EFFECT OF ORGANIC NUTRITION ON THE NUTRITIONAL STATUS AND YIELD OF RED CABBAGE PLANTS IN SANDY SOIL

S. Abou-El-Hassan[1], S. H. Ahmed[2] and M. Z. El-Shinawy[3]

[1] Central Lab of Organic Agriculture, Agricultural Research Center, Egypt.

[2] Central Laboratory for Agricultural Climate, Agricultural Research Center, Egypt.

[3] Hort. Dept., Faculty of Agric., Ain Shams Univ., Cairo, Egypt.

(Received: Nov. 12 , 2015)

ABSTRACT : *The objective of this research was to investigate the ability of improving nutritional status and the yield of red cabbage hybrid type(Lisa F_1) using organic nutrition with compost, humic acid and effective microorganisms in sandy soil. The experiment was conducted in the Experimental Farm of Arid Land Agricultural Research and Service Center (ALARC), Faculty of Agriculture, Ain Shams University, Cairo, Egypt; during the two successive winter seasons of 2012/2013 and 2013/2014. Two rates of compost (R_1C equal 6.25 and R_2Cequal 9.38 ton/feddan as 100 and 150% of recommended nitrogen respectively) with or without additions of humic acid and effective microorganisms (EM) individually or in combinations, were investigated comparing to recommended mineral fertilizers of NPK (control) on nutritional status and yield component of red cabbage. The results showed that R_1C and R_2C+humic acid + EM and R_2C + EM only gave significantly superior in nutrient concentrations and yield component of red cabbage compared to recommended mineral fertilizer. It is recommended that organic nutrition of red cabbage in sandy soil can be performed successfully by applying 9.38 ton/feddan ofcompost with adding EM, as well as using 6.25 ton/feddan of compost with adding humic acid and EM to improve nutritional status and yield of red cabbage.*

Key words: *Red cabbage, Organic nutrition, Compost, Humic acid, Effective microorganisms (EM), Sandy soil.*

INTRODUCTION

Consumption of cruciferous vegetables, such as cabbage, is known to reduce the risk of several cancers, especially lung, colon, breast, ovarian and bladder cancer and many research reveals that crucifers provide significant cardiovascular benefits (Beecher, 1994).Red cabbage is usually consumed fresh as an ingredient of coleslaws and mixed salads. Cabbage, a member of cruciferae, is one of the vegetables and an important source of food globally, it is a rich source of vitamin A and C (FAO, 2000).

Organic fertilizers use to reduce the amount of toxic compounds (such as nitrates) produced by mineral fertilizers particularly in the fresh vegetables and improving the quality of leafy vegetables produced as well as human health (Worthington, 2001;Mahmoud*et al.*, 2009).

The use of compost as organic fertilizer allows improvement the soil fertility, in addition to being excellent soil conditioner, improving their physical, chemical and biological, such as retention water, aggregation, porosity, increased the cation exchange capacity, increased fertility and increased life soil microbial, however the value compound fertilizer depends on the material used as raw material (Miyasaka*et al.*, 1997; Ahmad *et al.*, 2008; Fiorentino and Fagnano, 2011).

Humic acid has an essential role in agricultural processesby increasing cation exchange capacity and enhances soil fertility (Chen and Aviad, 1990) and converting the mineral elements into forms available for plants (Stevenson, 1994). Moreover humic substances lead to a greater uptake of nutrients into the plant root and through the cell membrane (Tipping, 2002) andit may possibly enhance the uptake of minerals through the stimulation of microbiological activity (Mayhew, 2004).

The effective microorganisms (EM) inoculants are liquid microbial concoctions containing yeasts, actinomycetes, lactic acid and photosynthetic bacteria (Daly and Stewart, 1999). Most of the species in EM inoculants are heterotrophic microorganisms and require organic sources of carbon and nitrogen for their nutrition. Therefore, EM inoculation has been more effective when applied in combination with organic materials to provide it with carbon and nitrogen (Yamada and Xu, 2000). The microorganisms produce plant hormones, beneficial bioactive substances (resulting in more rapid mineralization of organic matter, suppression of soil-borne pathogens)and antioxidants while solubilizing nutrients (Higa and Parr, 1994). Application of EM increases the soil organisms which have a beneficial effect for plant growth and increases crop yield and quality (Asia-Pacific Natural Network, 1995). Other studies reported that inoculation of the agroeco system with EM leads to an improvement in soil and crop quality in addition to higher crop yields (Higa and Parr, 1994; Li and Ni, 1995; Yan and Xu, 2002; Javaid, 2006; Khaliq *et al.,* 2006; Chantal *et al.,* 2010; Javaid and Mahmood, 2010; Javaid, 2011; Ncube *et al.,* 2011).

