Zagazig J.Agric. Res., Vol .31 No.(1) 2004 **117 - 137**

AVAILABILITY OF SOME MINORELEMENTS IN A CALCAREOUS SOIL TREATED WITH COMPOSTED SAW-DUST AND DIFFERENT NITROGEN SOURCES.

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Received 28 / 7 / 2003 ***Accepted 2 / 10 / 2003***

ABSTRACT: A field experiment was conducted in Noubaria normal calcareous soil to study the availability of some minor elements as affected by composted saw-dust application with a level of 2 or 4 ton/fed and different N sources namely, diluted nitric acid solution, mixed nitric acid and calcium nitrate 1:1, calcium nitrate and urea with a level of 30 kg N/fed. The used crops were squash through three pluckings of fruits and table beet.

Results indicated that fresh and dry matter yields significantly responded to the low level of saw-dust compost and nitrogen fertilization regardless their source in spite of superiority of the acidic form to urea in total fruit and beet root dry matter which followed generally the same trend of fresh yields.

Saw-dust compost resulted in increasing the uptake of Fe, Mn, Zn and Cu by squash fruits and table beet shoots and roots. The effect of the higher application level started to appear in beet. Nitrogen application was also essential in increasing these nutrients uptake.

Soil pH values decreased clearly by compost application and acidic forms of nitrogen particularly at the end of the experiment.

Soil available forms of Fe and Zn were raised by compost application to be in the middle range while Mn and Cu were still at the higher limits after the additions. Release of these nutrients by compost decomposition and plant consumption led to decreases after squash and increases after table beet seasons. Nitrogen application resulted in increases in the soil available form of these nutrients. Urea and the neutral form of nitrate treatments produced

more available forms after squash but acidic nitrate form treatments resulted in higher available forms of Fe and Mn after table beet season.

Key words: Calcareous soil, Saw-dust compost, Nitrogen forms, Squash, Table beet, Microelements.

INTRODUCTION

The problem of minor element in calcareous soils is due to less quantity and/or less availability to give the plants their requirements. Providing these nutrients as mineral or organic sources and modifying the soil media may be accepted to solve this problem.

Concerning the application of new quantities of these trace elements by soil manuring, several investigators have discussed the positive effects of these applications for squash and table beet (red beet) the two vegetable crops used in this study or other related crops. In a continuous work on application of compost products made from municipal solid waste to a calcareous soil planted with tomato followed with squash, Ozores *et al.* (1994), (1997) and Hanlon *et al.* (1996) found considerable increases in both crop growth and yield. Fruits were the plant part which was not affected with the released Co, Pb, Ni, Mn and Cu which increased in the Amm. Bicarbonate DTPA extract of the amended soil than the unamended one. Same results were obtained by Sawan *et al.* (1998) when they used saw-dust composted for 1- 4 months to grow cucumber plants while Sainz *et al.* (1998) and Alphonse and Saad (2000) reported that organic applications of urban solid wastes, chicken manure and farmyard-manure increased cucumber marketable yield and its content of macro and micro-nutrients. Planting table beet (red beet) in soils amended with farmyard manure Hongfei (1998), as a residual effect of mixed straw and farmyard manure; Ceglarek *et al.* (2000) and Bajkowska (2000) and after long term of sludge, Mcgrath *et al.* (2000) stated out that yield of beet roots and their contents of Zn (as a micro-nutrient) and Cd (as a heavy metal) did not increase by straw and farmyard manure mixture but increased by 23 years of sludge application.

The effect of using different N sources namely nitric acid solution

0.1 N, nitric acid-calcium nitrate 1:1, calcium nitrate and urea for vegetable crops grown in calcareous soils manured with composted saw-dust was studied on tomato by El-Gizy and Rifaat (2001), okra by Estefanous and Sawan (2002) and squash followed with table beet by Negm *et al.* (2003) concluded in general that acidification effect of diluted NO_3 solution and 1:1 nitric acid-calcium nitrate was found to be slight and temporary. These two acid-nitrogen forms increased Fe, Mn, Zn and Cu availability and also their uptake by tomato plants (El-Gizy and Rifaat, 2001).

So, this work target was to study the availability of the micro-nutrients Fe, Mn, Zn and Cu in calcareous soil as affected by composted saw-dust and different nitrogen sources by squash and table beet plants.

MATERIALS AND METHODS

A field experiment was carried out at Noubaria Horticulture Research Station Farm. The main physical and chemical characteristics of soil surface (0-30 cm) were determined according to the methods described by Piper (1950), Richards (1954) and Jackson (1973). Available N, P and K were extracted by 1% potassium sulphate, 0.5 M sodium bicarbonate and 1 N ammonium acetate solutions, respectively and determined according to Jackson (1973). Available micro-nutrients i.e. Fe, Mn, Zn and Cu were extracted by DTPA (diethylen triaminepenta acetic acid) (Lindsay and Norvell, 1978) and determined using atomic absorption spectrophotometer as shown in Table (1). The used compost was a composted mixture of fine saw-dust, cattle dung, ammonium sulphate (20.5%N) and superphosphate (15.5%P_2O_5) with a ratio of 100:100:5:5 kg, respectively, under aerobic conditions for four months till maturity. The main properties of that matured compost were determined according to Brunner and Wasmer (1978) and presented in Table (2).

