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EFFECT OF ORGANIC MANURES ON YIELD PRODUCTION, AVAILABILITY OF SOME MICRONUTRIENTS AND THEIR UPTAKE BY ONION PLANTS.

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ABSTRACT

A field experiment was conducted during two successive winter seasons of 2000/2001 and 2001/2002 on onion plant at Wady El- Moullak, Ismailia Governorate to study the effect of two sources of organic manures on yield production, availability of some micronutrients and their uptake by plant. The results revealed that increasing the application rates of urea fertilizer increased the yield production of onion. It was noticed that farmyard manure (FYM) resulted in a reduction of onion yield particularly in the first season. However, in the second season, yield production of onion was gradually increased. Application of chicken manure (ChM) at different rates increased the onion yield in both two seasons as compared with farmyard manure. Results also showed that application of farmyard manure combined with chicken manure at different rates gradually increased the yield. It was concluded that chicken manure combined with farmyard manure may correct the final C/N ratio of the mixture and could create a preferable condition for enhancing the mineralization of the organic-N. High percentage of yield production were noticed at ratio of (1:2) (FYM:ChM). The mean values of the yield production can be arranged in the descending order (FYM + ChM) > ChM > urea > FYM. Results also clarified that the effectiveness of the organic materials occurred in the second season than in the first one. Application of farmyard manure, chicken manure and their combination influenced the uptake of Fe, Mn, Zn and Cu by onion plant, and also increased the extractable fraction of the investigated elements particularly at 5 - 10cm depth as compared with other treatments. It was evident that organic fertilizers in all cases improved cropping, with the highest average yield of onion, being obtained from plots receiving farmyard or chicken manure or their combinations.

INTRODUCTION

Organic material is the component of mineral soils that makes it credible for successful growth of most plants. It improves the water holding capacity, cation exchange capacity and stabilizes the structure of sandy soils *(Wallace et al 1986, Doran and Smith 1987 and Abou Seeda 1997).* Organic matter improves the nutritional status for most soil, in general and sandy soil in particular *(El-aila et al 2002, Abou Seeda et al 1997).* Simultaneously, soil biological processes and species diversity were improved in organic farming systems. *Fliessbach et al. (2000)* suggested that organic manure application increased the transfer elements between the solid phase and soil solution and by the higher microbial activity. They also reported that organic soil

management improved the soil structure by increasing soil activity, thus reducing the risk of soil erosion and promoted the development of earth worms and aboveground arthropods. This action can improve the growing condition for the plants. The activity of soil microorganisms was higher in organic farming system which helped to recycle the nutrient more faster. Nutrients availability is governed by large numbers of soil and crop factors. Among the most limiting factors are soil pH, $CaCO_3$ content, organic matter, inherent soil fertility, physical and biological properties of the soil. Most of light textured soils are deficient in micronutrients especially under intensive cultivation. Under such condition organic matter may adjust this phenomenon by increasing nutrients availability of some micronutrients *(Taalab 1999, Fagbami et al. 1985, Abou Seeda et al. 1984 and Adiningsih et al. 1997).*

The objective of this research is to study the effect of organic matter (farmyard and chicken manures) on the yield production, availability of some micronutrients and their uptake by onion plants.

MATERIALS AND METHODS

A field experiment was conducted during two successive winter seasons of 2000/2001 and 2001/2002 on onion plant at Wady El-Moullak, Ismaila Governorate. The investigated soil is characterized by sand 75.3%, silt 20.4%, clay 4.3%, pH 8.2, EC 1.52 dS/m. The available DTPA-extraction of Fe, Mn, Zn and Cu are 4.1, 2.3, 0.83 and 0.41ppm, respectively.
Urea fertilizer (UF), farmyard manure (FM) and chicken manure (Ch M) were applied each at rates of 100, 130 and 160kg N/fed. The treatments were as follows:

1- urea 100 kg N/fed.
2- urea 130 kg N/fed.
3- urea 160 kg N/fed.
4- FM 100 kg N/fed.
5- FM 130 kg N/fed.
6- FM 160 kg N/fed.
7- Ch. M 100 kg N/fed.
8- Ch. M 130 kg N/fed.
9- Ch. M 160 kg N/fed.
10- FM + ChM (1:1) 100 kg N/fed.
11- FM + ChM (1:2) 130 kg N/fed.
12- FM + ChM (1:3) 160 kg N/fed.

Table (1): Some chemical characteristics of the investigated organic manures used.