MATERIALS AND METHODS

This experiment was carried out in the Experimental Farm of the Arid Land Agricultural Research Center (ALARC), Faculty of Agriculture, Ain Shams University, Egypt, during the two successive seasons of 2012/2013 and 2013/2014.Seeds of the red cabbage (*Brassica oleracea*var. *capitatarubra*) Lisa F_1were sown in the nursery on 11 and 7November in the first and second seasons, respectively. The seeds were placed in the seedling trays, which were filled with peat moss and vermiculite 1:1 (v:v). The plants were transplanted in sandy soil on 13 and 11 of December in the first and second seasons, respectively.The experimental trial was conducted in washed sand in cement plots (1 m^2).Each plot included 6 plants in two lines, the distance between plants was 30 cm, were irrigated by drip irrigation system. Emitter discharge rate was 4 L/hr. Chemical analyses of the sandysoilaccording to FAO (1980) are tabulated in Table (1).

Two rates of compost R_1C equal 6.25 and R_2Cequal 9.38 ton/feddanas100 and 150% from recommended nitrogen dose in sandy soil at 70 kg/feddan(fed = 0.4 hectare) with or without addition of humic acid and effective microorganisms (EM) individually or in combinations were investigated for organic nutrition of red cabbage comparing to conventional nutrition (recommended dose of NPK) by mineral fertilizer (RMF). The compost was produced by Arid Land Agricultural Research and Service Center, Faculty of Agriculture, Ain Shams University, from vegetable residues (eggplant and squash) and chicken manure, which had been composted in an aerobic heap for three months (Abdel-Wahab, 2008). The chemical analyses of the used compost according to FAO (1980) are illustrated in Table (2). The mineral fertilizers of NPK were applied according to recommendation of Ministry of Agriculture and Land Reclamation (2009) as follow: 70 kg N/fed as 340 kg ammonium sulphate (20.5% N), 45 kg P_2O_5/fed as 290 kg calcium super phosphate (15.5% P_2O_5) and 48 kg K_2O/fed as 100 kg potassium sulphate (48% K_2O). Calcium super phosphate was added one time during soil preparation, whereas ammonium sulphate and potassium sulphate were added at three equal portions, during soil preparation, after 3 and 6 weeks from transplanting. Each quantity of compost (6.25 and 9.38 ton/fed were added one time during soil preparation. Humic acid (HA) was kindly provided by Central Lab of Organic Agriculture, Agricultural Research Center. The diluted humic acid was prepared by adding 3 ml / L water according to Shahein *et al.* (2013). EM was produced by Ministry of Agriculture on liquid microbial concoction containing yeasts, actinomycetes, lactic acid and photosynthetic bacteria. The diluted EM was prepared by adding 2 ml concentrated EM with 2 ml molas / L water without chlorine for 24 hours (Yadav, 2002). The diluted solutions of humic acid and EM individually or in combinations were applied to the soil surface beside plants 4 times after 2, 4, 6 and 8 weeks from transplanting as 2 liter for plot.