A split plot design with four replicates, each area of 3.5 x 6 m^2, was used in which saw-dust compost was alloted to the main plots with 0, 2 and 4 ton/fed. levels. Soil samples were taken after thoroughly mixing the compost few days before sowing squash.

Squash seeds (*Cucurbita pepo var. Melopepo Alef*) were planted on the 1st of August 2000. Nitrogen forms solution as subplots namely A) diluted nitric acid (0.1N), B) nitric acid-calcium nitrate 1:1 mixture, C) calcium nitrate, D) urea and E) control. Mineral nitrogen sources application were applied after three weeks of sowing every 15 days for 6 times to be in a total of 30 kg N/Fed. Three pluckings were obtained after 70 days of planting, i.e., 8, 12 and 16th of October 2000. Nitrogen carriers were prepared by dissolving in a tap water according to the actual requirements of each dose and added in the day after irrigation using plastic containers with sprinkles toward the lower one third of the row. The used irrigation system in the experiment area was furrow system.

On the 11th of November 2000, seeds of the table beet (*Beta vulgaris L.*) were planted in the same plots and treated with nitrogen forms solution as previously mentioned before. Roots were harvested on the 31st of January 2001.

Table (1): Some properties of the field investigated soil.

(%) without $CaCO_3$ removal				Texture class	Moisture (%)	$CaCO_3$ (%)	SP (%)	pH (1:2.5 soil water susp.)	CEC (meq/100g soil)
C. sand	F. sand	Silt	Clay						
8.54	37.46	30.82	23.18	S.C.loam	2.56	26.13	43.20	8.20	19.72

T.S.S	Anions (meq/100g soil)			Cations (meq/100g soil)				Available K (ppm)	Available P (ppm)
	HCO_3^-	Cl^-	$SO_4^=$	Ca^{++}	Mg^{++}	Na^+	K^+		
0.144	0.23	1.08	1.02	0.86	0.49	0.84	0.13	617.86	7.02

Available N (ppm)		Total N (%)	O.C (%)	O.M (%)	C/N ratio	Total count of bacteria	Cellulose decomposition carbon	Dehydrogenase activity
NH_4-N	NO_3-N							
32	42	0.014	0.227	0.476	19.79	15 x10^6	0.17 x 10^4	59

Table (2): Some properties of matured saw-dust compost used in the study (on dry weight basis).

Total solids (%)	pH (1:10 manure susp.)	Mineral Nitrogen (ppm)	O.M %	O.C %	Total N (%)	C/N ratio	Fe (ppm)	Mn (ppm)	Zn (ppm)	Cu (ppm)
52.18	7.14	328.0	57.82	33.54	1.32	25.4	78.55	24.12	7.70	4.11

Squash fruits of each plucking and beet leaves and roots were collected and weighed. Samples of each plot were taken for determining the dry matter, Fe, Mn, Zn and Cu contents. Plant tissues were dried, ground and digested by the method of Sommers and Nelson (1972) to determine micro- nutrients as previously mentioned. Soil samples of each plot after squash turning under and table beet harvesting were chemically analyzed to obtain available Fe, Mn, Zn and Cu. Resulted data were statistically analyzed by the methods described by Snedecor and Cochran (1971).

RESULTS AND DISCUSSION

1. Fresh yields:

In case of most vegetable crops, fresh yields are generally the economic yields. The fresh yields of squash three pluckings and table beet roots are shown in Table (3). Composted saw-dust was significantly effective in increasing both squash fruit and table beet root yields compared to control treatment. In all cases, there were no significant differences between the two used rates of compost application (2 and 4 ton/fed), while in the 1st and 3rd squash pluckings the increases over the control were insignificant.

The stimulating influence of organic amendments on yield vigour might be attributed to improving the physical and chemical properties of the soil, also microbial activities in soil and probably improves the availability of the nutrients. Similar results were obtained by Wadas (1998) on potato. Kostov *et al.* (1995) found that using compost waste (vine branches, flax residues and grape prunings) treated with N, P, K, Mg, Cu and Fe as a media for cucumber, produced significant higher fruits yield than manured soil.

The different forms of nitrogen fertilization produced significant increases in the total squash and table beet yields over the control. In most cases urea was of the lowest effective nitrogen form. These results may be due to the assimilation of any ready nitrogen form added to the soil in presence of organic compost at the early weeks after application. In this connection, Osman (1986) reported that application of 25 kg N/fed. as calcium nitrate increased sugar beet root and shoot yields than urea grown on Mostorod area (Egypt).

Also, Fenn and Feagley (1999) attributed the superiority of NO_3-N to urea and each of them to control due to more ready N to be absorbed by plants.

Table (3): Squash three pluckings (kg/fed.) and table beet yields (ton/fed.) as influenced by saw-dust compost and nitrogen treatments.