Materials	pH (1:10)	EC dS/m (1:10)	OM %	Total N%	C/N ratio	Available nutrients (ppm)			
						Fe	Mn	Zn	Cu
Farmyard manure (FM)	7.5	2.5	61.3	1.50	23.1	901	364	210	50
Chicken Manure (ChM)	7.1	3.9	59.2	4.13	8.1	986	481	185	74

The experiments were designed as randomized complete block with three replicates. The organic materials were thoroughly mixed with 0-30 cm of the surface soil layer one week before transplanting. Nitrogen fertilizer was applied in two equal doses, after 20 and 40 days from the transplanting of onion seedlings. Phosphorous and potassium fertilizers were added at rates of 60 and 25 kg/fed as superphosphate and potassium sulphate, respectively. The experimental plot consisted of 10 rows each of 3.5 m long and 125 cm in

width. The plot area was about 35 m^2 (3.5 × 10), spacing between plants was 20 cm. Onion seeds (Giza 20 cultivar) were sown in nursery on 10th October and transplanting on 15th December. Harvesting stage was occurred on 5th June. Plant samples washed with distilled water, dried, ground and digested. The investigated micronutrients were determined according to the method described by *Cottenie et al (1982)*. After harvesting, soil samples from each plot were taken at different layers (0-20cm), (20-40cm), and (40-60cm). The DTPA-extractable fraction of Fe, Mn, Zn and Cu were determined in each layer. The combined analysis of variance was performed for the data of the two growing seasons according to *Snedecor and Cochran (1982)*.

RESULTS AND DISCUSSION

Data in Table (2) show that application of urea fertilizer at the rates of 130 and 160kg N/fed increased the yield production of onion by an average increase of about 22% and 46% as compared with the rate of 100kgN/fed, respectively. It was noticed that application of FM resulted in a reduction of the yield. This phenomenon may be due to high C/N ratio of the farmyard manure (C/N= 23). Such circumstance may encourage the immobilization process of N particularly at the first season. *Broadbent and Carlton (1978) and Ponnamperuma (1984)* reported that such phenomenon is probably due to large amounts of carbonaceous farmyard manure.

Table (2): Effect of organic manures and urea fertilizer on onion yield production (ton/fed) during the two successive seasons.

Fertilizer treatments	N level (Kg / fed)	Yield of onion (ton/fed)	
		First season 2000-2001	Second season 2001-2002
Urea (UF)	100	5.41	5.99
	130	6.60	7.22
	160	7.88	8.10
Mean		6.63	7.10
Farmyard manure	100	5.21	6.23
(FM)	130	6.98	7.69
	160	6.25	8.51
Mean		6.10	7.48
Chicken manure	100	7.06	8.05
(ChM)	130	7.51	8.57
	160	8.93	9.50
Mean		7.83	8.71
FM+ ChM (1 : 1)	100	8.11	8.60
(1 : 2)	130	10.05	10.53
(1 : 3)	160	10.56	11.00
Mean		9.57	10.04
LSD 0.05		0.40	0.53

Farmyard manure caused excessive nutrients immobilization and temporary nutrients starvation of plants in the early stages of growth. However, application of chicken manure at different levels of nitrogen (100, 130 and 160 kg N /fed). increased the yield production of onion as compared with urea fertilizer levels. This finding may be due to the fertility status of the added organic material, *Moritsuka et al. (2001)*, stated that the contribution of the net supply of N, P and K by the replenishment from the soil solid phase was higher for the organic fertilizer treatment than for the inorganic fertilizer treatment. *Fliessbach et al. (2000)*, suggested that this observation may be explained by increased transfer of elements between the solid phase and the soil solution and also by the higher microbial activity and organic soil management which improved the growing conditions for the crop. *Kropisz (1992)* stated that organic fertilizers in all cases improved cropping with the highest average yields being obtained on plots receiving FYM + NPK. An average increase of the yield was about 30 %, 14 % and 13% as compared with urea at 100, 130 and 160Kg N / fed, respectively.

Results also indicated that application of farmyard manure combined with chicken manure at (1:1), (1:2) and (1:3) ratios gradually increases the yield production of onion by about 50 % , 52% and 34 % as compared with urea at the studied rates of nitrogen. It was observed that chicken manure has a beneficial and pronounced effect on yield production than urea and farmyard manure. This is because it contains easily degradable compounds, meanwhile its narrow C/N ratio can help in its readily biodegradation. Thus, when added to the soil can improve conductive conditions of temperature and soil moisture *(Kumada, 1977)*. Chicken manure combined with farmyard manure may correct the final C/N ratio of the mixture (FM + ChM) in order to obtain a preferable condition for enhancing the mineralization of the organic - N. Results also show that combination of farmyard manure with chicken manure at different ratios (1 : 1), (1:2) and (1 : 3) significantly increased the yield production of onion as compared with urea and farmyard manure alone. Higher percentage of increase was recorded at ratio 1:2 (FM:ChM) as compared with urea at the same N- doses (130 Kg/N / fed).

