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EFFECT OF SOME ORGANIC SOURCES IN WHEAT YIELD AND SOIL SANDY FERTILITY

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ABSTRACT

Two field experiments were conducted at Abdel Menem Riyadh village, Al-Bostan, Beheira Governorate in two successive winter seasons of 2008/2009 and 2009/2010 to assess the effects of some organic sources viz. chicken manure (CM), farmyard manure (FYM) and organic wastes (OW) in combination with different levels of inorganic N fertilizer 60, 90 and120 kg N/fed on wheat yield and its components under sprinkler irrigation system prevailing in the region and to evaluate to what extent the fertilizer treatments impact on soil fertility status of the experimental field. The results showed that application of organic nitrogen sources in combination with inorganic nitrogen recorded significant effect on wheat grains and straw yields and weight of one-1000 grain. The significant effect of the organic nitrogen sources was in the following order:

CM > FYM > OW with the exception of the significant effect of OW and FYM, which were similar on their effect on wheat straw yield. Applying CM (at rate of 50 kg organic-N/fed. =2ton CM/fed) combination with 90 kg N/fed significantly yielded the most significantly favorable N, P and K uptake in wheat grains and straw. When CM was applied at rate (50 kg organic nitrogen/fed.) in combination with 90 kg N/fed, the experimental soil gained after harvest the highest amounts of N, P and K as well as the highest amount of organic matter that will support the subsequent crop.

INTRODUCTION

Sandy soils represent the main solution to get out the old narrow Nile valley for inevitable horizontal expansion particularly after the population has greatly increased for the last decade. These soils are characterized by very low plant nutrient contents, low water holding capacity and little or bare organic matter that supplies plants with a continuous source of nutrients, furnishes energy and carbon dioxide to beneficial organisms and improves soil structure. Organic sources such as chicken manure, farmyard manure and town wastes contain varying amounts of water, mineral nutrients and organic matter (Edwards and Daniel, 1992 and Brady and Weil, 1996). The need and utilization of chicken manure has overtaken the use of other animal manure because of its high content of nitrogen, phosphorus and potassium (Warman, 1986 and Schjegel, 1992). Escalating prices of inorganic fertilizers due to the increase in the fuel prices have also prompted the use of chicken manure (Place *et al*., 2003 and Duncan, 2005).

Many researchers introduced organic sources through different aspects related to soil physical, chemical and nutritional properties. Warman (1986) and Duncan (2005) illustrated that chicken manure was preferred amongst other animal wastes because of its high concentration of macro nutrients. Chescheir *et al*., (1986) found increase in nitrogen levels from 40-

60% and 17-38% with respect to control for Norfolk sandy soil and Cecil sandy loam soils, respectively, following application of manure. In addition, application of chicken manure to soil enhances concentration of water soluble salts in soil. Plants absorb nutrients in the form of soluble salts, but excessive accumulation of soluble salts (or soil salinity) suppresses plant growth. Stephenson *et al*., (1990) reported the EC of chicken manure of about 11dSm^{-1} in silt loam soils too high for salinity sensitive crops. Lopez-Masquera *et. al*., (2008) mentioned that the pH of dry chicken manure pellets was found to be 7.9 with most of nutrients available while the decrease in the soil pH (< 6.5) affects the availability of nutrients to plants . Agbede *et. al*., (2008) indicated that if chicken manure was applied correctly it would act as a good soil amendment and/or fertilizer (would provide N, P and K) and would also increase the soil and leaf N, P, K, Ca and Mg concentrations. Thus, the current investigation aims to assess the effects of chicken manure, farmyard manure and organic wastes in integration with different levels of inorganic nitrogen on wheat yield and its components in sandy soil of Al-Bustan.

MATERIALS AND METHODS

Two field experiments were carried out at Abdel Monaem Riyadh village, Al-Bostan (falling within longitude 11^o 35'- 12^o 05' and latitude 10^o 10'-10^{o}31'), Beheira Governorate in two successive winter seasons of 2008/2009 and 2009/2010 to assess the effects of some organic sources viz. chicken manure (CM), farmyard manure (FYM) and organic wastes (OW) in combination with different levels of inorganic fertilizer 60, 90 120 kg N/fed on wheat yield and its components under sprinkler irrigation system prevailing in the region and to evaluate to what extent the fertilizer treatments impact on soil fertility status of the experimental field. Some representative surface soil samples (0-30cm) were collected from the experimental field in each season to determine some physical and chemical properties of the experimental fields Table (1) according to standard methods and procedures described by Piper (1950), Jackson (1973) and Black *et al*. (1965).

Table (1): Some physical and chemical properties of the experimental soil .

Properties	Values	
	2008/2009	**2009/2010**
Particle size distribution (%)		
Sand	80	81.24
Silt	16.50	16.23
Clay	3.00	2.00
Texture	Sandy	
E.C (dSm^{-1}, Soil paste ext.)	1.60	1.10
pH (1:10 Soil water susp.)	7.30	7.21
$CaCO_3$(%)	1.64	1.41
O.M (%)	0.12	0.10
Available N (mg/kg)	17.00	16.00
Available P (mg/kg)	8.00	8.50
Available K (mg/kg)	171	150

The current investigation included the use of farmyard manure (FYM) and chicken manure (CM). They were brought from domestic farms around Al-Bostan area and placed near the experimental fields in two locations of cemented floor to avoid infiltration. The organic materials were covered with dark plastic sheets and kept for composting for 100 days to make sure that they were homogeneous and free from germs and/or insects that may hinder the growth of wheat. The experimental treatments comprised organic wastes (OW) which was brought from an authenticated private plant specialized in treating and recycling town wastes operating in Alexandria. Representative samples were taken from these organic sources for analysis and the relevant data are shown in Table (2).