Yield	Compost rate (ton/fed.)	Nitrogen treatments						L.S.D. at 0.05 level for	
		A	B	C	D	E	Mean		
First	0	152.50	135.25	76.50	100.00	129.75	118.80	Com. Level:	92.99
	2	302.75	198.00	156.75	250.00	102.00	201.90	N-source:	53.69
	4	225.00	297.25	287.00	266.50	178.50	250.85	Com. X N:	99.59
	Mean	226.75	210.17	173.42	205.50	136.75			
Second	0	136.75	95.00	87.50	71.25	47.50	87.60	Com. Level:	26.36
	2	146.00	128.25	131.25	160.00	127.25	138.55	N-source:	43.46
	4	197.25	176.25	172.50	138.75	100.00	156.95	Com. X N:	75.28
	Mean	160.00	133.00	130.00	123.33	91.58			
Third	0	26.25	22.25	25.00	15.00	27.25	23.15	Com. Level:	10.30
	2	40.25	36.75	45.00	20.00	20.00	32.40	N-source:	9.06
	4	38.75	47.50	28.75	43.75	20.00	35.75	Com. X N:	15.69
	Mean	35.08	35.50	32.92	26.25	22.42			
Total squash	0	315.50	252.50	189.00	186.25	204.50	229.55	Com. Level:	20.80
	2	489.00	363.00	333.00	430.00	249.25	372.85	N-source:	76.56
	4	461.00	521.00	488.25	449.00	298.50	443.55	Com. X N:	132.61
	Mean	421.83	378.83	336.75	355.08	250.75			
Total beet roots	0	3.74	3.60	4.23	3.28	3.22	3.62	Com. Level:	0.35
	2	4.99	5.69	5.99	5.77	3.94	5.28	N-source:	0.33
	4	5.98	5.98	5.38	5.16	3.65	5.23	Com. X N:	0.57
	Mean	4.90	5.09	5.20	4.74	3.61			

A: diluted nitric acid (0.1 N).
B: nitric acid- calcium nitrate 1:1 mixture.
C: calcium nitrate.
D: urea.
E: control.

2. Dry matter production:

Table (4) revealed that dry matter production of squash pluckings and table beet roots tended to be the same trend of their fresh yields. Also, table beet leaves and consequently beet whole plant dry matter responded to compost

Table (4): Squash three pluckings and table beet dry matter yields(kg/fed) as influenced by saw-dust compost and nitrogen treatments.

Dry matter yield	Compost rate (ton/fed)	Nitrogen treatments A	B	C	D	E	Mean	L.S.D.at 0.05 level for	
First	0	76.25	67.63	38.25	50.00	64.88	59.40	Com.level:	47.50
	2	151.38	99.00	78.38	125.00	51.00	100.95	N-source:	28.93
	4	112.50	111.13	143.50	133.25	89.25	117.93	Com. X N:	50.11
	Mean	113.38	92.58	86.71	102.75	68.38			
Second	0	68.38	47.50	43.75	35.63	23.75	43.80	Com.level:	13.14
	2	73.00	64.13	65.63	77.50	63.63	68.78	N-source:	22.02
	4	98.63	88.13	86.25	69.38	50.00	78.48	Com. X N:	38.14
	Mean	80.00	66.58	65.21	60.83	45.79			
Third	0	13.13	11.13	12.50	7.50	13.63	11.58	Com.level:	6.06
	2	11.13	18.38	22.50	10.00	10.00	14.40	N-source:	4.42
	4	19.38	23.75	14.38	21.88	10.00	17.88	Com. X N:	7.65
	Mean	14.54	17.75	16.46	13.13	11.21			
Total squash	0	158.00	126.50	111.50	103.25	102.25	120.30	Com.level:	19.45
	2	219.75	206.75	191.75	190.25	125.00	186.70	N-source:	29.39
	4	205.75	235.50	219.25	199.75	149.50	201.95	Com. X N:	50.92
	Mean	194.50	189.58	174.17	164.42	125.58			
Table beet roots	0	742	690	873	674	708	737	Com.level:	100
	2	1186	1099	1201	1233	929	1130	N-source:	82
	4	1291	1299	1147	979	755	1094	Com. X N:	142
	Mean	1073	1029	1073	962	798			
Table beet leaves	0	424	428	521	503	394	454	Com.level:	107
	2	527	517	632	690	459	565	N-source:	71
	4	575	710	542	518	492	567	Com. X N:	124
	Mean	509	552	565	570	448			
Whole table beet plants	0	1166	1118	1394	1177	1102	1191	Com.level:	65
	2	1713	1616	1833	1923	1388	1695	N-source:	113
	4	1866	2009	1689	1497	1247	1661	Com. X N:	195
	Mean	1582	1581	1638	1532	1245			

application significantly regardless the added level. The obtained results go in line with those of Ragimova (1987) on melon.

Total dry matter of the three squash fruit pluckings as well as table beet roots and whole plants were significantly higher by adding nitrogen fertilization whatever the source than untreated control pla

The difference within nitrogen forms are generally insignificant with the exception of those between the acid form (the higher) and urea (the lower) in case of total squash fruit and table beet root dry matter reflecting the acidification effect of the added diluted nitric acid solution by the end of fertilization process. These results are in accordance with those reported by Heuer (1991) who stated that cucumber top, root growth and ion content of plants grown in hydroponic nutrient solutions were always lower when urea was the major N source. In the same respect, Thomson *et al.* (1993) found higher dry weight of tomato shoots and roots by more acidification of bulk soil and rhizospher and was confirmed with the increase of dry matter in plants received nitric or nitrate-N forms than that received urea.