The Treatmentswere asfollow:

1. Recommended NPK as mineral fertilizers (RMF) as control treatment.
2. 6.25ton compost /feddan (R_1C)
3. 6.25 ton compost /feddan + humic acid (R_1C+ HA)
4. 6.25 ton compost /feddan + EM (R_1 + EM)
5. 6.25 ton compost /feddan + humic acid + EM (R_1C +HA + EM)
6. 9.38 ton compost /feddan (R_2C)
7. 9.38 ton compost /feddan + humic acid (R_2C + HA)
8. 9.38 ton compost /feddan + EM (R_2C + EM)
9. 9.38 ton compost /feddan + humic acid + EM (R_2C + HA + EM)

Treatments were arranged in a completely randomized block design, with three replicates for each treatment. After 90 days from transplanting, the plants were harvested and total yield was recorded for each plot. Three plants were randomly chosen from each experimental plot to measure the weight, surround and length of head. Head firmness and percentage of total soluble solids (TSS) were measured by using Pressure Tester and Digital Refractometer, respectively, As well as vitamin C in red cabbage heads was determined as described in FAO (1980). Anthocyanin content was determined using spectrophotometer according to Geza*et al.* (1984). Content of macronutrient (N, P, K, Ca), micronutrient (Fe, Zn, Mn, Cu), and nitrate were determined in dry matter of head. Total nitrogen was determined by Kjeldahl method according to the procedure described by FAO (1980). Phosphorus content was determined using spectrophotometer according to Watanabe and Olsen (1965). The nutrient of K, Ca, Fe, Zn, Mn and Cu were determined spectrometrically using Phillips Unicum Atomic Absorption Spectrometer as described by Chapman and Pratt (1961). Nitrate content was determined using Brucine method reported by Holty and Potworowski (1972).

Table 1: Chemical analyses of the sandy soil.

pH 1:5	EC 1:10 dS/m	Cationsmeq/L				Anions meq/L			
		Ca^{++}	Mg^{++}	Na^+	K^+	Co_3^-	HCO_3^-	Cl^-	$SO_4^=$
7.58	0.82	1.55	0.32	1.36	0.58	-	1.63	1.81	1.14

Table 2: Chemical analyses of the compost.

pH 1:5	EC 1:10 dS/m	Moisture (%)	O.M (%)	C/N Ratio	Macro elements (%)					Micro elements (ppm)			
					N	P	K	Ca	Mg	Fe	Zn	Mn	Cu
7.74	5.32	20.40	32.40	16.82	1.12	0.71	1.40	1.26	0.63	3165	96	238	146

Data were statistically analyzed by the analysis of variance using one way ANOVA according to Snedecor and Cochran (1980) with using SAS package. Comparison of treatment means was done using Tukey test at significance level 0.05.

RESULTS AND DISCUSSION

Macro and micronutrients

The highest concentrations of N, P and K were produced by R_2C + EM with or without HA treatments followed by RMF and R_1C+ HA + EM as shown at (Table 3). On the other hand, the lowest concentrations of N, P and K in red cabbage plants were found atR_1Cwithout adding HA or EM treatment. While Applying $R_2C$with adding HA and EM individually or in combinations, RMF and R_1C+ HA + EM gave the highest concentration of Ca in red cabbage plants. On the contrary, R_1Conly gave the lowest concentration of Ca.

Table 3: Effect of compost, HA and EM on macronutrients percentage of red cabbage plants during 2012/2013 and 2013/2014 seasons.

Treatments	N	P	K	Ca
	First season			
RMF	3.42 b	0.445 cd	2.45 bc	1.61 Ab
R_1C	2.23 f	0.248 g	1.32 f	0.86 f
R_1C+ HA	2.50 e	0.334 f	1.67 e	1.18 e
R_1C+ EM	3.08 c	0.384 e	2.03 d	1.29 d
R_1C+HA + EM	3.41 b	0.435 cd	2.45 bc	1.59 b
R_2C	2.87 d	0.422 d	2.29 c	1.44 c
R_2C+ HA	3.23 c	0.453 c	2.35 c	1.63 ab
R_2C+ EM	3.68 a	0.516 b	2.61 ab	1.66 ab
R_2C+HA + EM	3.73 a	0.553 a	2.78 a	1.68 a
	Second season			
RMF	3.55 b	0.457 b	2.52 b	1.63 b
R_1C	2.30 f	0.255 f	1.37 e	0.88 f
R_1C + HA	2.59 e	0.343 e	1.73 d	1.20 e
R_1C + EM	3.20 d	0.395 d	2.14 c	1.41 d
R_1C + HA + EM	3.55 b	0.451 bc	2.58 b	1.62 bc
R_2C	3.10 d	0.424 c	2.46 b	1.55 c
R_2C + HA	3.38 c	0.466 b	2.52 b	1.67 ab
R_2C + EM	3.85 a	0.514 a	2.81 a	1.70 ab
R_2C + HA + EM	3.91 a	0.535 a	2.99 a	1.72 a

Means followed in same column by similar letters are not statistically different at 0.05 level according to Tukey test.

