J. Agric. Sci. Mansoura Univ., 33(5): 3865 - 3879, 2008

EFFECTS OF ORGANIC MANURE AND MINERAL N ON SOME SOIL PROPERTIES AND SPINACH (*Spinacia olerasea* L.,) PRODUCTIVITY UNDER SALINE SOIL CONDITIONS.

Shaban, Kh. A. H.; E.E.E. Khafaga and Hoda S. Saied
Soils, Water and Environment Research Institute, Agric. Res. Centre Giza, (Egypt).

ABSTRACT

A field experiment was conducted during 2006 - 2007 and 2007-2008 period growing seasons at Galbana village of Sahl El-Tina plane east Sueiz canal, Egypt ,which representing a new reclaimed area ,to study effects of organic material and mineral nitrogen rates on some chemical soil properties (EC , pH, cations, anions and available N, P K , Fe ,Mn, Zn , and Cu contents in saline soil and spinach productivity

Results proved that the addition of organic martial and mineral N-fertilizer led to decrease EC and pH values significantly. Increasing of organic material and N – fertilizer additions to soil led to increasing available macro- and micronutrients in soil compared with plots without organic material. The amendment effect on available micronutrients content in soil followed the order, ChM manure > FYM > PRC for Fe, Zn, Cu while for Mn was effect of PRC > ChM > FYM. The organic amendments rates and mineral N-fertilizer led to increase in spinach productivity and its content of macro and micronutrients in leaf The efficient treatments graduated in the orders ChM > PRC > FYM when each of them was added at a rate of 10 ton fed.$^{-1}$ combined with 40kg urea fed.$^{-1}$.

Keywords: Saline soil, organic manure, mineral -N, spinach (*Spinacia olerasea* L.,).

INTRODUCTION

Organic manuring system is followed in Egypt from ancient times Ahmed (2007) reported that organic matter plays a major role in the productivity of such soils particularly in terms of their fertility and water holding capacity under strong weathering. El-Kassas *et al.* (1997) mentioned that using three different animal organic manures at the rate of 20kg line^{-1} decreased soil pH values at the beginning and at the end of the experiment. Abdel- Samad and Eid, (1995) found that application of different composted plant residues and chicken manure resulted in a reduction of soil pH value. Tisdall and Oades (1980) and Ahmed (2007) proved that organic matter quality is more important than quantity in relation to aggregate stability. They also observed that a greater quantity of organic material is needed to improve soil structural properties more than it is necessary to supply the nutrient requirements of a growing crop. Moreover as they added, the combination effect of the different organic amendments may play an important role taking into consideration the economic and environmental impact to quantifying the use value of organic amendments. Seddik, *et al* (2006) found that the values of pH and EC were lower, for first and second seasons, with application of FYM and chicken manure compared to treatments without organic manure .Dahdoh *et al.* (2001) reported that increasing application of chicken manure

increased available soil N, P, K, Fe, Mn, Zn, Cu, Ni, Pb, Cd, Co and Cr. Soliman and Hassan (2004) showed that the application of organic materials either alone or in combination with chemical fertilizers caused a substantial increase in soil available N,P and K. Hammad *et al* (2007) Vats *et al*. (2001) reported that the annual application of FYM at 10-15t $ha.^{-1}$ in conjunction with optimal NPK fertilizers improved spinach productivity by 16.44% in various soil types at several locations. Fusun (2005) found that increments in nitrogen doses of urea from 0 (control) to 150kg N level $ha.^{-1}$ increased NO_3^-,NO_2^-,total N contents and yield of spinach significantly.

Spinach (*Spinacia olerasea* L.,) is one of the vegetables having inherently high nitrate concentration. Nitrate accumulations in petioles have several folds higher than that in leaf blades. Nevertheless, high nitrate concentration is found in leafy vegetables practically under intensive nitrogen fertilization, Rashed, (2006) reported that the soil content of available N, P and K increased as the level of mineral N fertilization increased.

So the aim of this study is to investigate the direct and residual effects of applied organic manures derived from different sources during successive two growing seasons on some chemical properties of saline soil and spinach (*Spinacia olerasea* L.,) productivity at Gelbana village , Sahl El-Tina plain located in eastern Suez Canal ridge.

MATEREIALS AND METHODS

A field experiment was carried out in private farm at Gelbana village of Sahl El-Tina plain east Suiz Canal, in two successive winter seasons of 2006-2007 and 2007- 2008, to study the effect of organic additions on some chemical soil properties and spinach productivity under salinity stress. Soil characteristics are shown in Table (1). The experiment was layed out in a split split plot design with 3 replicates. Organic fertilizers types were plant residues compost (PRC), farmyard manure (FYM) and chicken manure (ChM) as main treatments The sub plots were occupied by application rates of 0, 10 and 15 ton $fed.^{-1}$ which were added 25 days before planting during tillage process. The chemical properties of the used organic manures are illustrated in Table 2. The nitrogen fertilizer treatments as sub sub plots were urea (46 % N) at the rates 80 and 40kg urea $fed.^{-1}$ after 21 and 42 days from planting. The experiment was sown twice in the first season on 15th September 2006 and 20th of January 2007.The two sowing dates in the second season on the 15th September 2007 and 30th of January 2008.All plots received phosphorus fertilizer during field preparation at a rate of 15.5kg P_2O_5 $fed.^{-1}$ as calcium superphosphate (15.5% P_2O_5). Potassium fertilizer was given on two equal doses each of 20 and 30kg K_2O $fed.^{-1}$ as Potassium sulphate (48% K_2O) added after 21 and 35 days of planting respectively. All the plots were surface irrigated from El-Salam canal.

Soil analyses: Mechanical, chemical properties and nutrient availability were determined in the soil collected from surface layer(0-30cm) by the methods described by Black (1965) and Soltanpour and Schwab (1977)

.Organic manure analyses were carried out according to stander methods described by Brunner and Wasmer(1978),shown in Table (2)

Plant analyses: The plant samples were taken after harvesting washed with tap water and distilled water and oven dried at 70 C°. Total nitrogen in plant samples was determined according to Jackson (1967).Potassium was determined according to Chapman and Pratt (1961) by flame- photometer , phosphorus and Fe ,Mn, Zn and Cu were determined by atomic absorption immersion according to Soltanpour and Schwab (1977) Obtained data were statistically analyzed according to Snedecor and Cochran (1971).