It was observed that at high rate of farmyard and chicken manure and their combination, a reduction in onion yield was taken place, due to the salinity effect of the organic material added , Since both FM and ChM contain about 1.6% and 2.5% salt, respectively . *Mac Nicol and Backett (1989)* stated that use of organic materials as fertilizer may have a depressive effect on crop. However, this effect is avoidable if the organic materials are subjected to an adequate process of composting before using in agricultural land, similar results were observed by *Abou seeda et. al (1997)*. Data in Table (2) revealed, in first season the mean values of the yield production due to the studied treatments were 6.63, 6.10, 7.83 and 9.57 ton/fed. The higher yield production was noticed in farmyard manure combined with chicken manure, whereas the lowest was observed at the treatment of farmyard manure alone. Mean values of the yield production can be arranged in the descending order (FM+ ChM) > ChM > urea > FM.

In the second season, application of organic matter resulted in a significant increase in the yield production of onion plants as compared with urea fertilizer.

It was observed that the effectiveness of the organic materials occurred in the second season than in the first one. Composting of the organic material during the growing season rectifies the wide range between the C:N due to the degradability of the easily soluble components of the organic material. Such process creates suitable circumstances for mineralization of organic-N. The mean values of the yield production of onion plants (Table 2) as a result of the previous treatments were 7.10 , 7.48 , 8.71 and 10.04 (ton/fed). Results indicated that the effectiveness of the organic matter added has more pronounced effects than urea due to the nutritional status and also can increase the availability of the nutrients through the formation of organic complexes *(Abou Seeda et. al 1984; Abou Seeda and Verloo 1986, Abou Seeda et. al. 1989, and Abou seeda et. al. 1992 a , b).*

Effect of organic manures and urea fertilizer on some nutrients concentration and its uptake.

Data in Table (3) show that the concentration and uptake of Fe, Mn, Zn, and Cu by onion plants as influenced by adopted treatments during the growing seasons. *Abou Seeda et. al (1997) and Champ et al. (1984),* stated that organic matter can regulate the availability of heavy metals through chelation reactions in which the minerals may form stable 5 or 6 membered ring structure with carboxy and hydroxyl functional groups of organic aggregates, thus becoming a part of solid phase that is unavailable to plants . Also soluble organic molecules (SOM) especially low molecules weight organic acids, produced during the microbial decomposition of added organic materials can complex with Fe , Mn and make them more available to the growing plant *(Abou seeda 1987, Clapp et. al. 1986 and Hue et al. 1988)* .

It was noticed that the added of organic manure increased the uptake of Fe, Mn, Zn and Cu by onion plant due to the beneficial effect of organic matter for improving the nutritional status particularly micronutrients. Increasing the uptake of Fe, Mn and Cu with increasing chicken manure (CnM) and its combination with FM as shown in Table (3) may be explained either by high native content of these elements or by chelating process and thus their availability could be gradually increased *(Singh and Dahiya 1980).*

Effect of organic manures and urea fertilizer on the extractable fraction of micronutrients .

The extractable fractions of Fe , Mn , Zn and Cu are plotted versus depth of soil treated with the urea , farmyard , chicken manure and their combination are presented in Fig (1). It was observed that application of farmyard manure combined with chicken manure gave the highest extractable fraction of the studied elements. It was noticed that accumulation of most micronutrients was observed in the surface soil (5-10cm)due to the presence of the organic matter added . The mobilizable fraction of micronutrients was detected at a depth of 30 cm . It was noticed that organic matter enhanced the movement of the studied element throughout the soil

Table (3): Effect of farmyard, chicken manure and their combination on the concentration and its uptake by onion plants during the growing seasons 2000/2001 and 2001/2002.

