast	6.78	7.11	14.40	14.85
Algae	7.03	7.41	13.93	14.28
Humic acid	6.49	6.71	15.11	15.25
LSD at 5 %	0.14	0.07	0.05	0.05
D- Interactions:				
A × B	NS	NS	*	NS
A × C	*	*	*	NS
B × C	*	*	*	*
A × B × C	NS	NS	*	*

Table 9. Nitrate content (NO_3-N) and inuline percentages in artichoke receptacles as affected by the interaction among organic, biological fertilization and foliar spraying treatments during 2014/2015 and 2015/2016 seasons.

Treatments			NO_3-N (ppm)		Inulin (%)	
Organic	Biological	Spraying treatments	2014/2015	2015/2016	2014/2015	2015/2016
Farmyard manure	Without	Without	8.66	9.00	11.98	12.29
		Yeast	8.25	8.66	12.53	13.25
		Algae	8.47	8.79	12.26	12.53
		Humic acid	7.77	8.21	13.36	13.47
	Microhiza	Without	7.94	8.35	13.09	12.99
		Yeast	7.21	7.50	14.48	14.50
		Algae	7.48	7.85	13.97	13.98
		Humic acid	7.64	7.15	14.76	14.98
	Phosphorin	Without	8.14	8.52	12.48	12.75
		Yeast	7.36	7.68	13.71	14.26
		Algae	7.67	7.99	13.20	13.76
		Humic acid	7.05	7.35	14.23	14.73
Chicken manure	Without	Without	7.07	7.47	13.76	13.98
		Yeast	6.71	7.07	13.95	14.99
		Algae	6.84	7.33	13.66	14.24
		Humic acid	6.13	6.53	14.78	15.21
	Microhiza	Without	6.34	6.69	14.49	14.73
		Yeast	5.49	5.79	16.05	16.18
		Algae	5.78	6.17	15.38	15.72
		Humic acid	5.13	5.42	17.16	16.67
	Phosphorin	Without	6.50	6.91	14.19	14.46
		Yeast	5.66	5.97	15.67	15.96
		Algae	5.98	6.35	15.12	15.46
		Humic acid	5.26	5.59	16.38	16.44
LSD at 5 %			NS	NS	0.12	0.13

The best interaction treatment that produced the optimum values of aforementioned characters was organic fertilizing soil with chicken manure (20 m^3 per fed) and treated soil with Mycorrhiza at the rate of 1 L/20 L water in addition to foliar spraying three times with HA (1.5 ml/liter water) in both seasons. The second best interaction treatment was organic fertilizing with chicken manure and Phosphorin beside foliar spraying three times with humic acid in both seasons. Despite the fact that, organic fertilizing with farmyard manure and without biological fertilizing soil with any biological fertilizers and without foliar spraying resulted in the minimum values of formerly mentioned characters in both seasons.

CONCLUSION

It can be concluded that organic fertilizing soil with chicken manure (20 m^3 per fed) and treated soil with Mycorrhiza at the rate of 1 L/20 L water in addition to foliar spraying three times after 60, 75 and 90 days from planting with HA (1.5 ml/liter water) in order to obtain high growth, yield and its components and chemical composition of artichoke Balady cultivar under the environmental conditions of Abo El-Matamir Region, El-Behira Governorate, Egypt.

REFERENCES

Abd El-Al, F.S. ; M.R. Shafeek ; A.A. Ahmed and A.M. Shaheen (2005). Response of growth and yield of onion plants to potassium fertilizer and humic acid. J. Agric. Sci. Mansoura Univ. 30(1): 441-452.

Al-Karaki, G.N. (2006). Nursery inoculation of tomato with arbuscular mycorrhizal fungi and subsequent performance under irrigation with saline water. Sci. Hort., 109: 1-7.

Arafa, A.A. ; S.F. Hussien and H.S. Mohamed (2013). Effect of potassium fertilizer, biostimulants and effective microorganisms on growth, carbohydrates concentration and ion percentage in the shoots of potato plants. . Plant Production, Mansoura Univ., 4(1): 15-32.

Araya, S. and N. Suporn (2011). A simplified spectrophotometric for the determination of inulin in Jerusalem artichoke tubers. Euro. Food Res. Tech., 233: 609-616.

Eid, K. (2013). Field applications of some bioagents and safety chemicals to control stem rot disease of Jerusalem artichoke (*Helianthus tuberosu*s L.). J. of App. Sci. Res., 9(11): 5825-5834.