Table 1: Some physical and chemical properties in soil before planting

Crosse sand (%)	Fin sand (%)	Silt (%)	Clay (%)		Texture	O.M (%)		$CaCO_3$ (%)
2.10	78.25	8.90	10.75		Sandy	0.49		7.98
pH (1:2:5)	EC (dS/m)	Cations (meq^{-1})				Anions (meq^{-1})		
		Ca^{++}	Mg^{++}	Na^{+}	K^{+}	HCO^{-}_{3}	Cl^{-}	SO^{--}_{4}
8.29	13.64	8.66	17.73	110.00	1.15	7.49	92.00	38.05
Available nutrients ($mgkg^{-1}$ soil)								
N	P	K	Fe	Mn	Zn	Cu		
45.00	4.99	166.00	2.68	5.93	0.57	0.068		

Table 2: Some chemical properties of different organic fertilizer used in study

Organic manure	pH 1:2.5)	EC (dSm^{-1})	C/N	N	P	K	Fe	Mn	Zn	Cu
			(%)				DTPA extractable ($mgkg^{-1}$)			
PRC	7.25	5.76	22.5	1.83	0.88	2.23	25.9	40.9	28.6	4.5
FYM	8.12	8.79	23.85	1.31	1.08	1.75	31.9	53.2	24.0	5.5
Ch M	7.34	6.51	26.30	1.67	0.89	1.91	30.0	69.8	38.9	4.7

RESULTS AND DISSUCION

Soil pH

Data in Table 3 show that soil pH values were affected by all the used amendments significant. The decrease in soil pH values may be related directly the active organic acids released from the added manure which encouraged the reduction in soil pH These findings are in agreement with those reported by Shaban (2005) and Ahmed (2007).More increasing of manure addition rate from 10 to 15 ton $fed.^{-1}$, resulted in more depression in soil pH for all the used sources The relative decreases in soil pH values were 0.61,1.22 and 0.25,0.49 % for treatments with composted rates 10 and 15 each them combined with 40 and 80kg N fed^{-1} compared to treatments of 40 and 80kg urea/fed only respectively .The soil treatments with organic farm(FYM) by rate 10 and 15 ton fed^{-1} combination with nitrogen fertilizer,40 and 80kg urea $fed.^{-1}$ relative decreases pH values with 0.50,1.00 and 0.49,0.87 % compared soil treatment of 40 and 80kg urea $fed.^{-1}$ only, respectively Whoever, the soil treatments of chicken manure (ChM) by rate 10 and 15 ton $fed.^{-1}$ combination with urea by rate 40 and 80kg urea $fed.^{-1}$ obtained relative

decreases in soil pH with 2.44,2.70 and 0.5,1.00 % compared soil treatment with 40 and 80kg urea fed.$^{-1}$ only ,respectively. These findings are in agreement with those reported Seddik, *et al* (2006) and Ashmaye, *et al*. (2008)

Salinity (EC) of Soil.

Data given in Table 3 show that the total soluble salts expressed as soil electric conductivity (EC) tented to decrease with increasing the added of organic manures. The soil electric conductivity values were depressed with about 30, 29, and 24 % by addition 15 ton fed.$^{-1}$ of PRC, FYM and Ch M, respectively. Increasing urea application reduced EC also in all cases. These results proved that EC values decreased with increasing organic manures and nitrogen fertilizer, this results reflected the organic matter effect on improvement soil properties .Rajinder and Mandeep (2007) found that the effect of organic manures and mineral fertilizer on changed of soil pH and EC led to decreasing them long term.

Data show that increasing organic and mineral nitrogen fertilization rates led to positively significant decreased soil salinity (ECe) This may be due to the positive effect of released active organic acids which enhancing soil aggregation and created conductive prose which led to the excess of soluble salts, Seddik, *et al*, (2006)) and Ahmed ,(2007).

Table 3: Mean values of some chemical properties of soil after *Spinacia oleracea* L. harvest during two seasons:

Treatment	Ton /fed	Kg urea /fed	PH (1:2.5)	EC dSm^{-1}	Cations (mql^{-1})				Anions (mql^{-1})		
					Ca+2	Mg+2	Na+	K+	HCO^{-}_{3}	Cl-	SO^{--}_{4}
PRC	0	40	8.23	10.19	9.28	17.45	74	0.60	8.72	51	41.01
	10		8.18	8.87	9.76	17.36	61	0.64	8.55	43	37.21
	15		8.13	7.21	9.88	17.21	45	0.67	8.16	31	33.60
	0	80	8.14	10.00	9.30	17.39	73	0.70	8.29	49	42.92
	10		8.12	8.75	10.14	15.69	61	0.73	7.38	41	39.18
	15		8.10	7.11	10.35	15.51	44	0.77	7.12	28	35.51
FYM	0	40	8.14	10.12	9.35	16.28	75	0.68	8.15	53	40.16
	10		8.10	9.63	9.38	16.36	70	0.71	8.06	48	40.39
	15		8.06	8.52	9.40	16.48	59	0.73	7.89	42	32.71
	0	80	8.07	9.51	9.37	16.47	69	0.69	7.76	47	40.77
	10		8.03	8.48	9.45	16.78	58	0.75	7.98	41	36.00
	15		8.00	7.23	9.89	16.85	45	0.79	7.78	32	32.75
ChM	0	40	8.02	9.88	10.03	14.34	74	0.64	7.54	58	33.47
	10		8.00	8.82	10.12	14.18	64	0.67	7.66	49	32.31
	15		7.98	8.74	10.18	14.25	62	0.71	7.43	46	33.71
	0	80	8.01	9.59	10.08	14.36	71	0.69	7.23	51	37.90
	10		7.97	8.31	10.17	14.32	58	0.73	7.52	40	35.70
	15		7.93	7.49	10.21	14.28	51	0.75	7.31	37	31.93
LSD %5 Organic			0.43	0.46	0.19	0.56	0.16	0.04	0.32	6.76	3.56
LSD %5 Rats organic			0.48	0.51	0.21	0.60	0.81	0.05	0.36	6.75	3.15
LSD % 5 Nitrogen			1.38	0.01	0.16	0.48	0.27	0.06	0.56	5.52	8.01

Cotion and Anion Contents in Soil.

The concentration of cations and anions in soil paste extracts are presented in Table 3. The obtained data revealed that the soluble ion contents at surface layer (30cm) during spinach planting through the two seasons were affected with the used organic manures and urea on soluble ion content in soil study. However, values of Ca^{++} and K^{+} increased in all organic amendments but values of Mg^{++}, Na^{+}, HCO^{--}_{3} and Cl^{-} decreased in manured plots. Application of urea and organic manure tended to pronounced decrease in soluble Mg^{+2}, HCO^{--}_{3}, Cl^{-} , especially with increasing the applied rates.

Available macronutrients in the studied Soils.

Concerning available N (Table 4), it could be noticed that different manures were of significant differences among each other in both seasons. In the 1st season Ch M was only significantly superior to PRC. In the both seasons, FYM and Ch M were statistically as the same .Manure application rates did not produce significant effect in the 1st season but in the 2nd one each of 10 and 15 ton fed.$^{-1}$ gave significantly higher available N than in unmanured plots. On the other hand urea application gave the some effect in the 2nd season but 80kg urea fed.$^{-1}$ was significantly superior in the 1st one. The double and triple interactions were of significant effect among them. The higher available N treatments were that received 15 ton Ch M and 80kg urea fed.$^{-1}$in both seasons which were of significant effect on unmanured plots of 40kg urea and significantly over the others. These results were in agreement by Soliman and Hassan (2004) and Fusun (2005).