3. Nutrients uptake by plants:

3.1 Iron:

Composted saw-dust was enough by applying 2 ton/fed. for raising Fe uptake by squash fruits and table beet whole plant significantly over the control but the higher compost level was more effective in case of beet root with significant difference over the lower level as shown in Table (5). Iron uptake by beet leaves was not significantly affected with compost treatments. These results are in agreement with Kapur and Kanwar(1989) who reported that application of 4.20 t/fed. cattle manure increased Fe content in sugar beet leaf in alkaline sandy loam soil.

Nitrogen application was necessary to increase Fe uptake significantly by squash and table beet in all cases. Among nitrogen forms, urea application resulted in the highest Fe uptake by squash fruits. That value was significantly higher than that of 1:1 mixture nitric-calcium nitrate solution and calcium nitrate treatments. It may be due to CO_2 pressure effect which resulted from urea decomposition to mmonium carbamate $\longrightarrow$ ammonium carbonate $\longrightarrow$ ammonia + CO_2 gas in the root zone of soil layer. As for table beet, nitrate nitrogen in acid form, salt or mixture was superior to urea but without real significant differences. Such results stood in accordance with those reported by Osman (1986) on sugar beet.

Table (5): Iron uptake by plants (g/fed.) through the two seasons as affected with saw-dust compost and nitrogen treatments.

Uptake by	Compost rate (ton/fed.)	Nitrogen treatments						L.S.D.at 0.05 level for	
		A	B	C	D	E	Mean		
Squash	0	40.76	54.90	36.13	24.47	25.97	36.45	Com.level:	7.15
	2	67.24	54.58	56.95	85.04	35.25	59.81	N-source:	8.98
	4	56.17	47.34	46.04	79.10	42.46	54.22	Com. X N:	15.56
	Mean	54.73	52.27	46.37	62.87	34.56			
Beet roots	0	238.10	398.13	358.33	307.23	301.72	320.70	Com.level:	65.76
	2	540.82	481.47	504.32	550.93	289.85	473.48	N-source:	45.83
	4	669.77	533.68	644.61	520.56	355.84	544.89	Com. X N:	79.38
	Mean	482.90	471.10	502.42	459.57	315.80			
Beet leaves	0	110.60	111.64	206.58	227.47	94.83	150.23	Com.level:	n.s
	2	299.48	125.69	223.64	161.40	148.18	191.68	N-source:	30.13
	4	155.18	262.61	131.71	141.35	125.33	163.24	Com. X N:	52.18
	Mean	188.42	166.65	187.31	176.74	122.78			
Total uptake	0	389.47	564.67	601.04	559.17	422.53	507.37	Com.level:	78.36
	2	907.54	661.75	784.90	797.37	473.27	724.97	N-source:	58.30
	4	881.12	843.63	822.36	741.01	523.63	762.35	Com. X N:	100.97
	Mean	726.04	690.02	736.10	699.18	473.14			

3.2. Manganese:

Table (6) revealed that Mn uptake by squash fruits and table beet shoots and roots followed the same trend of Fe as affected by saw-dust compost applications.

Also, nitrogen fertilization was significantly effective on Mn uptake by squash and table beet.

Comparing N forms with each others, a significant difference exists between the diluted acid solution and urea in case of squash fruits. Urea was more effective than the diluted acidic nitrate on Mn uptake by beet shoots. Referring to Table (5), it is clear that the used N forms showed the opposite trend in Mn uptake than Fe uptake. It could be explained due to the competition between them where increasing Mn supply reduced the Fe content according to Somers and Shive (1942). Generally, Sideris and Young

(1949) reported that the more general effects of different N sources on cation-anion balance during the uptake process is rather than the specific competition between NH_4^+ and Mn^{+2} for uptake. In this respect, Thomson *et al.* (1993) and Azzazy *et al* .(1994) stated that soil acidifying materials increased Mn availability in calcareous soil due to organic manure, compost and/or acid effect of N and consequently, Mn uptake increased by tomato plants.

Table (6): Manganese uptake by plants (g/fed.) through the two seasons as affected with saw-dust compost and nitrogen treatments.