RMF = recommended NPK of mineral fertilizer

R_1C= 100% N of compost R_2C = 150% N of compost

HA = humic acid EM = effective microorganisms

Data in Table (4) indicated that applying R_2Cwith or without adding HA or EM increased the content of Fe, Zn, Mn and Cu. Conversely, applying R_1Cwithout HA or EM decreased the contents of Fe and Zn. Whereas, there were not significant differences among R_1 Cwithout HA or EM treatments and RMF treatment in the contents of Mn and Cu. These effects approximately were true in the two seasons. These results might be due to the beneficial effects of compost which increase cation exchange capacity of sandy soil to maintain nutrients in available form for plants (Miyasaka *et al.,* 1997; Ahmad *et al.,* 2008; Fiorentino and Fagnano, 2011). Moreover, positive effects of humic acid and EM may increase the stimulation of microbiological activity and enhance the uptake of minerals by plant roots through releasing and solubilizing of various nutrients (Chen and Aviad, 1990; Stevenson, 1994; Higa and Parr, 1994; Tipping, 2002; Mayhew, 2004; Ncube *et al.*, 2011).

Table 4: Effect of compost, HA and EM on micronutrient concentration (ppm) of red cabbage plants during 2012/2013 and 2013/2014 seasons.

Treatments	Fe	Zn	Mn	Cu
	First season			
RMF	111.87 c	29.50 c	26.67 b	10.37 c
R_1C	68.50 e	20.43 d	22.43 b	8.20 c
R_1C + HA	85.67 d	22.53 d	25.43 b	9.37 c
R_1C + EM	95.77 d	23.37 d	25.40 b	9.03 c
R_1C + HA + EM	109.87 c	24.57 d	26.10 b	9.67 c
R_2C	111.87 b	30.50 bc	36.27 a	13.00 b
R_2C + HA	140.77 a	35.20 a	38.27 a	15.23 ab
R_2C + EM	140.10 a	34.17 ab	37.00 a	15.07 ab
R_2C + HA + EM	143.37 a	36.43 a	38.93 a	16.40 a
	Second season			
RMF	118.94 bc	30.34 cd	27.96 b	10.74 cd
R_1C	68.88 e	21.01 f	22.85 c	8.50 d
R_1C + HA	88.09 d	23.17 ef	26.66 bc	9.71 d
R_1C + EM	98.48 d	24.03 ef	26.63 bc	9.36 d
R_1C + HA + EM	113.18 c	27.09 de	27.36 b	11.02 cd
R_2C	128.77 b	31.97 bc	38.02 a	13.54 bc
R_2C + HA	146.78 a	35.82 ab	40.12 a	15.90 ab
R_2C + EM	147.62 a	36.90 a	38.79 a	15.73 ab
R_2C + HA + EM	151.07 a	38.19 a	40.81 a	17.12 a

Means followed in same column by similar letters are not statistically different at 0.05 level according to Tukey test.

RMF = recommended NPK of mineral fertilizer

R_1C = 100% N of compost

R_2C = 150% N of compost

HA = humic acid

EM = effective microorganisms

Yield and head quality

Data in Tables (5 and 6) revealed that R_2C + HA + EM treatments gave the highest values of total yield, weight, surround and length of head compared to other treatments. The treatments of R_1C + HA + EM and R_2C+ EM came in the second order and superior in comparing to RMF treatment. On the other hand, the lowest values of total yield, weight, surround and length of head were obtained by R_1Cwithout adding HA or EM in both seasons. These effects might be due to that the most of microorganism species in EM inoculants are heterotrophic and require organic sources of carbon and nitrogen for their nutrition. Therefore, EM inoculation has been more effective when applied in combination with organic materials (Yamada and Xu, 2000).

Table 5: Effect of compost, HA and EM on yield, weight, surround and length of red cabbage heads during 2012/2013 and 2013/2014 seasons.