Regarding available P, organic sources were of significant effect in the descending order of FYM > Ch M > PRC in the 1st season while in the 2nd one there were no significant differences among them. On the contrary, rates which were statistically as the season in the 1st season caused significant elevation in available P in the 2nd season by using 15 ton.fed.$^{-1}$ referring to those unmanured. Doublication of urea rate did not caused significant effect in the both season. The interaction double and triple effects were found in the both seasons insignificant. These results were in agreement with Dahdoh, *et al.* (2001) and Ashmaye et al (2008)

As for available K in plots after the 1st season two cultivation did not affect with each individual treatment or their combination. In the second season, available K was significantly affected with sources of manures in the order Ch M = FYM > PRC, with 15 ton fed.$^{-1}$ application rate over unmanured ones and finally with application of 80kg urea fed.$^{-1}$ these responses were reflected on the double and triple interactions resulting in superiority of 15 ton fed.$^{-1}$ Ch M combined with 80kg urea significantly to PRC combined with 40 or unmanured plots received 40kg urea. Generally, it may be worthy to mention that concentration of available forms of nutrient could be affected with several factors rather than treatments such as soil layer, volatilization for N and precipitation P so these available concentrations are secondary expressing parameters.

Available micronutrients in studied Soil.

Data of Table 5 show the available forms of Fe, Mn, Zn and Cu in soil after the two cultivations of each season.

5

That pronounced increases in soil available micronutrient contents were achieved as a result of organic manure through two seasons. This is more related to the residual organic compounds after different biochemical and chemical changes, which led to released more available micronutrients.

For available Fe data show that the double and triple interactions of the applied combination treatments these were of significant effect among them in the 1st season but in the 2nd one they were insignificant. Concerning available Mn the applied double interaction treatments (rates of manures and mineral nitrogen and rate source of the organic manures) resulted in significance in the 1st season while the other treatment factors were insignificant in the 1st and 2nd seasons. On the other hand available Cu did not response to the interaction effect of the double and triple ones in the both seasons were insignificant except those (manures rates and mineral N) which were significant in both seasons.

Generally The increase or decrease in available micronutrient concentrations in the studied soil attributed to increasing rates of manures, mineral N fertilizer and decreased of soil pH. These results are agreement by Wajahat *et al* (2006) who found that the availability of micronutrients were particularly sensitive to changes in soil environment. These factors according to them which effect on the contents of such micronutrients are organic matter, soil pH, lime content, sand, silt, and clay contents. The relative increase percentage of Fe available content as affected with the applied organic manures at the rates of 10 and 15 ton fed.$^{-1}$ were 4.20,3.60 and 5.32,5.77 % in the 1st season which 1.33,1.60 and 4.10,4.30 % in the 2nd seasons at applied rates of 40 and 80kg urea fed.$^{-1}$, respectively.

The corresponding values were 1.13,2.10 and 1.11,1.74 % in the 1st seasons while 1.00,1.93 and 0.31,0.78 % in the 2nd seasons for available Mn as affected with applied organic manures at rate of 10 and 15 ton fed^{-1} combination with rates of 40 and 80kg urea fed^{-1} respectively. Regarding that the relative increase of Zn values as affected addition organic manures at rate of 10 and 15kg urea fed.$^{-1}$ were 6.98,9.30 and 4.17,6.25 in the 1st seasons which 9.30,13.95 and 4.00,7.00 % in the 2nd seasons at the applied rate 40 and 80kg urea fed.$^{-1}$ respectively. Also, the corresponding relative increase (%) of the applied organic manures at the rate of 10 and 15 ton fed.$^{-1}$ were 5.33,24.00 and 6.25,11.25 % in the 1st seasons and 5.41,17.57 and 4.60,5.75 % in the 2nd seasons at applied rates of 40 and 80kg urea fed.$^{-1}$ for available Cu content , respectively.

Effect of Organic Manures and N-fertilizer on the Spinach Plant.

Plant growth and productivity:

The results obtained show that soil chemical properties and fertility status positively or negatively reflected on plants growth, and in turn on their yields. Direct effects of the used different organic materials and nitrogen mineral rates on *Spinacia oleracea .L* yield are shown in Table 6. The obtained data show that the values of dry matter yield of both studied cultivations increase with increasing rates of organic manures and nitrogen fertilizer rate and 1st and 2nd seasons, due to more reduction in soil salinity and sodicity. The fresh weights (ton fed.$^{-1}$) of spinach plants increased with increasing organic manures and N application rates significantly.

As well as their combination in both seasons while the manure type factor was insignificant in the 1st and 2nd seasons. The mean values were 2.49–3.25, 2.88–3.23 and 3.02–3.36 ton fed.$^{-1}$ in 1st seasons and 2.98–3.28, 2.90–3.27 and 3.10 – 3.42 ton fed.$^{-1}$ yield fresh weight in 2nd seasons for FRC, FYM and ChM and Nitrogen rates, respectively .Increase application rates from N fertilizer it has essential roles as a constituent of protein, nucleic acids, chlorophyll and growth hormones. This result was in agreement by Hammad *et al* (2007).

The addition of organic material and mineral N rates led to increased for leaf fresh (g), leaf dry weight (g) and plant height (cm) significantly in response to all treatments. Leaf fresh (g), leaf dry weight (g) and plant highest (cm) in the 1st seasons were insignificant response to the double and tribal combination of treatments with exception of combination organic manures +N rates, organic + rates and tribal combination treatment which were significant in the 2nd seasons for Leaf fresh (g), leaf dry weight (g) The higher of plants growth was proportionally correlated with higher manure and mineral N applications combares to those received mineral only, these result agreement by Peyvast *et al* (2007).

Macronutrients concentration in Spinach leaves:

Data in Table 7 show the effect of organic manures and N- mineral rates on macronutrients N, P and K concentration in spinach leaf was more pronounced by increasing application of organic manures and N-mineral rates addition. However, increase of N, P, and K concentration it my be attributed to the interaction effects of organic matter and mineral -N rates. Data showed also that the concentrations of N in leaf spinach were at sufficient limits or the critical concentration for N being as mentioned by Goos *et al* (1981)

It is evident from the distribution patterns of N, P and K concentration by both spinach seasons that organic manures could be arranged according to their effects on these contents in the following orders: ChM > FYM > FRC for N and P in leaf spinach, while ChM > FRC > FYM for K in spinach leaves . These results agreed with Vats, *et al*. (2001). The relative increases of N, P and K percentage in leaf of spinach as affected by the used organic manures rates 10, 15 ton fed.$^{-1}$ and rates of 40 and 80kg urea fed.$^{-1}$, were 15.00-22.00 % and 16.00–18.00 % in 1st seasons while 16.00 – 22.40 % in 2nd seasons for N respectively. On the other hand the relative increases 6.38 – 13.00 % and 12.00 – 16.00 % in the 1st season but 6.00 – 14.00 % and 9.00 – 14.29 % in 2nd seasons for P respectively. Concerning that the corresponding values percentage 2.12 – 3.53 % and 1.73 – 3.81 % in 1st season while 2.44 – 3.50 % and 2.40 – 3.75% in 2nd seasons for K respectively. Data showed that the applied double and tribal combined treatments resulted in a significant effect on the concentration in leaf of N, P and K in 1st seasons except that between organic sources and their rates treatment which were insignificant.