Uptake by	Compost rate (ton/fed.)	Nitrogen treatments						L.S.D. at 0.05 level for	
		A	B	C	D	E	Mean		
Squash	0	4.27	4.81	2.12	2.88	2.35	3.18	Com. level:	0.56
	2	5.27	4.34	4.60	4.95	2.75	4.38	N-source:	0.81
	4	5.76	4.48	5.92	4.00	2.84	4.60	Com. X N:	1.40
	Mean	5.10	4.54	4.21	3.77	2.65			
Beet roots	0	65.27	65.55	63.81	47.84	34.01	55.30	Com. level:	9.55
	2	65.23	70.35	80.0	113.39	52.95	78.40	N-source:	7.09
	4	99.37	90.90	100.94	91.00	60.44	88.53	Com. X N:	12.28
	Mean	76.62	75.60	81.60	84.08	49.13			
Beet leaves	0	7.63	8.13	10.65	17.61	8.26	10.46	Com. level:	n.s
	2	14.76	11.90	13.90	15.86	10.55	13.40	N-source:	2.15
	4	12.07	17.74	10.84	9.84	9.34	11.97	Com. X N:	3.72
	Mean	11.49	12.59	11.80	14.44	9.38			
Total uptake	0	77.17	78.48	76.57	67.83	46.62	68.94	Com. level:	9.96
	2	85.27	86.59	98.56	134.20	66.25	94.18	N-source:	7.59
	4	115.58	114.73	117.70	104.83	72.62	105.1	Com. X N:	13.16
	Mean	92.67	93.27	97.61	102.29	61.17			

3.3. Zinc:

Composted saw-dust application of 2 ton / fed resulted in significant increases in Zn uptake by squash fruits and table beet shoots and roots over the control as shown in Table (7). The higher level (4 ton/fed) was found to be without significant effect more than the lower level with the exception of beet roots. That trend was similar to that of Fe and Mn uptakes as previously mentioned. Similar results were obtained by Kapur and Kanwar (1989) on sugar beet.

Nitrogen application was generally of a significant effect on Zn uptake regardless differences sources indicating that there was no pronounced effect of the role of these sources in the soil on Zn uptake by squash or table beet. It may be noticed that the acidic form was significantly lower than urea as the same as control in case of beet leaves but this depression didn't effect on the total Zn uptake in this treatment.

Table (7): Zinc uptake by plants (g/fed.) through the two seasons as affected with saw-dust compost and nitrogen treatments.

Uptake by	Compost rate (ton/fed.)	Nitrogen treatments						L.S.D.at 0.05 level for	
		A	B	C	D	E	Mean		
Squash	0	7.58	7.83	8.81	5.47	6.14	7.17	Com.level:	1.62
	2	15.16	11.79	10.35	14.84	7.13	11.85	N-source:	1.82
	4	10.91	12.01	11.18	12.19	9.87	11.23	Com. X N:	3.15
	Mean	11.22	10.54	10.12	10.83	7.71			
Beet roots	0	26.70	38.64	38.41	26.95	42.51	36.64	Com.level:	5.09
	2	47.44	50.67	50.43	51.77	35.30	47.12	N-source:	4.05
	4	64.53	51.94	58.50	47.95	30.22	50.63	Com. X N:	7.01
	Mean	46.22	47.08	49.11	42.22	36.01			
Beet leaves	0	17.80	17.97	19.82	16.61	16.53	17.74	Com.level:	5.27
	2	20.56	21.72	25.27	31.73	24.77	24.81	N-source:	2.82
	4	23.57	29.81	24.39	22.78	16.22	23.35	Com. X N:	4.88
	Mean	20.64	23.17	23.16	23.71	19.17			
Total uptake	0	52.09	64.43	67.04	49.03	65.17	59.55	Com.level:	5.99
	2	83.17	84.18	86.06	98.33	67.20	83.79	N-source:	4.82
	4	98.99	93.76	94.07	82.91	56.31	85.21	Com. X N:	8.36
	Mean	78.08	80.79	82.39	76.76	62.89			

3.4. Copper:

As shown in Table (8), there was positive effect by the application of saw-dust compost at any of its used levels in increasing Cu uptake by squash fruits, table beet roots and whole plants significantly. The higher compost level decreased than the lower one but insignificantly in case of squash and beet shoots but that difference was significant in case of beet roots and consequently the total uptake. The behaviour of Cu and Zn as shown in Tables (2 and 7) was in agreement with that obtained by Chaudhry and Loneragan (1970) who concluded that application of Zn fertilizers showed to aggravate Cu deficiency in soils with marginal Cu levels.

Concerning mineral nitrogenous form effect, Cu uptake by squash fruits significantly. It increased by application of nitrate in acidic, salt or mixture form over that of the control or urea treatments. Uptake of Cu by roots and total uptake were raised significantly than the control by the use of any form and without significant differences among treatments in beet leaves. Also, it could be noticed that urea was significantly less than nitrate forms in their effects on Cu uptake by table beet roots and whole plant. Generally, urea form didn't encourage Cu uptake comparing with nitrate. These results agreed with the previous findings of Osman (1986) on sugar beet and Heuer (1991) on cucumber.

Table (8): Copper uptake by plants (g/fed.) through the two seasons as affected with saw-dust compost and nitrogen treatments.