Treatments	yield kg/m²	Head weight kg	Head surround cm	Head length cm
	First season			
RMF	4.50 cd	0.747 c	39.33 bc	18.50 bcd
R_1C	3.47 f	0.580 e	35.33 d	16.00 f
R_1C + HA	4.12 e	0.687 d	37.33 cd	17.17 e
R_1C + EM	4.31 de	0.720 cd	38.67 cd	18.00 de
R_1C + HA + EM	5.01 b	0.843 ab	41.33 ab	19.00 abc
R_2C	4.11 e	0.680 d	37.67 cd	18.17 cd
R_2C + HA	4.53 c	0.760 c	39.67 bc	18.50 bcd
R_2C + EM	5.00 b	0.840 b	41.33 ab	19.33 ab
R_2C + HA + EM	5.27 a	0.883 a	43.33 a	19.67 a
	Second season			
RMF	4.72 c	0.836 c	41.60 c	18.90 bc
R_1C	3.58 f	0.629 e	37.00 e	16.20 f
R_1C + HA	4.30 e	0.753 d	38.96 d	17.47 e
R_1C + EM	4.52 d	0.783 d	40.42 cd	18.43 d
R_1C + HA + EM	5.27 b	0.905 b	43.37 b	19.28 b
R_2C	4.32 e	0.746 d	39.63 d	18.57 cd
R_2C + HA	4.73 c	0.834 c	41.73 c	18.86 c
R_2C + EM	5.35 b	0.933 ab	44.06 ab	19.85 a
R_2C + HA + EM	5.55 a	0.961 a	45.117 a	20.00 a

Means followed in same column by similar letters are not statistically different at 0.05 level according to Tukey test.

RMF = recommended NPK of mineral fertilizer

R_1C = 100% N of compost R_2C = 150% N of compost

HA = humic acid EM = effective microorganisms

Table 6: Effect of compost, HA and EM on firmness, TSS, vitamin C, anthocyanin and nitrate of red cabbage heads during 2012/2013 and 2013/2014 seasons.

Treatments	Firmness Kg/cm^2	TSS %	Vit. C mg/100g	Anthocyanin %	NO_3 %
	First season				
RMF	6.50 b	5.20 bc	33.27 cd	0.308 de	0.340 a
R_1C	5.27 d	3.77 e	32.07 g	0.296 h	0.062 d
R_1C + HA	5.53 cd	4.07 e	32.47 fg	0.300 gh	0.067 cd
R_1C + EM	6.13 bc	4.63 d	32.57 ef	0.302 fg	0.072 cd
R_1C + HA + EM	6.70 ab	5.60 ab	33.67 bc	0.312 cd	0.079 cd
R_2C	5.77 cd	4.87 cd	32.93 de	0.304 ef	0.091 c
R_2C + HA	6.13 bc	5.13 bcd	33.80 bc	0.313 bc	0.117 b
R_2C + EM	6.70 ab	5.73 a	34.23 a	0.317 ab	0.123 b
R_2C + HA + EM	7.23 a	5.93 a	34.63 a	0.321 a	0.132 b
	Second season				
RMF	6.32 bc	5.10 cd	32.99 c	0.304 b	0.350 a
R_1C	5.05 e	3.66 g	31.67 f	0.291 e	0.062 d
R_1C + HA	5.40 de	3.95 g	32.16 e	0.295 de	0.068 d
R_1C + EM	5.96 c	4.53 f	32.40 de	0.296 cd	0.073 cd
R_1C + HA + EM	6.48 b	5.34 bc	33.53 b	0.307 b	0.083 cd
R_2C	5.52 d	4.73 ef	32.63 d	0.299 c	0.092 c
R_2C + HA	6.05 c	4.99 de	33.49 b	0.308 b	0.118 b
R_2C + EM	6.58 ab	5.64 ab	34.00 a	0.314 a	0.125 b
R_2C + HA + EM	6.94 a	5.77 a	34.26 a	0.316 a	0.130 b

Means followed in same column by similar letters are not statistically different at 0.05 level according to Tukey test.