Ezz El-Din, A.A. ; E.E. Aziz ; S.F. Hendawy and E.A. Omer (2010). Impact of phosphorus nutrition and number of cuttings on growth, yield and active constituents of artichoke. Intern. J. of Academic Res., 2(4): 240-244.

Forsee, W. T. (1938). Determination of sugar in plant materials a photoelectric method. Indus. Eng. Chem. Anal. Ed. 10: 411-418.

Gmaa, S.S. (2015). Effect of organic and bio-fertilization on tomato production. Intern. J. of Adv. Res., 3(10): 1799-1805.

Gomez, K.N. and A.A. Gomez (1984). Statistical procedures for agricultural research. John Wiley and Sons, New York, 2nd ed., 68 p (C.F. computer Search).

Habimana, S. ; C. Uwamahoro and J.B. Uwizerwa (2014). Influence of chicken manure and NPK (17-17-17) fertilizer on growth and yield of carrot. Net J. of Agric. Sci., 2(4): 117-123.

Hafez, M. R. (2013). Effect of some biological components on Jerusalem artichoke (*Helianthus tuberosus* L.) productivity under north sinai conditions. J. of App. Sci. Res., , 9(1): 804-810.

Huosman, Z.A. ; B.N. Asari and S.J. Musa (2016). Effects of farmyard manure and spacing on the growth and yield of garlic in Zaria, Nigeria. African J. of Agric. Econ. and Rural Dev., 4 (6): 400-403.

Liorach, R. ; J.C. Espin ; F.A. Tomas and F. Ferreres (2002). Artichoke (*Cynara scolymus*) by product as a potential source of Health promoting antioxidant phenolics. J of Agri. & Food Chem., 50: 3458-3464.

Mahmoued, T.R. (2001). Botanical studies on the growth and germination of Mahnolia (*Magnolia grandiflora* L.) plants. M. Sci. Thesis. Fac. of Agric. Moshtohor, Zagazig Univ., Egypt.

Ouzounidou, G.M.M and R. Strasser (1997). Sites of action of copper in the photosynthetic apparatus of maize leaves: kinetic analysis of chlorophyll fluorescence oxygen evolution, absorption changes and thermal dissipation as monitored by photoacoustic signals. Australian J. Plant physiol., 24: 81-90.

Said-Al Ahl, H.A.H ; A.G. El Gendy and E.A Omer (2016). Humic acid and indole acetic acid affect yield and essential oil of dill grown under two different locations in Egypt. J. Pharm. Sci. & Res., 8(7): 594-606.

Samy, M. M. ; Nagwa A. Mohamed and Mervat G. Abd El-Aziz (2015). Effect of boron, copper and humic acid treatments on vegetative growth, yield and storability of Jerusalem artichoke tubers. J. Product. & Dev., 20(3): 325- 342.

Shalaby, T.A. and H. El-Ramady (2014). Effect of foliar application of bio-stimulants on growth, yield, components, and storability of garlic (*Allium sativum* L.). Australian J. of Crop Sci., 8(2): 271-275.

Shams, A. S. (2014). Effect of silver nano-particles and mycorrhizae symbiosis on the development of artichoke. Intern. J. of Agric. Sci. and Res., 4(5): 27-36.

Sheng Mao, Y. ; L. Feng Min ; G. Tian Wen ; W. Jian Guo ; S. Bing Ling and J. Shao Ling (2006). Effect of long term fertilization on soil productivity and nitrate accumulation in Gansu Oasis, China. Agric. Sci. in China, 5 (1): 57-67 (C.F. computer Search).

Shiyam, J.O. and W.B. Binang (2013). Effect of poultry manure and plant population on productivity of fluted pumpkin (*Telfaiaria occidentalis* Hook F.) in Calabar, Nigeria. J. of Organic Systems, 8(2): 29-35.

Singh, J.P. (1988). A rapid method for determination of nitrate in soil and plant extracts. Plant and Soil, 110: 137-139.

Snedecor, G. W. and W. G. Cochran (1980). Statistical Methods. 7Th Ed. Iowa State University Press, Iowa, USA., PP. 507.

Spencer, T.F.T. ; S.M. Dorothy and A.R.W. Smith (1983). Yeast genetics "Fundamental and applied aspects", pp: 16-18, ISBN 387-390973-9, Springer. Verlag. New York, U.S.A.