Micronutrients concentration of Spinacia leaves:

Results in Table 8 show that applying of organic manures and urea caused markedly increases in the concentrations of Fe , Mn, Zn and Cu in spinach leaves, with a more pronounced increase with increasing the application rates 10- 15 ton fed.$^{-1}$ of organic manures and 80kg urea fed^{-1} in the two seasons .

7

The relative increases of the studied micronutrients (Fe , Mn, Zn and Cu) in spinach leaves are mainly depend on the used different rates of manures and 40 and 80kg urea fed.$^{-1}$ These mean values for the two seasons arranged as follows: FRC > FYM > ChM, for Fe and Mn. While ChM > FYM > FRC ,for Zn , compared to those of urea (40 and 80 kg urea fed^{-1}) alone but the Cu , relative increases arranged into: ChM > FYM > FRC with 40kg urea fed.$^{-1}$ and FRC > FYM > ChM, of used 80kg urea fed.$^{-1}$ as compared to mineral -N only, respectively. These results agreement by Abd El-Aal, *et al* (2003).Data show that the applied combination treatments resulted in insignificant interaction effects on the concentration (mgkg^{-1}) of Fe, Mn and Zn, while the effect was significant for Cu in the two seasons.

REFERENCES

Abd El-Aal, S. I.;Abd El-Hamid , M. A; Ismaiel , S. A.; Abd-El-Fattah ,A; and Taalab , A. S. (2003) effect of organic farming practice on nutrient availability and wheat yield grown on torripsamments, Egyp. J.Soil Sci .43(1):47–62

Abd El-Samad , S. I and Eid, M. A. (1995) Influence of different levels and sources of organic manure on alluvial soil characteristics and yield of wheat. Egyptian Soil Sci. Soci. 5 th Nat. Congress, Nov ,20-21 Cairo

Ahmed, M.A. (2007).Evaluation of Some Amendments in Newly Reclaimed Soils. MSc .Thesis, Fac. of Agric Zagazig Univ.

Ashmaye, S.H.;Shaban, Kh. A. and Abd El-Kader, M.G.(2008) Effect of mineral nitrogen, sulphure, organic and bio-fertilization on maize productivity in saline soil of Sahl El-Tina Minufiya Agric .Rec. (33), (1):195–209.

Black , C. A. (1965) Methods of Soil Analysis (part 1) American Society of Agronomy. Inc. Madison, Wiscon Sin. USA.

Chapman, H.D. and Pratt, P.F. (1961), Methods of Analysis for Soils, Plants and Water. Agric. Publ. Univ., of California, Reverside.

Dahdoh, M. A. S.; El-Maghrby, S .E., and Mousa, B.I. (2001) Chicken manure as natural soil conditioner for controlling the hazards of irrigating calcareous soil with sludge effluents. Soil Fertility, 51, (2):320-334.

El-Kassas, H.L.; Abou –Hadid , A.F. and Eissa, N .M. (1997) Effect of different organic manure on the yield and experimental composition of sweet pepper plants grown on sandy soil. Egypt. Journal of Applied Sciences, 12 (3) 262-281.

Fusun. G. (2005) Effects of ammonium sulphate and urea on NO_3^- and NO_2^- accumulation, nutrient contents and yield criteria in spinach Sciatica Horticulture. 106, (3) 330 -340.

Goos, R.J.; Westfall, D. G., and Ludwick, A.E, (1981) Grain protein content as indicator of nitrogen fertilizer needs in inter wheat in eastern Colorado. Serince in Action, Colorad State. Univ. Ext. Bull. No 555.

Hammad, S.A. Abou-Seeda, M.A. El-Ghamry A.M. and Selim, E.M. (2007) Nitrate accumulation in spinach plants by using N-fertilizer types in alluvial soil .Egypt. Journal of Applied Sciences 3 (7):511-518

Jackson , M. L. (1967) Soil Chemical Analysis . Prentice–Hall of India Limted, New Delhe.

Jarecki, M. (1991) The interaction of organic and mineral fertilizers in influencing yield quantity and quality and chemical properties of light soil, Rozprawy , Akademia Rolnicza Wszecinie, 132.

Kumar, V.; Yaday, D.S. and Singh, M. (2007) Effects of urea rates, farmyard manure, CaCO3, salinity and alkalinity levels on urea hydrolysis and nitrification in soils. Australian Journal of Soil Research. 26(2) 367-374.

Peyvast , Gh ;Olfati , J.A. ;Madeni , S. and Forghani A.(2007) Effect of vermicompost on the growth and yield of spinach (Spinacia oleracea.L.).Journal of Food, Agriculture & Environment (6):1-7

Rajinder S. A. and Mandeep, S. (2007) Effect of organic manures and fertilizers on organic matter and nutrients status of the soil. Agronomy and Soil Science (5):519–528.

Raphael J. Manlay, Maguette Kairé, Dominique Masse, Jean-Luc Chotte, Giles Ciornei, and Christian Floret,(2002).Carbon, nitrogen and phosphorus allocation in agro-ecosystems of a West African savanna. I. The plant component under semi-permanent cultivation. Agriculture, Ecosystems and Environments 88(8):215-232

Rashed , S. H. (2006) Effect of bio and organic fertilization on *Zea m*aze MSc. Thesis, Fac. of Agric. Mansoura Univ. Egypt.

Seddik, W. A.; Gehan, H .Y. and Mona H. M. (2006) Changes in soil physico – chemical properties and macronutrients contents of pea and tomato plants due to organic manure and some natural minerals fertilization. J. Agric. Sci. Mansoura, Univ, 31 (11):347-362.

Shaban, Kh.A. (2005) Effect of different irrigation water resources on properties and productivity of salt affected soils. Ph.D. Thesis, Fac. of Agric., Minufiya University. Egypt

Sndecor, G.W. and W. G. Cochran (1971) Statistical Methods 7thed .IOWA, State Univ. U.S.A.

Soliman, B. M. and Hassan, M. A. (2004) Influence of organic N–sources on some chemical and physical properties of soil, growth, root distribution and leaf N, P and K content of young Valencia orange trees grown on sandy soil under drip irrigation , Zagazig ,J. Agric , Res, 31 (1):201–218.

SoltanPour, N. and Schwab, A.P. (1977) A new soil test for simultaneous extraction of macro and micronutrients in alkaline soils. Commun. Soil Sci. plant Anal.3 (3):195-201

Tisdall, J. M. and Oades, J. M. (1980) The effect of crop rotation on aggregation in a red–brown earth .Austr. J. Soil. Res. 18(2):423-434

Vats, M.R, Sehgal – DK, and Meta- DK (2001) Integrated effect of organic and inorganic manuring on yield sustainability in long term fertilizer experiments. Ind J of Agric. Rec .35 (1):19–24.