RMF = recommended NPK of mineral fertilizer
R_1C = 100% N of compost R_2C = 150% N of compost
HA = humic acid   EM = effective microorganisms

Application ofR_2C + EM with or without HA and R_1C + HA + EM increased the firmness of head, while R_1C with or without HA and R_2C only decreased the head firmness, whereas the other treatments were mediated. This effect could be resulted from the decrease of calcium element concentration in the plant tissues that treated byR_1C with or without HA and R_2C only as shown at (Table 3) where this element is located in the middle lamella in plant tissue, which give the strength to the cell walls leads to an increase in the head firmness as was reported by Marschner (1995). The same trend approximately was true with TSS, vitamin C and anthocyanin contents in red cabbage heads in the two seasons. As increasing the rate of compost to R_2C with HA and EM individually or in combinations increased TSS, vitamin C and anthocyanin contents in red cabbage heads.

Generally, increasing the rate of compost to R_2C with addition of HA and EM significantly increased the nutrient concentrations, yield and quality of red cabbage. The positive influences of this treatment may be due to the increased availability of nutrients in the soil by increased the rate of compost with presence of humic acid and EM, which may result in accumulating more carbohydrates in plants, thereby enhancing yield and head quality. These results were supported by Li & Ni (1995), Asia-Pacific Natural Network (1995) on natural agriculture, Yan and Xu (2002) on peanut, Javaid (2006) on pea, Chantal*et al.* (2010) on cabbage, Javaid and Mahmood (2010) on soybean and Ncube *et al.* (2011) on tomato.

Concerning nitrate content in red cabbage heads in both seasons, all compost with or without HA and EM treatments reduced NO_3 content of red cabbage heads significantly comparing with the recommended NPK of mineral fertilizer treatment. This explains that applying the various organic fertilizertreatments decrease nitrate accumulation in vegetables as were found by El-Shinawy *et al.* (1999) and Abou-El-Hassan & Desoky (2013) on lettuce, Worthington (2001) on vegetables, Mahmoud *et al.* (2009) on cucumber and Shehata *et al.* (2010) oncelery.

CONCLUSIONS

It could be concluded that organic nutrition of red cabbage in sandysoil can be performed successfully by applying 9.38 ton/fed of compost with adding EM, as well as using 6.25 ton/fed of compost with addinghumic acid and EM to improve nutritional status and yield of red cabbage.

ACKNOWLEDGEMENT

This work has been supported by Central Lab of Organic Agriculture, Central Laboratory for Agricultural Climate, Agriculture Research Center – Horticulture Department and Arid Land Agricultural Research and Service Center, Faculty of Agriculture, Ain Shams University.

REFERENCES

Abdel-Wahab, A.F.M. (2008). Evaluation of enriched compost and its role in synergy with rhizobacteria and nertilization for improving maize productivity in sandy soil. Arab Univ. J. Agric. Sci., 16: 319-334.

Abou-El-Hassan, S. and A.H. Desoky (2013). Effect of compost and compost tea on organic production of head lettuce. J. Appl. Sci. Res., 9(11): 5650-5655.

Ahmad, R., S.M. Shehzad, A. Khalid, M. Arshad and M.H. Mahmood (2008). Growth and yield response of wheat and maize to nitrogen and L tryptophan enriched compost. Pak. J. Bot., 39(2): 541-549.

Asia-Pacific Natural Agriculture Network (1995). EM application manual for APNAN countries. M. Shintani (ed). Asia-Pacific Natural Agriculture Network Bangkok, Thailand. http://www.agriton.nl/apnanman.html.

Beecher, C. (1994). Cancer preventive properties of varieties of Brassica oleracea a review. Am. J. Clin. Nutr., 59: 1166S.

Chantal, K., S. Xiaohou, W. Weimu and B.T. IroOngor (2010). Effects of effective microorganisms on yield and quality of vegetable cabbage comparatively to nitrogen and phosphorus fertilizers. Pak. J. Nutr., 9 (11): 1039-1042.

Chapman, H.D. and P.F. Pratt (1961). Methods of Analysis for Soil, Plant and Water Division of Agric. Sci., Calif. Univ.