تأثير التسميد العضوي والحيوى ومعاملات التسميد الورقى بالمواد المختلفة على النمو ومكونات المحصول والتركيب الكيميائي للخرشوف

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أجريت تجربتان حقليتان بحقل خاص بقرية المدنى ، مركز أبو المطامير، محافظة البحيرة ، مصر، خلال موسمي ٢٠١٤/٢٠١٥ و٢٠١٥/٢٠١٦ لدراسة تأثير التسميد العضوي (السماد البلدى بمعدل ٣٠ م^3 / فدان وسبلة الدواجن بمعدل ٢٠ م^3 / فدان) والحيوى (بدون تسميد حيوى "معاملة المقارنة" ومعاملة التربة بالميكورهيزا بمعدل ١ لتر / ٢٠ لتر ماء و بالفوسفورين بمعدل ٤٥٠ جم / فدان) ومعاملات التسميد الورقى بالمواد المختلفة (بدون رش ورقي "معاملة المقارنة" والرش الورقي بمستخلص الخميرة بمعدل ١٠٠ مل / لتر ماء ، بالطحالب بمعدل ١.٠ جم ماء / لتر و بحمض الهيومك بمعدل ١.٥ مل / لتر ماء) وكذلك تفاعلاتها على النمو والمحصول ومكوناته والتركيب الكيميائي للخرشوف تحت الظروف البيئية بمركز أبو المطامير، محافظة البحيرة ، مصر. وقد أجريت التجربة في تصميم الشرائح المتعامدة المنشقة فى ثلاث مكررات. ويمكن تلخيص النتائج المتحصل عليها كما يلي:أدى التسميد العضوي لنباتات الخرشوف بسماد سبلة الدواجن بمعدل ٢٠ م^3 / فدان للحصول على أعلى القيم لصفات النمو الخضري ، المحصول ومكوناته ، المكونات الكيميائية بالأوراق والمكونات الكيميائية بالرؤوس الزهرية للخرشوف في الموسمين الأول والثاني من هذه الدراسة، باستثناء محتوى النترات بالتخت اللحمى للخرشوف ، حيث تم الحصول على أعلى القيم منها باستخدام السماد البلدى بمعدل ٣٠ م^3 / فدان في كلا الموسمين.أظهرت النتائج المتحصل عليها أن معاملة التربة بالميكورهيزا بمعدل ١ لتر / ٢٠ لتر ماء أدت للحصول على أعلى القيم لصفات النمو الخضري ، المحصول ومكوناته ، المكونات الكيميائية بالأوراق والمكونات الكيميائية بالتخت اللحمى للخرشوف، باستثناء محتوى النترات بالأقراص الزهرية للخرشوف ، حيث تم الحصول على أعلى القيم منها من معاملة المقارنة (بدون تسميد حيوى) في كلا الموسمين.أظهر الرش الورقي لنباتات الخرشوف ثلاث مرات بحمض الهيومك بمعدل ١.٥ مل / لتر ماء تفوقاً على جميع معاملات الرش الورقى الأخرى وأدى للحصول على أعلى القيم لصفات صفات النمو الخضري ، المحصول ومكوناته ، المكونات الكيميائية بالأوراق والمكونات الكيميائية بالرؤوس الزهرية للخرشوف، باستثناء محتوى النترات بالأقراص الزهرية للخرشوف حيث نتجت أعلى القيم منها من معاملة المقارنة (بدون رش ورقي) في الموسمين الأول والثاني من هذه الدراسة.توصى نتائج هذه الدراسة بالتسميد العضوى بسماد سبلة الدواجن بمعدل ٢٠ م^3/فدان مع معاملة التربة بالميكورهيزا بمعدل ١ لتر / ٢٠ لتر ماء بالإضافة إلى الرش الورقى لنباتات الخرشوف ثلاث مرات بعد ٦٠ و ٧٥ و ٩٠ يوما من الزراعة بحمض الهيومك بمعدل ١.٥ مل / لتر ماء للحصول على أفضل النتائج لصفات النمو الخضري ، مكونات المحصول، المكونات الكيميائية بالأوراق والمكونات الكيميائية بالرؤوس الزهرية (التخت) للخرشوف تحت الظروف البيئية لمركز أبو المطامير ، محافظة البحيرة ، مصر.