Wajahat, N., Sajida, P. and Iftikhar S. (2006) Status of micronutrients in soils of district bhimber (Azad Jammu and Kashmir) Journal of Agricultural and Biological Science. 1(2):190-195

تأثيرات التسميد العضوي والنتروجينى المعدني على بعض صفات التربة و إنتاجية السبانخ تحت ظروف الأراضي الملحية.

خالد عبده حسن شعبان، الحسيني المرسى السيد خفاجي و هدى صدقي سعيد
معهد بحوث الاراضى والمياه والبيئة – مركز البحوث الزراعية -الجيزة – مصر

أجريت تجربه حقليه في قرية جلبانة بمنطقة سهل الطينة لموسمى ٢٠٠٦- ٢٠٠٧و٢٠٠٧-٢٠٠٨ لدراسة التأثير الايجابي للتسميد العضوي والنتروجينى تحت تأثير الملوحة على بعض صفات التربة الكيمائية EC , pH الكاتيونات والانيونات والعناصر الميسرة في التربة النتروجين والفوسفور والبوتاسيوم والحديد والمنجنيز والزنك والنحاس وإنتاجية محصول السبانخ ومحتوى العناصر في أوراقه.حيث تم استخدم ثلاث مصادر من التسميد العضوي بمعدلات صفر – ١٠ – ١٥ طن /فدان وكانت كمبوست مخلفات نباتية مكمورة أو السماد البلدى او مخلفات الدواجن وكذالك استخدم مستويان من التسميد النتروجينى ٤٠ و ٨٠ كجم يوريا/ فدان وكانت النتائج كالتالي :

أدى استخدام الأسمدة العضوية إلى انخفاض في قيم pH and EC التربة وكان لمعدلى الإضافة ١٠ و ١٥ طن /فدان تأثير معنوي.

زاد محتوى التربة من العناصر الميسرة من النتروجين والفوسفور والبوتاسيوم زيادة معنوية بزيادة معدلات التسميد العضوي و المعدني

تدرج ترتيب تأثير سماد الدواجن يليه السماد البلدى يليه الكمبوست معنويا على زيادة عناصر الحديد والزنك والنحاس .بينما كان ترتيب السمادالمكمور ويليه سماد الدواجن يلية سماد الإسطبل الماشية ذا تأثير معنوي على زيادة عنصر المنجنيز

أدى اشتراك التسميد العضوي مع التسميد النتروجينى إلى زيادة إنتاجية محصول السبانخ.

زيادة معدلات التسميد العضوي و المعدني أدت إلى زيادة محتوى أوراق السبانخ من العناصر الكبرى والصغرى زيادة معنوية .

أظهرت النتائج أن أفضل النتائج المتحصل عليها كانت من سماد الدواجن و المكمور و السماد البلدى كانت عند إضافة معدل ١٠ طن /فدان مع٤٠ كجم يوريا بنفس الترتيب السابق لأنواع السماد العضوي المذكورة

Table 4: Available of macronutrients (mgkg^{-1}) content in soil as affected with amendments.

Nutrin	Season	Org. rate (ton/fed)	FRC			FYM			Ch M			Mean of mineral N Rate			L. S. D. at 0.05 level	L. S. D. at 0.05 level interaction
			urea kg /fed		mean	urea kg /fed		mean	urea kg /fed		mean	urea kg /fed		mean		
			40	80		40	80		40	80		40	80			
Nitrogen	1 St	0	59	64	62	67	71	69	74	75	75	67	70	69	Org = 4.68	Org. Rate=9.60
		10	62	63	63	69	74	72	76	77	77	69	71	70	Rate = 5.54	Org. N = 2.75
		15	66	70	68	72	78	75	77	79	78	72	76	74		Rate. N = 2.75
		Mean	62	66	64	69	74	72	76	77	77	69	72	71	N- = 1.59	Org. R. N=4.77
	2 nd	0	61	68	65	69	76	73	78	79	79	69	74	72	Org = 3.24	Org. Rate=6.27
		10	64	71	68	75	78	77	79	84	82	73	78	76	Rate = 3.62	Org. N = 9.56
		15	69	74	72	77	82	80	83	87	85	76	81	79	N- = 5.52	Rate. N = 9.56
		Mean	65	71	68	74	79	77	80	83	82	73	78	76		Org. R. N=16.56
Phosphorus	1 St	0	5.48	5.51	5.00	5.66	5.89	5.78	5.69	5.83	5.76	5.61	5.74	5.68	Org = 0.34	Org. Rate=0.59
		10	5.56	5.58	5.57	5.82	5.94	5.88	5.73	5.98	5.86	5.84	5.83	5.83	Rate = 0.42	Org. N = 0.73
		15	5.61	6.12	5.87	6.04	6.14	6.09	5.91	6.17	6.04	5.85	5.81	5.83		Rate. N = 0.73
		Mean	5.55	5.74	5.48	5.84	6.00	6.92	5.78	6.00	5.89	5.75	5.91	5.83	N- = 0.41	Org. R. N=1.23
	2 nd	0	5.55	5.59	5.65	5.59	5.91	5.75	5.72	5.94	5.88	5.62	5.83	5.73	Org = 0.32	Org. Rate=0.55
		10	5.67	5.65	5.66	5.86	5.96	5.91	5.78	6.04	5.91	5.77	5.88	5.82	Rate = 0.31	Org. N = 0.54
		15	5.74	6.23	5.98	6.12	6.23	6.18	5.96	6.15	6.06	5.94	6.20	6.07	N. = 2.21	Rate. N = 0.54
		Mean	5.65	5.82	5.76	5.86	6.03	5.95	5.82	6.04	5.95	5.78	5.96	5.87		Org. R. N=6.63
Potassium	1 St	0	178	184	181	190	198	194	189	204	197	186	195	191	Org = 19.99	Org. R=35.00
		10	185	188	187	196	200	198	195	212	204	192	200	196	Rate = 17.81	Org. N =30.85
		15	192	195	194	199	205	202	201	218	209	197	206	202		Rate. N =30.85
		Mean	185	189	187	195	201	198	195	211	201	192	200	196	N. = 42.16	Org. R. N=126.5
	2 nd	0	188	191	189	198	207	203	195	218	207	194	205	200	Org = 7.25	Org. R=12.56
		10	194	196	195	205	209	207	198	226	212	199	210	205	Rate = 5.06	Org. N = 8.76
		15	196	199	198	210	215	213	210	229	219	205	214	210	N = 10.90	Rate. N = 8.76
		Mean	193	195	194	204	210	208	201	224	213	199	210	205		Org. R. N=32.70

Table 5: Available of micronutrients ($mgkg^{-1}$) content in soil as affected with amendments.