Chen, Y. and T. Aviad (1990). Effects of humic substances on plant growth. In: McCarthy P, Calpp CE, Malcolm RL. Bloom, Readings.ASA and SSSA, Madison, WI. pp. 161-186.

Daly, M.J. and D.C.P. Stewart (1999). Influence of effective microorganisms on vegetable production and carbon mineralization a preliminary investigation. Sust.Agr. 14: 15-28.

El-Shinawy, M.Z., E.M. Abd-Elmoniem and A.F. Abou-Hadid (1999). The use of Organic manure for lettuce plants grown under NFT conditions. Acta Hort. 491: 315-318.

FAO (Food and Agriculture Organization) (1980). Soil and Plant Analysis.Soils Bulletin 38/2,250.

FAO (Food and Agriculture Organization) (2000). Statistical database food and Agricultural Organization of the United Nations, Rome, Italy.

Fiorentino, N. and M. Fagnano (2011). Soil fertilization with composted solid waste: short term effects on lettuce production and mineral N availability. Geophysical Research Abstracts, Vol. 13, p 10520.

Geza, H., G.F. Parsons and L.R. Maattick (1984). Physiological and biochemical events during development and maturation of grape berries. Am. J. Enol. Vitic., 35(4):220-227.

Higa, T. and J.F. Parr (1994). Beneficial and effective microorganisms for a sustainable agriculture and environment. International Nature Farming Research Center, Atami, Japan. http://www.agriton.nl/higa.html.

Holty, J.G. and H.S. Potworowski (1972). Brucine analysis for high nitrate Concentrations. Environmental Sci. 8: Technology, 6, 835- 837.

Javaid, A. (2006). Foliar application of effective microorganisms on pea as an alternative fertilizer. Agronomy for Sustainable Development 26: 257-262.

Javaid, A. (2011). Effects of biofertilizers combined with different soil amendments on potted rice plants. Chil. J. AGR. RES., 71(1): 157-163.

Javaid, A. and N. Mahmood (2010). Growth and nodulation response of soybean to biofertilizers. Pakistan Journal of Botany 42: 863-871.

Khaliq, A. M.K. Abbasi and T. Hussain (2006). Effect of integrated use of organic and inorganic nutrient sources with effective microorganisms (EM) on seed cotton yield in Pakistan.Bioresource Technology 97: 967-972.

Li, W. and Y. Ni (1995). Research and application of EM (effective microorganisms). Chin. J. Ecol. 14: 58-62.

Mahmoud, E.K., N. Abd EL- Kader, P. Robin, N. Akkal-Corfini and L. Abd El-Rahman (2009). Effects of different organic and inorganic fertilizers on Cucumber Yield and Some Soil Properties. World J. Agric. Sci., 5(4): 408-414.

Marschner, H. (1995). Mineral Nutrition of Higher Plants (2nd ed.). Academic press. New York. pp 243-244.

Mayhew, L. (2004). Humic substances in biological agriculture [Online].Available at www.acresusa.com/toolbox/reprints/Jan04_Humic%20Substances.pdf.

Ministry of Agriculture and Land Reclamation (2009). Symptoms of Nutrient Deficiency on Some Field and Horticultural Crops.Soils, Water and Environment Research Institute, Agricultural Research Center.

Miyasaka, S., Y. Nakamura and H. Okamoto (1997). Yield and nutrient absorption by lettuce by liming and fertilization mineral and organic soil. Brazilian Horticulture, 8(2): 6-9.

Ncube, L., P.N.S. Mnkeni and M.O. Brutsch (2011). Agronomic suitability of effective micro-organisms for tomato production. Afr. J. Agric. Res. 6(3): 650-654.

Shahein, M.M., S. Abou El Hassan and A.A. Ragab (2013). Reduction of mineral fertilizers in lettuce production by using microbial inoculation, Potassium Humate and Potassium Silicate.Hortscience J. Suez Canal University, 1: 77-84.

Shehata, S.M., H.S. Abdel-Azem, A. Abou El-Yazied and A.M. El-Gizawy (2010). Interactive effect of mineral nitrogen and biofertilization on the growth, chemical composition and yield of celeriac plant. European Journal of Scientific Research, 47(2): 248-255.