Uptake by	Compost rate (ton/fed.)	Nitrogen treatments						L.S.D.at 0.05 level for	
		A	B	C	D	E	Mean		
Squash	0	2.21	2.02	2.12	1.86	2.05	2.05	Com.level:	0.49
	2	3.96	3.93	4.03	3.04	2.38	3.47	N-source:	0.85
	4	3.29	4.24	3.73	3.20	2.69	3.43	Com. X N:	0.38
	Mean	3.15	3.40	3.29	2.70	2.37			
Beet roots	0	6.68	8.28	8.59	7.41	8.50	7.87	Com.level:	1.50
	2	15.86	20.89	16.81	12.79	9.29	15.13	N-source:	1.37
	4	14.20	14.28	18.35	11.70	6.80	13.07	Com. X N:	2.38
	Mean	12.25	14.48	14.58	10.63	8.20			
Beet leaves	0	4.08	3.94	7.30	7.55	5.51	5.68	Com.level:	n.s
	2	8.19	9.64	5.69	6.90	8.72	7.83	N-source:	n.s
	4	7.47	7.10	6.50	4.14	4.42	5.93	Com. X N:	2.29
	Mean	6.58	6.89	6.50	6.20	6.22			
Total uptake	0	12.96	14.25	18.01	16.82	16.06	15.62	Com.level:	2.16
	2	28.01	29.99	26.52	22.73	20.38	25.53	N-source:	1.58
	4	24.96	25.62	28.58	19.04	13.91	22.42	Com. X N:	2.92
	Mean	21.97	23.28	24.37	19.53	16.78			

4. Micro - nutrient availabilities in soil:

The availability of Fe, Mn, Zn and Cu after saw-dust compost addition, generally, depends on the total added quantities of these nutrients and soil conditions particularly soil reaction due to acidic forms of N.

From Table 9 and Figs (1 and 2) it is clear that soil pH values lie in a narrow range between 7.97 and 8.28 as affected by compost application and different forms of nitrogen. Application of saw-dust compost at 2 ton/fed level decreased soil pH with about 0.1 pH units and at 4 ton/fed with about another 0.1 unit just after addition. The pH values tended to be more alkaline after 3 months of application due to the domination of ammonification process and return to more lower by the end of the season where the ammonification process was stopped. Generally, urea recorded the highest pH values especially after squash turning under in the soil while the trend of pH proportionally correlated with the acidic effect of nitrate form (0.1-0.04 pH unit). In this respect, several investigators observed slight decreases in soil pH after organic matter addition which is probably caused by production of CO_2 and organic acids during the breakdown of the organic matter causing the decrease of soil pH and increase nutrients availability, such as Khalil and El-Shinnawi (1989); Bierman and Rosen (1994) and Estefanous *and* Sawan (2002) who found that addition of saw-dust compost to calcareous soil led to slight decrease in soil pH.

Regarding to available forms of the studied micro-nutrients it could be noticed that application of saw-dust compost raised soil Fe available concentration from less than the lower limit to the middle range (Table 9) just after application while Mn and Cu were higher than the higher limits meanwhile Zn was low than the lower limit, before and after compost applications.

Decomposition of the organic additions along with plant consumption led to decrease in Fe after squash and table beet and Mn after squash but increase in Zn and Cu after squash and table beet and Mn after table beet season which may be attributed to nutrient competition.

Application of nitrogen forms resulted, generally, in increases of the soil available form of these nutrients over the control after

Table (9): Soil pH and available forms of Fe, Mn, Zn and Cu (mg/kg soil).

Sample	Compost rate (ton/fed.)	Nitrogen treatments	pH (1:2.5 soil water susp.)	Available forms (mg/kg soil)			
				Fe	Mn	Zn	Cu
Initial	0	-	8.20	3.178	5.088	0.223	0.588
	2	-	8.09	5.120	5.865	0.318	1.135
	4	-	7.96	5.738	5.820	0.328	1.045
After three squash pluckings	0	A	8.22	6.355	6.105	0.833	1.723
		B	8.22	4.153	4.788	0.770	1.500
		C	8.20	6.335	6.583	1.320	1.998
		D	8.25	5.793	7.490	0.755	1.883
		E	8.20	3.655	5.843	0.685	1.983
	2	A	8.14	3.598	5.048	0.558	1.840
		B	8.19	3.883	4.685	0.863	1.693
		C	8.18	4.793	4.925	0.725	1.910
		D	8.16	3.703	4.908	0.983	2.108
		E	8.15	3.385	4.893	1.050	1.450
	4	A	8.11	3.753	4.883	0.533	1.993
		B	8.22	4.423	4.890	0.675	1.308
		C	8.23	5.264	4.898	0.303	1.078
		D	8.28	4.280	4.883	0.458	2.138
		E	8.21	4.693	4.903	0.828	2.298
After table beet harvest	0	A	7.82	2.958	4.330	0.558	2.110
		B	7.95	2.970	6.560	0.348	1.588
		C	8.10	5.158	8.620	1.330	2.083
		D	8.19	4.143	4.835	0.803	2.265
		E	8.06	3.795	6.135	0.358	1.548
	2	A	8.03	2.990	5.128	0.198	1.145
		B	7.95	5.885	6.958	0.833	1.965
		C	8.02	4.608	8.190	0.975	2.083
		D	7.98	4.095	7.723	0.885	2.033
		E	7.96	2.140	3.545	0.595	2.013
	4	A	7.93	5.925	9.465	1.253	1.678
		B	8.00	5.813	6.893	1.310	1.800
		C	7.96	3.230	6.508	0.558	2.135
		D	8.03	3.015	5.008	0.235	1.213
		E	7.91	4.310	6.878	0.285	1.725
The higher limit*				6.00	5.00	2.00	1.00
The lower limit*				4.00	2.00	1.00	0.50