Nutrinets	Seasons years	Org rate (ton/fed)	FRC			FYM			Ch M			Mean of mineral N Rate Mean			L. S. D. at level 0.05	L. S. D. at 0.05level interaction
			urea kg /fed		Mean	urea kg /fed		Mean	urea kg /fed		Mean	urea kg /fed		Mean		
			40	80		40	80		40	80		40	80			
Fe	1 St	0	3.58	3.66	3.62	3.62	3.67	3.65	3.51	3.58	3.55	3.57	3.64	3.61	Org = 0.017 Rate = 0.019 N. = 0.030	Org. Rate =0.030 Org. N = 0.033 Rate. N= 0.033 Org. R. N. =0.090
		10	3.86	3.94	3.90	3.74	3.75	3.74	3.55	3.63	3.59	3.72	3.77	3.75		
		15	3.89	4.00	3.95	3.78	3.88	3.83	3.62	3.68	3.65	3.76	3.85	3.81		
		Mean	3.78	3.87	3.82	3.71	3.77	3.74	3.56	3.63	3.60	3.68	3.76	3.72		
	2 nd	0	3.77	3.84	3.81	3.66	3.72	3.69	3.57	3.62	3.60	3.67	3.73	3.70	Org = 0.281 Rate = 0.314 N = 0.478	Org. Rate =0.487 Org. N = 0.544 Rate. N = 0.544 Org. R. N. =1.434
		10	3.92	3.97	3.95	3.79	3.85	3.82	3.59	3.68	3.63	3.77	3.83	3.80		
		15	3.96	4.02	3.99	3.83	3.91	3.87	3.66	3.74	3.70	3.82	3.89	3.86		
		Mean	3.88	3.94	3.92	3.76	3.83	3.79	3.61	3.68	3.64	3.73	3.82	3.84		
Mn	1 St	0	6.75	6.86	6.81	5.69	5.81	5.75	6.12	6.25	6.19	6.19	6.31	6.25	Org = 0.166 Rate = 0.186 N = 0.223	Org. Rate =0.288 Org. N = 0.320 Rate. N = 0.320 Org. R. N. =0.669
		10	6.88	6.95	6.92	5.75	5.89	5.82	6.15	6.29	6.22	6.26	6.38	6.32		
		15	6.91	7.01	6.96	5.86	5.93	5.89	6.19	6.31	6.25	6.32	6.42	6.37		
		Mean	6.85	6.94	8.89	5.77	5.88	5.83	6.15	6.28	6.22	6.26	6.37	6.32		
	2 nd	0	6.82	6.97	6.91	5.71	5.91	5.81	6.17	6.28	6.23	6.23	6.40	6.32	Org = 0.458 Rate = 0.512 N = 0.583	Org. Rate =0.793 Org. N =0.887 Rate. N = 0.887 Org. R. N. =1.749
		10	6.90	7.02	6.96	5.77	5.94	5.86	6.19	6.31	6.25	6.29	6.42	6.36		
		15	6.94	7.05	7.00	5.89	5.96	5.93	6.22	6.33	6.28	6.35	6.45	6.40		
		Mean	6.89	7.01	6.96	5.79	5.94	5.87	6.19	6.31	6.25	6.29	6.42	6.36		
Zn	1 St	0	0.78	0.94	0.86	0.85	0.91	0.88	0.95	1.04	0.99	0.86	0.96	0.91	Org = 0.056 Rate = 0.060 N = 0.248	Org. Rate =0.097 Org. N = 0.104 Rate. N = 0.104 Org. R. N. =0.744
		10	0.83	0.97	0.90	0.89	0.97	0.93	0.99	1.07	1.03	0.92	1.00	0.96		
		15	0.88	0.99	0.94	0.93	0.99	0.96	1.01	1.09	1.05	0.94	1.02	0.98		
		Mean	0.83	0.97	0.90	0.89	0.96	0.92	0.98	1.07	1.05	0.91	0.99	0.95		
	2 nd	0	0.81	0.97	0.89	0.88	0.95	0.91	0.98	1.08	1.03	0.86	1.00	0.93	Org = 0.059 Rate = 0.069 N = 0.064	Org. Rate =0.102 Org. N = 0.119 Rate. N=0.119 Org. R. N = 0.192
		10	0.87	1.01	0.94	0.93	1.02	0.98	1.02	1.10	1.06	0.94	1.04	0.99		
		15	0.92	1.03	0.98	0.98	1.04	1.01	1.04	1.14	1.09	0.98	1.07	1.03		
		Mean	0.87	1.00	0.94	0.93	1.00	0.97	1.01	1.11	1.06	0.93	1.04	0.98		
Cu	1 St	0	0.078	0.081	0.079	0.064	0.073	0.068	0.083	0.085	0.084	0.075	0.080	0.078	Org = 0.0020 Rate = 0.0021 N = 0.0011	Org. Rate =0.0035 Org. N = 0.0036 Rate. N = 0.0036 Org. R. N =0.0033
		10	0.084	0.086	0.085	0.067	0.077	0.072	0.086	0.093	0.089	0.079	0.085	0.082		
		15	0.088	0.092	0.090	0.072	0.079	0.076	0.088	0.097	0.093	0.093	0.089	0.091		
		Mean	0.083	0.086	0.085	0.068	0.076	0.072	0.086	0.092	0.089	0.079	0.085	0.082		
	2 nd	0	0.082	0.096	0.089	0.068	0.075	0.072	0.087	0.090	0.088	0.074	0.087	0.081	Org = 0.008 Rate = 0.009 N = 0.014	Org. Rate =0.0139 Org. N = 0.0156 Rate. N=0.0156 Org. R. N.=0.0420
		10	0.089	0.098	0.094	0.069	0.081	0.075	0.091	0.095	0.093	0.078	0.091	0.085		
		15	0.093	0.094	0.093	0.074	0.083	0.079	0.094	0.099	0.097	0.087	0.092	0.090		
		Mean	0.088	0.096	0.092	0.070	0.080	0.075	0.091	0.095	0.093	0.080	0.090	0.085		