Snedecor, G.W. and W.G. Cochran (1980). Statistical methods. Sixth Edition, Iowa state university press, Ames., Iowa, U.S.A.

Stevenson, F.J. (1994). Humus Chemistry: Genesis, composition, reactions, 2nd edition, John Wiley and Sons, Inc, New York.

Tipping, E. (2002). Cation binding by humicsubstances.Cambridge University Press, Cambridge, U.K.

Watanabe, F.S. and S. R. Olsen (1965). Test of an ascorbic acid method for determining phosphorus in water and Na HCO3 extracts from soil. Soil Sci. Soc. Amer. Proc. 29: 677 – 678.

Worthington, V. (2001). Nutritional quality of organic versus conventional fruits, vegetables and grains. J. Alternative Complent. Med., 7: 161-173.

Yadav, S.P. (2002). Performance of effective microorganisms (EM) on growth and yields of selected vegetables. Nature Farming & Environment 1:35-38.

Yamada, K. and H.L. XU (2000). Properties and applications of an organic fertilizer inoculated with effective microorganisms. Crop Prod., 3: 255-268.

Yan, P.S. and H.L. Xu. (2002). Influence of EM Bokashi on nodulation, physiological characters and yield of peanut in nature farming fields. Journal of Sustainable Agriculture 19:105-112.

تأثير التغذية العضوية على الحالة الغذائية والمحصول لنباتات الكرنب الاحمر فى التربة الرملية

سعد أبو الحسن عبد العزيز(١) ، سيد حسن احمد(٢) ، محمد زكى الشناوى(٣)

(١) المعمل المركزى للزراعة العضوية– مركز البحوث الزراعية – الجيزة – مصر.

(٢) المعمل المركزى للمناخ الزراعى– مركز البحوث الزراعية – الجيزة – مصر.

(٣) قسم البساتين – كلية الزراعة – جامعة عين شمس – القاهرة – مصر.

الملخص العربى

الهدف من هذا البحث هو دراسة تأثير التغذية العضوية (بالكمبوست و حمض الهيوميك والكائنات الحية الدقيقة النشطة) على الحالة الغذائية ومحصول الكرنب الاحمر (هجين ليزا) فى التربة الرملية. أجريت التجربة فى المزرعة البحثية التابعة لمركز بحوث وخدمات الزراعة فى المناطق القاحلة بكلية الزراعة – جامعة عين شمس – جمهورية مصر العربية ،خلال موسمى ٢٠١٢/٢٠١٣ و ٢٠١٣/٢٠١٤.

تم دراسة استخدام مستويين من الكمبوست (٦,٢٥ و ٩,٣٨ طن/فدان كنسبة ١٠٠ و ١٥٠ % من المعدل الموصى به من عنصر النيتروجين) مع او بدون اضافة حمض الهيوميك والكائنات الحية الدقيقة النشطة منفردة او مخلوطة ومقارنتها باستخدام المعدل الموصى به من من عناصر النيتروحين والفوسفور والبوتاسيوم كاسمدة معدنية من حيث الحالة الغذائية ومكونات المحصول للكرنب الاحمر.

أوضحت النتائج المتحصل عليها أن معاملات الكمبوست بكلا المعدلين(٦,٢٥ و ٩,٣٨ طن/فدان) مع اضافة حمض الهيوميك والكائنات الحية الدقيقة النشطة ومعاملة المعدل الثانى من الكمبوست (٩,٣٨ طن/فدان) مع اضافة الكائنات الحية الدقيقة النشطة فقط اعطت تفوق معنوى فى تركيز العناصر الغذائية ومكونات المحصول للكرنب الاحمر مقارنة بمعاملة المعدل الموصى به من السماد المعدنى (المقارنة).

توصى هذه الدراسة بان التغذية العضوية للكرنب الاحمر فى التربة الرملية يمكن ان تتم بنجاح باستخدام ٩,٣٨ طن/فدان من الكمبوست مع اضافة الكائنات الحية الدقيقة النشطة.او باستخدام ٦,٢٥ طن/فدان من الكمبوست مع اضافة حمض الهيوميك والكائنات الحية الدقيقة النشطة لتحسين الحالة الغذائية والمحصول .