*** According to Lindsay and Norvell (1978)**

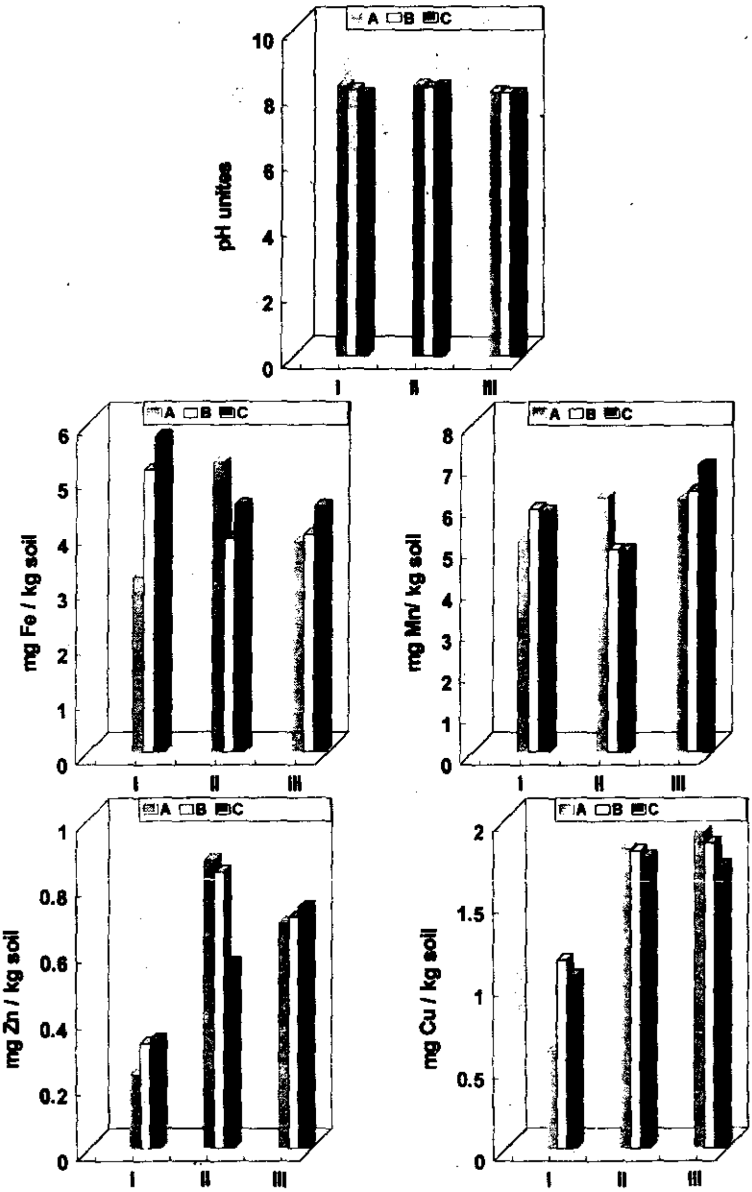

Fig (1): Compost treatment averages of soil pH and available Fe,Mn,Zn and Cu at the initial (I), after squash (II) and after table beet(III).