Table 6: Effect of amendments on characters and yield *Spinacia oleracea* L

treat	Seasons	Org rate (ton/fed)	FRC			FYM			Ch M			Mean of mineral N Rate			L. S. D. 0.05 at level	L. S. D. at 0.05 level interaction
			urea kg /fed		Mean	urea kg /fed		Mean	urea kg /fed		Mean	urea kg /fed		Mean		
			40	80		40	80		40	80		40	80			
Leaf fresh weight (g/ plant)	1 St	0	12.58	13.21	12.90	12.89	13.42	13.16	12.94	13.64	14.12	12.65	13.42	13.04	Org = 0.32 Rate = 0.36 N= 0.55	Org. Rate = 0.55 Org. N =0.62 Rate. N=0.62 Org. R. N. =1.65
		10	14.42	14.75	14.60	14.88	14.96	14.92	14.79	15.29	15.04	14.70	15.00	14.85		
		15	15.34	15.55	15.45	15.69	15.84	15.77	15.83	16.48	16.16	15.62	15.96	15.79		
		Mean	14.11	14.50	14.31	14.49	14.74	14.62	14.52	15.14	14.83	14.32	14.79	14.56		
	2 nd	0	12.63	13.35	13.00	12.92	13.49	13.21	12.97	13.69	13.33	12.84	13.51	13.18	Org = 0.46 Rate = 0.63 N= 1.66	Org. Rate =0.80 Org. N =1.09 Rate. N=1.09 Org. R. N. =4.98
		10	14.51	14.80	14.70	14.93	14.98	14.96	14.83	15.35	15.10	14.76	15.07	14.92		
		15	15.41	15.64	15.53	15.74	15.87	15.81	15.86	16.53	16.20	15.67	16.01	15.84		
		Mean	14.18	14.25	14.22	14.53	14.78	14.66	14.55	15.19	14.87	14.42	14.86	14.64		
Plant height (cm))	1 St	0	30.25	32.12	31.20	31.78	32.65	32.22	31.38	32.58	31.98	31.14	32.45	31.80	Org = 3.37 Rate = 3.77 N= 5.74	Org. Rate =5.84 Org. N =6.53 Rate. N=6.53 Org. R. N. =17.22
		10	30.45	32.56	31.51	31.92	32.74	32.33	31.59	32.86	32.23	31.32	32.72	32.02		
		15	30.49	32.89	31.69	32.28	32.88	32.58	31.79	33.72	32.66	31.52	33.16	32.34		
		Mean	30.38	32.52	31.47	31.99	32.76	32.38	31.60	33.05	32.29	31.32	32.75	32.05		
	2 nd	0	30.24	32.15	31.20	31.76	32.67	32.22	31.40	32.60	32.00	31.13	32.47	30.80	Org = 6.76 Rate = 6.80 N= 5.52	Org. Rate =11.71 Org. N =11.78 Rate. N=11.78 Org. R. N. =16.56
		10	30.43	32.58	31.51	31.93	32.76	32.35	31.61	32.88	32.25	31.32	32.74	32.03		
		15	30.48	32.90	31.69	32.31	32.90	32.61	31.82	33.75	32.79	31.54	33.18	32.36		
		Mean	30.38	32.54	31.46	32.00	32.78	3.24	31.61	33.08	32.35	31.33	32.80	32.16		
Leaf dry weight (g/ plant)	1 St	0	2.56	2.63	2.60	2.63	3.02	2.83	2.85	3.12	3.09	2.68	2.92	2.80	Org = 0.16 Rate = 0.18 N= 0.28	Org. Rate =0.28 Org. N =0.31 Rate. N=0.31 Org. R. N. =0.48
		10	2.77	2.79	2.78	2.79	3.24	3.02	2.94	3.34	3.14	2.83	3.12	2.98		
		15	2.86	2.94	2.90	2.92	3.38	3.15	3.05	3.46	3.26	2.94	3.26	3.10		
		Mean	2.73	2.79	2.79	2.78	3.21	3.00	2.95	3.31	3.13	2.82	3.10	2.96		
	2 nd	0	2.60	2.66	2.63	2.66	3.04	2.85	2.88	3.15	3.02	2.71	2.95	2.83	Org = 4.73 Rate = 2.84 N= 1.97	Org. Rate =8.19 Org. N =4.92 Rate. N=4.92 Org. R. N. =5.91
		10	2.79	2.81	2.80	2.81	3.25	3.03	2.97	3.36	3.17	2.86	3.14	3.00		
		15	2.87	2.96	2.92	2.93	3.39	3.16	3.09	3.48	3.29	2.96	3.28	3.12		
		Mean	2.75	2.81	2.78	2.80	3.23	3.02	2.98	3.33	3.16	2.51	3.12	2.82		
Yield fresh weight (ton /fed)	1 St	0	2.75	3.05	2.90	2.72	2.85	2.89	2.94	3.05	3.00	2.80	2.98	2.89	Org = 0.16 Rate = 0.18 N= 0.28	Org. Rate =0.28 Org. N =0.31 Rate. N=0.31 Org. R. N. =0.84
		10	2.96	3.28	3.12	2.85	3.28	3.10	3.04	3.48	3.26	2.95	3.35	3.15		
		15	3.12	3.43	3.28	3.08	3.56	3.32	3.09	3.56	3.33	3.10	3.52	3.31		
		Mean	2.94	3.25	3.10	2.88	3.23	3.10	3.02	3.36	3.20	2.95	3.28	3.12		
	2 nd	0	2.78	3.08	2.93	2.75	2.89	2.82	2.99	3.11	3.05	2.84	3.03	2.96	Org = 0.09 Rate = 0.11 N= 0.16	Org. Rate = 0.156 Org. N =0.191 Rate. N=0.191 Org. R. N. =0.480
		10	2.99	3.29	3.14	2.86	3.31	3.10	3.08	3.53	3.31	2.98	3.38	3.18		
		15	3.15	3.48	3.32	3.10	3.61	3.36	3.12	3.61	3.37	3.12	3.57	3.35		
		Mean	2.98	3.28	3.13	2.90	3.27	3.10	3.10	3.42	3.24	2.98	3.33	3.16		

Table 7: Macronutrients (%) concentrations in *shoot Spinacia oleracea* L as affected with amendments.