Treat*.	N level (kg/fed)	Fe				Mn				Zn				Cu			
		First season		Second season		First season		Second season		First season		Second season		First season		Second season	
		Conc. (ppm)	Uptake (g/fed)	Conc. (ppm)	Uptake (g/fed)	Conc. (ppm)	Uptake (g/fed)	Conc. (ppm)	Uptake (g/fed)	Conc. (ppm)	Uptake (g/fed)	Conc. (ppm)	Uptake (g/fed)	Conc. (ppm)	Uptake (g/fed)	Conc. (ppm)	Uptake (g/fed)
UF	100	380	2056	390	2336	28.1	152.0	30.0	179.7	41.3	223.4	46.0	275.5	8.3	44.9	8 4	50.3
	130	382	2521	396	2851	28.0	184.8	34 0	244.8	40.5	267.3	47.4	341.3	8.0	52.8	7.9	56.9
	160	380	2994	399	3232	28.3	223.0	38.7	313.5	42.0	331.0	50.2	406.6	8.2	64.6	7.9	64.0
Mean		381	2524	395	2806	28.1	186.6	34 2	246.0	41.3	273.9	47.9	341.1	8 2	54 1	8.1	57.1
FYM	100	401	2089	425	2648	25.5	132.9	33.2	206.8	40.8	212.6	45.5	283.5	7 8	40 6	8.1	50.5
	130	450	3141	466	3584	30.6	213.6	40.1	308.4	47.2	329.5	50.4	387.6	8.2	57 2	8.3	63.8
	160	435	2719	476	4051	30.6	191.3	46.9	399.1	49.4	308.8	55.4	471.5	8 0	50 0	8.4	71.5
Mean		429	2650	456	3427	28.9	179.2	40 1	304.8	45.8	283.6	50.4	380.8	8.0	49 3	8 3	61.9
ChM	100	460	3248	487	3920	33.4	235.8	50.0	402.5	56.6	399.6	60.2	484.6	6 9	48.7	7.0	56.4
	130	470	3530	495	4242	36.7	275.6	77.0	659.9	53.2	399.5	65.4	560.5	7.8	58 6	7.7	66.0
	160	485	4331	510	4845	38.0	347.4	78 0	741.0	48.8	435.8	66.8	634.6	6.3	56.3	7.0	66.5
Mean		472	3703	497	4336	36.3	286.3	68 3	601.1	52.9	411.6	64.1	559.9	7 0	54 5	7.2	62.9
FYM	100	475	3852	488	4197	29.0	235.2	36.0	309.6	45.4	368.2	50.7	436.0	9.1	73 8	8.5	73.1
+ChM	130	485	4874	499	5254	35.3	354.8	78.0	821.3	50.8	510.5	60.2	633.9	9.0	90 5	9,5	100
	160	495	5227	520	5720	35.1	370.7	80.0	880.0	49.9	526.9	60.0	660.0	9.0	95 0	9.0	99.0
Mean		485	4651	502	5057	33.1	320.2	64.7	670.3	48.7	468.6	57.0	576.6	9.0	86 4	9.0	90.7

- UF= urea fertilizer (46 % N)
- FYM= farmyard manure (1.5 % N)
- ChM= Chicken manure (4.13 % N)