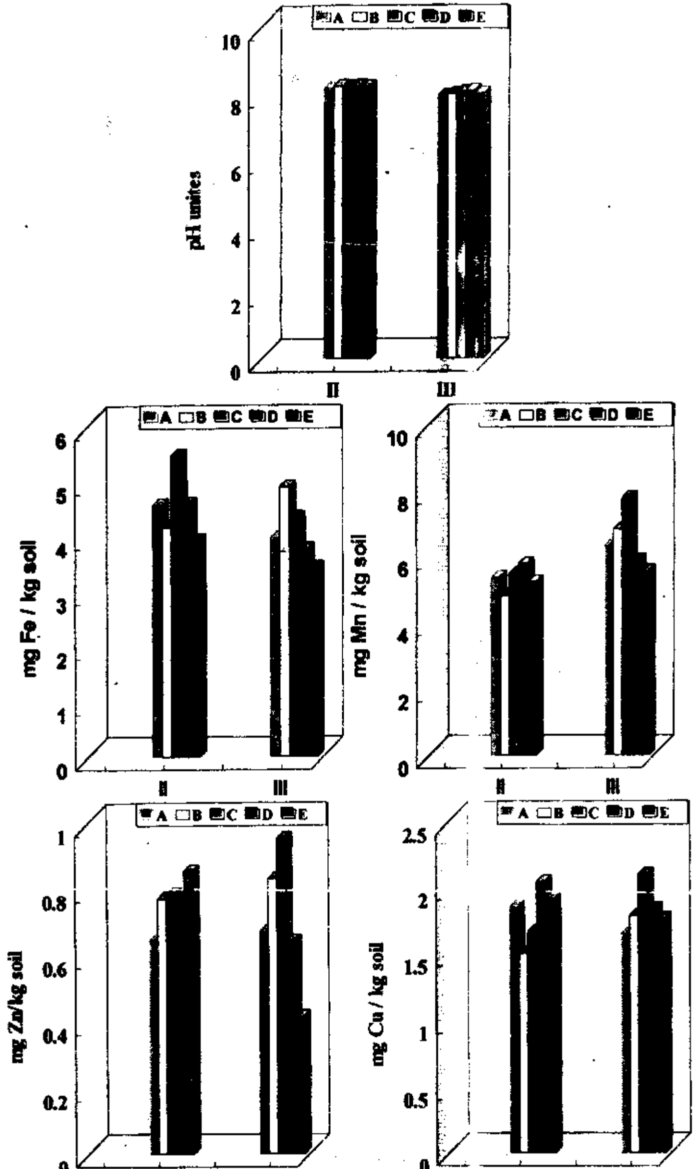

Fig (2): Nitrogen form averages of soil pH and available Fe, Mn,Zn and Cu after squesh(II) and after table beet(III).

squash or table beet season. After squash, urea and the neutral forms of nitrate treatments were of the higher concentrations of Fe, Mn and returned to be lower than acidic nitrate form after table beet season while they were of the higher concentrations of Cu after squash and table beet seasons. The neutral form of nitrate produced the higher Zn concentration after squash and table beet seasons. The higher squash yield and consequently higher nutrient uptake in nitrate treatments compared with that of urea resulted in extensive consumption of the available forms of these nutrients from nitrate treated soil than that in urea case. The continuous release of these nutrients from decomposed saw-dust compost as well as continuous application of the acidifying nitrogen forms converted that status after table beet season as previously mentioned. In this concern, Thomson *et al* (1993) studied the effect of NO_3^--N and NH_4^+-N on acidification of the bulk soil and found that nutrient availability increased due to acidification of the rhizosphere.

CONCLUSION

From the aforementioned results, it could be concluded that adding saw-dust compost at 2 ton/fed to such calcareous soil in presence of acidic nitrogen fertilizer could be recommended to obtain the best results for squash and table beet yields, favourable Fe, Mn, Zn and Cu uptake. That addition of saw-dust compost and acidic nitrogen form decreased soil pH after harvesting and increased the release of above micro-nutrients after the later crop and improved soil fertility.

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تيسر بعض العناصر الغذائية الصغرى في ارض جيرية معاملة بمكمورة نشارة الخشب و صور نيتروجينية مختلفة

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أقيمت تجربة حقلية على أرض جيرية عادية لدراسة تيسر العناصر الصغرى المتأثرة بإضافة مكمورة نشارة الخشب بمعدل ٢، ٤ طن/فدان مع صور نيتروجينية مختلفة بمعدل ٣٠ كم/فدان و هي: (١) محلول حامض نيتريك مخفف (٠,١ أساسي) (٢) مخلوط حامض النيتريك و نترات الكالسيوم بنسبة١: ١ (٣) محلول نترات الكالسيوم (٤) محلول اليوريا ، لكل منها و كانت المحاصيل المختبرة هي الكوسة و بنجر المائدة.

أظهرت النتائج أن الوزن الغض و الجاف للمحصولين يتأثران معنويا بإضافة مكمورة نشارة الخشب عند معدل الاضافة المنخفض و كذا التسميد النيتروجيني بغض النظر عن صورة النيتروجين مع أفضلية الصور الحامضية عن اليوريا على المحصول الكلي لثمار الكوسة والوزن الجاف لجذور بنجر المائدة أدت إضافة مكمورة نشارة الخشب الى زيادة امتصاص كل من الحديد و المنجنيز و الزنك و النحاس الكلي في موسم زراعة بنجر المائدة، وكانت لإضافة النيتروجين أهميتها في زيادة امتصاص هذه العناصر. و لم يكن للصور الحامضية للنترات تأثير واضح في أغلب الأحيان عن الصورة المتعادلة أو اليوريا. هذا و قد انخفض الرقم الحامضي للتربة عموما بإضافة مكمورة نشارة الخشب و الصور الحامضية من النيتروجين خاصة في نهاية التجربة.

زادت تركيزات الصور الصالحة من الحديد و الزنك بإضافة مكمورة نشارة الخشب لمدى متوسط بينما ظل المنجنيز و النحاس أعلا من الحدود العليا لهما بعد الإضافة. و أدي انطلاق هذه العناصر بالتربة بتحلل مكمورة نشارة الخشب و استهلاك النبات المستمر لها الى انخفاض تركيزها بعد محصول الكوسة بينما زاد بعد محصول بنجر المائدة. من ناحية أخرى أدت اضافة النيتروجين الى زيادة الصور الصالحة من هذه العناصر بالتربة بصفة عامة، وقد أدت معاملات كل من اليوريا و الصور المتعادلة للنترات الى زيادة الصور الصالحة من العناصر الصغرى بالتربة بعد محصول الكوسة بينما كان لمعاملات الصور الحامضية للنترات تأثير أكبر علي تيسر كل من الحديد و المنجنيز بعد محصول بنجر المائدة.