Nutri	Seaso	Org rate (ton/fed)	FRC			FYM			Ch M			Mean of mineral N Rate			L. S. D. at level 0.05	L. S. D. at 0.05 level interaction
			urea kg /fed		Mean	urea kg /fed		Mean	urea kg /fed		Mean	urea kg /fed		Mean		
			40	80		40	80		40	80		40	80			
Nitrogen	1 St	0	2.14	2.27	2.21	2.26	2.47	2.37	2.34	2.76	2.55	2.25	2.50	2.38	Org = 0.094 Rate = 0.105 N= 0.159	Org. Rate = 0.163 Org. N = 0.182 Rate. N= 0.182 Org. R. N. =0.477
		10	2.58	2.87	2.73	2.67	2.89	2.78	2.55	2.93	2.74	2.60	2.90	2.75		
		15	2.66	2.92	2.79	2.88	2.93	2.91	2.69	2.99	2.84	2.74	2.95	2.85		
		Mean	2.46	2.69	2.58	2.60	2.76	2.68	2.53	2.90	2.71	2.53	2.78	2.66		
	2 nd	0	2.17	2.31	2.24	2.28	2.49	2.39	2.38	2.80	2.59	2.28	2.53	2.41	Org = 0.042 Rate = 0.047 N= 0.072	Org. Rate = 0.073 Org. N = 0.081 Rate. N= 0.081 Org. R. N.=0.216
		10	2.60	2.91	2.76	2.71	2.94	2.83	2.61	2.96	2.79	2.64	2.94	2.79		
		15	2.69	2.97	2.83	2.93	2.96	2.95	2.74	3.04	2.89	2.79	3.00	2.90		
		Mean	2.49	2.73	2.61	2.64	2.80	2.72	2.58	2.93	2.76	2.57	2.82	2.70		
Phosphorus	1 St	0	0.45	0.46	0.46	0.48	0.52	0.50	0.49	0.53	0.51	0.47	0.50	0.49	Org = 0.067 Rate = 0.070 N= 0.055	Org. Rate = 0.116 Org. N = 0.121 Rate. N= 0.121 Org. R. N. =0.165
		10	0.48	0.53	0.51	0.49	0.55	0.52	0.52	0.59	0.56	0.50	0.56	0.53		
		15	0.52	0.55	0.54	0.51	0.58	0.55	0.55	0.60	0.58	0.53	0.58	0.56		
		Mean	0.48	0.51	0.51	0.49	0.55	0.52	0.52	0.57	0.55	0.50	0.55	0.53		
	2 nd	0	0.49	0.51	0.50	0.53	0.57	0.55	0.51	0.59	0.55	0.51	0.56	0.54	Org = 0.032 Rate = 0.036 N = 0.060	Org. Rate = 0.055 Org. N = 0.062 Rate. N= 0.062 Org. R. N. =0.180
		10	0.52	0.58	0.55	0.54	0.62	0.58	0.56	0.64	0.60	0.54	0.61	0.58		
		15	0.57	0.61	0.59	0.55	0.65	0.60	0.63	0.66	0.65	0.58	0.64	0.61		
		Mean	0.53	0.57	0.55	0.54	0.61	0.58	0.57	0.63	0.60	0.54	0.60	0.57		
Potassium	1 St	0	2.78	2.84	2.81	2.83	2.91	2.87	2.87	2.91	2.89	2.83	2.89	2.86	Org = 0.008 Rate = 0.009 N= 0.014	Org. Rate = 0.014 Org. N = 0.016 Rate. N= 0.016 Org. R. N. =0.042
		10	2.83	2.87	2.85	2.89	2.98	2.94	2.94	2..98	2.96	2.89	2.94	2.91		
		15	2.88	2.93	2.91	2.94	3.02	2.98	2.98	3.05	3.02	2.93	3.00	2.97		
		Mean	2.83	2.88	2.86	2.89	2.97	2.93	2.93	2.98	2.96	2.88	2.94	2.91		
	2 nd	0	2.79	2.87	2.83	2.87	2.94	2.91	2.91	3.05	2.98	2.86	2.93	2.90	Org = 0.320 Rate = 0.036 N.=0.055	Org. Rate =0.554 Org. N = 0.062 Rate. N= 0.062 Org. R. N. =1.65
		10	2.86	2.90	2.88	2.94	3.02	2.98	2.98	3.08	3.03	2.93	3.00	2.97		
		15	2.92	2.96	2.94	2.97	3.05	3.01	2.96	3.10	3.03	2.96	3.04	3.00		
		Mean	2.86	2.91	2.88	2.93	3.00	2.97	2.95	3.08	3.01	2.92	2.99	2.96		

Table 8: Micronutrients (mgkg^{-1}) concentrations in *shoot Spinacia oleracea* L as affected with amendments

Nutrinets	Seas	Org rate (ton/fed)	FRC			FYM			Ch M			Mean of mineral N Rate			L. S. D. at level 0.05	L. S. D. at 0.05 level interaction
			urea kg /fed		Mean	urea kg /fed		Mean	urea kg /fed		Mean	urea kg /fed		Mean		
			40	80		40	80		40	80		40	80			
Fe	1 St	0	489	492	491	487	493	490	491	493	492	490	493	492	Org = 28.09 Rate = 31.38 N.=47.81	Org. Rate = 48.65 Org. N=54.35 Rate. N=54.35 Org. R. N. =134.43
		10	496	508	502	495	507	501	498	503	501	496	506	501		
		15	510	514	512	511	513	512	510	516	513	510	514	512		
		Mean	498	505	502	498	504	501	497	504	502	499	504	502		
	2 nd	0	490	497	494	492	497	495	495	505	500	492	500	496	Org = 9.36 Rate = 10.46 N =15.94	Org. Rate=16.2 Org. N=31.97 Rate. N=31.97 Org. R. N=47.82
		10	499	512	510	498	511	506	504	510	507	500	511	506		
		15	514	521	518	514	517	516	518	522	520	515	520	518		
		Mean	501	510	507	501	508	506	502	512	509	502	510	507		
Mn	1 St	0	41	44	43	40	45	43	44	51	48	42	47	45	Org = 3.24 Rate = 3.62 N= 5.50	Org. Rate=5.61 Org. N=6.27 Rate. N=6.27 Org. R. N=16.50
		10	49	57	53	47	53	50	50	57	54	49	56	53		
		15	56	59	58	51	58	55	55	59	57	54	58	56		
		Mean	49	53	51	46	52	49	50	56	53	48	54	51		
	2 nd	0	45	48	47	44	49	47	47	54	51	45	50	48	Org = 3.24 Rate = 3.62 N=5.52	Org. Rate=5.61 Org. N=6.27 Rate. N=6.27 Org. R. N=16.56
		10	52	60	56	49	56	53	56	61	59	52	59	56		
		15	59	63	61	55	62	59	59	63	61	58	63	61		
		Mean	52	57	55	49	56	53	54	59	57	52	57	55		
Zn	1 St	0	58	60	59	59	61	60	58	55	57	58	59	58	Org = 3.25 Rate = 3.62 N= 5.53	Org. Rate=5.63 Org. N=6.27 Rate .N=6.27 Org. R. N=16.59
		10	60	65	63	62	66	64	63	64	63	62	65	64		
		15	63	67	65	64	68	66	66	68	67	64	68	66		
		Mean	60	64	62	62	65	64	62	62	62	61	64	63		
	2 nd	0	60	63	62	62	64	63	60	59	60	61	62	61	Org = 5.61 Rate = 5.12 N= 5.54	Org. Rate =9.72 Org. N=8.87 Rate. N=8.87 Org. R. N=16.62
		10	63	68	66	66	71	69	66	68	67	65	69	67		
		15	65	70	68	68	72	70	69	73	71	67	72	70		
		Mean	63	67	65	65	69	67	65	67	66	64	68	66		
Cu	1 St	0	7.89	8.03	8.00	8.07	8.12	8.10	8.11	8.16	8.14	8.02	8.10	8.06	Org = 9.36 Rate = 0.001 N= 0.002	Org. Rate = 16.68 Org. N=0.002 Rate. N=0.002 Org. R.N=0.006
		10	7.96	8.29	8.13	8.17	8.26	8.23	8.22	8.26	8.24	8.12	8.27	8.20		
		15	8.05	8.33	8.19	8.24	8.31	8.28	8.30	8.33	8.32	8.20	8.32	8.26		
		Mean	8.00	8.22	8.11	8.16	8.23	8.20	8.21	8.25	8.23	8.11	8.23	8.17		
	2 nd	0	7.91	8.07	8.00	8.09	8.19	8.14	8.15	8.23	8.19	8.05	8.16	8.11	Org = 0.0020 Rate = 0.0021 N = 0.0032	Org. Rate = 0.003 Org. N =0.004 Rate. N=0.004 Org. R. N=0.010
		10	7.98	8.31	8.15	8.21	8.31	8.26	8.27	8.31	8.29	8.12	8.31	8.22		
		15	8.09	8.36	8.23	8.28	8.36	8.32	8.37	8.35	8.36	8.25	8.37	8.31		
		Mean	8.00	8.25	8.13	8.20	8.27	8.24	8.26	8.30	8.28	8.14	8.28	8.21		