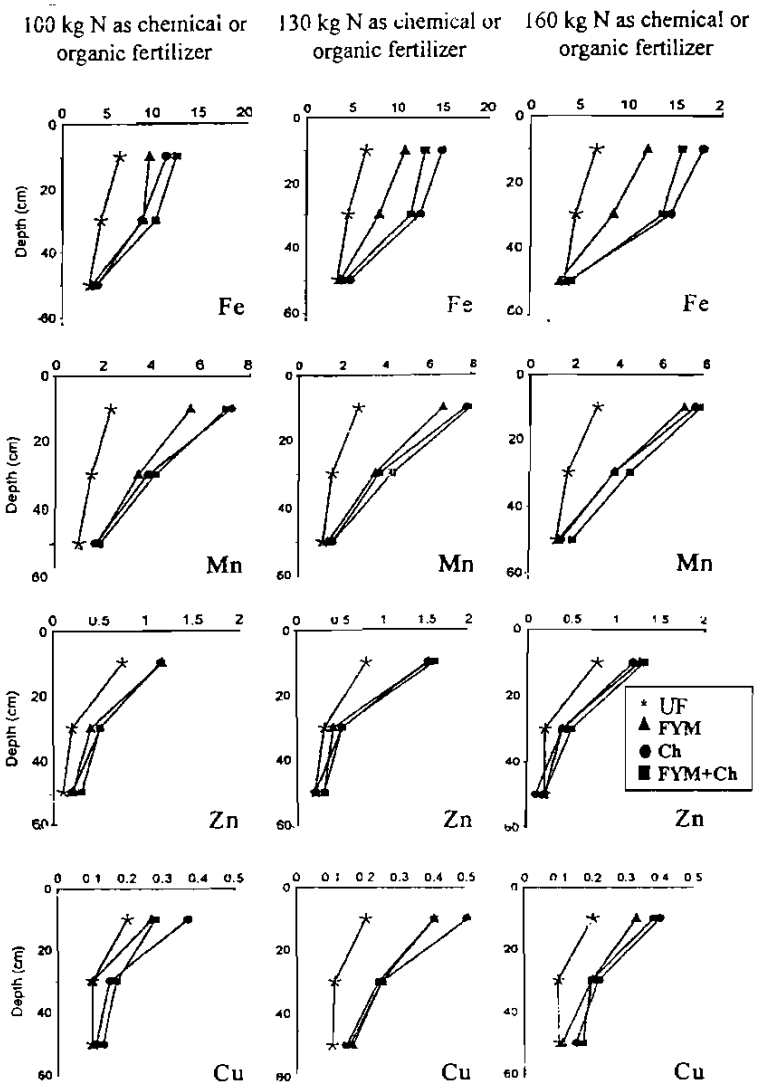

Fig (1): Effect of farmyard, chicken manure and their combination on the extractable fraction of Fe, Mn, Zn and Cu at different depths

depth up to 50 cm . This phenomenon may be attributed to the formation of the humic substances that improve the absorption capacity and also increase the mobilizable fraction of Fe , Mn, Zn and Cu as well . *Parfitt et. al (1977)* and *Dick and McCoy (1993)* reported that the mechanism of humic and fulvic acid adsorption involves ligand exchange. The beneficial effect due to the application of organic matter on the movement of micronutrients, mobile dissolved organic carbon (DOC) is believed to enhance the transport of the associated contaminants through the porous media *Champ et. al (1984), Nelson et. al (1985) Gschwend and Wu (1985)* and *Mc Carthy and Zachara (1989) and Abou Seeda (1997)* . If however, the dissolved organic carbon is immobilized as noticed in Fig 1, during transport , the mobility of the associated contaminants will be impeded .

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تأثير المادة العضوية على تيسر وامتصاص بعض العناصر الصغرى وانتاج نباتات البصل

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قسم تغذية النبات – المركز القومى للبحوث – الدقى – جيزة

أقيمت تجربتان حقليتان فى الموسم الشتوى ٢٠٠٠، ٢٠٠١ على نباتات البصل بمزرعة وادى الملاك محافظة الإسماعيلية، لدراسة تيسر وامتصاص بعض العناصر الصغرى بواسطة المادة العضوية وتأثير ذلك على إنتاج نباتات البصل، حيث أظهرت النتائج ما يلى :

- أدت إضافة سماد اليوريا إلى حدوث زيادة فى إنتاج محصول البصل فى كلا الموسمين.
- أدت إضافة سماد الأسطبل (FYM) إلى حدوث إنخفاض محصول البصل خلال الموسم الأول فى حين زاد إنتاج المحصول تدريجيا خلال الموسم الثانى.
- أدت إضافة سماد الدواجن (ChM) بمعدلات مختلفة إلى زيادة محصول البصل خلال الموسمين وذلك مقارنة بسماد الأسطبل (FYM).
- أدت إضافة سماد الأسطبل (FYM) مختلطا مع سماد الدواجن (ChM) بمستويات مختلفة إلى حدوث زيادة تدريجية فى محصول البصل.
- أدت إضافة سماد الدواجن مختلطا مع سماد الأسطبل إلى تصحيح نسبة الكربون/ النيتروجين (C/N ratio) وحدوث أفضل ظروف لعملية معدنة النيتروجين (Mineralization of organic-N) .
- أدت إضافة سماد الأسطبل مع سماد الدواجن (FYM : ChM) بنسبة (١: ٢) إلى الحصول على إنتاج من محصول البصل حيث يمكن ترتيب المحصول ترتيبا تنازليا حسب المعاملات كالآتى :

(FYM + ChM) > ChM > Urea > FYM.

حيث كان تأثير المادة العضوية أفضل فى الموسم الثانى عن الموسم الأول.

- أدت إضافة سماد الأسطبل (FYM)، سماد الدواجن (ChM) كل على حدة أو مختلطان معا إلى زيادة محتوى الحديد والمنجنيز والزنك والنحاس فى نباتات البصل وكذلك إلى زيادة نسبة هذه العناصر فى مستخلص التربة خاصة على عمق من ٥-١٠سم مقارنة بباقى المعاملات وعلى ذلك يمكن القول بأ=ن المادة العضوية أدت إلى إعطاء أعلى محصول مع تحسين صفات الجودة لنباتات البصل.