Table (2): Some chemical properties of organic sources used in the experimental fields

Properties	C.M	FYM	O.W
pH (1:10 organic material water susp)	7.22	7.43	7.35
EC (dS/m)	6.17	6.09	6.01
Organic matter % (dry wt. basis)	46.47	64.32	29.91
Organic carbon % (dry wt. basis)	36.95	37.31	17.34
Total N % (dry wt. basis)	2.44	1.64	0.68
Total P% (dry wt. basis)	0.32	0.22	0.12
Total K % (dry wt. basis)	0.54	0.63	0.41
C/N Ratio	15.14	22.75	25.50

The organic materials were applied at an amount equivalent to 50kg organic nitrogen/fed on the basis of total nitrogen contents in the organic sources as elaborated in Table (3).

Table (3): Amount of organic sources equivalent to 50 kg organic nitrogen fed-1and the different amounts being applied to the experimental plot.

Organic sources	Total N %	Amount equivalent to 50 kg organic N fed^{-1}	Amount applied kg $plot^{-1}$
CM	2.44	2049.18	5.12
FYM	1.64	3048.78	7.62
OW	0.68	7352.94	18.38

The two experiments were carried out in a split-split plot design with three replicates and each split-split-plot measured (3m x 3.50m) and the main plots were allocated for organic sources i.e. CM, FYM and OW, whereas the sub-plots were assigned for organic rates 0 and 50 kg organic N fed^{-1}. The sub-sub plots were allotted for N levels 60, 90 and 120 kg fed^{-1}. According to figures illustrated in Table (3), CM, FYM and OW were incorporated into the experimental plots by labor hands in hill bottoms one time before sowing. Wheat grains of Giza 168 cultivar were broadcast in late Nov. 2009 at the rate of 100 kg fed^{-1} Nitrogen levels were applied as urea (46% N) in four equal doses after 20, 40, 55 and 70 days from sowing. In the meantime, P-fertilizer was broadcast as ordinary super-phosphate (15% P_2O_5) one time at the rate of (300 kg fed^{-1}) when preparing and servicing soil before sowing. potassium fertilizer was added in the form of potassium sulfate (48% K_2O) equally to all sub-sub-plots at the rate of 50 kg fed^{-1} in two equal doses after 20 and 40 days from sowing. The experimental fields were previously planted with summer green fodder. Sprinkler irrigation was scheduled for the two field experiments by meteorological services and other agricultural practices were performed particularly weed control such as *Avena fatualolium*, *Avena sativa* and *Avena strilisloli* in cooperation with agricultural extension. When plants get fully matured by the end of May, 2009 and 2010, a sample of an area of 1 m^2 was taken from each sub-sub-plot by a 1 m side long square like wooden frame that has been dropped on the middle of each sub-sub-plot and plants fallen within the wooden frame were harvested and bound with twines attached with numbered labels. Samples were weighted to calculate the whole grains and straw. After the samples have been threshed, grain weight was subtracted from the whole weight of wheat sample to extract straw weight.

Samples of grains and straw were ground in a step to determine N, P and K as outlined in A. O. A. C. (1990). Analysis of variance was computed for each trait as combined means of the two growing seasons according to Snedecor and Cochran (1980) and treatment means were compared using LSD at 5% level of probability.

RESULTS AND DISCUSSION

1-Effect of fertilizer treatments on wheat yield and its components:

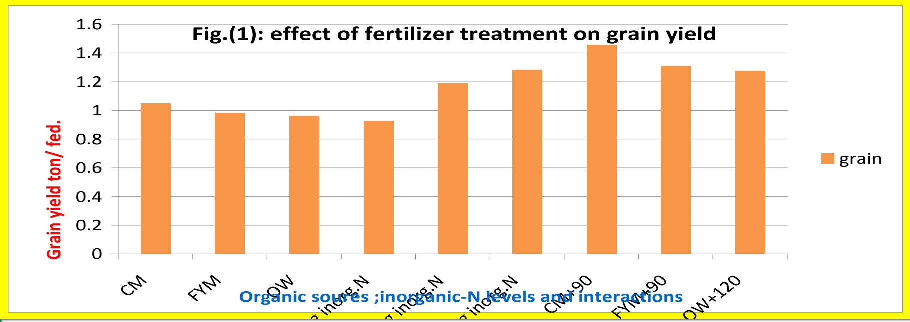
Data in Table 4and fig.1,2,3 illustrate the effect of organic nitrogen sources represented by CM, FYM and OW, their rates and the levels of inorganic nitrogen applied alone or in combination on wheat yield and its components. The results elucidated that CM significantly exceeded FYM and OW in wheat grain yields and one-1000 grain weight, but OW and FYM significantly had the same effect on straw yield.

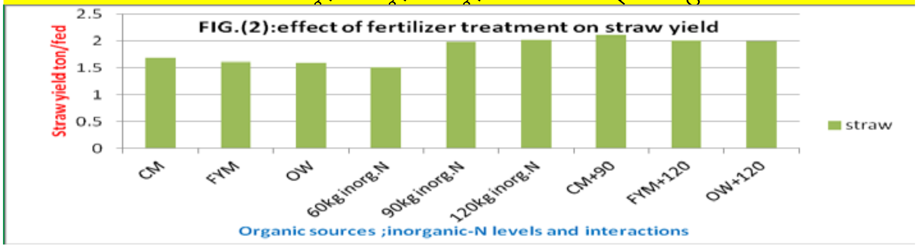
The results confirmed that application of these organic sources with rate (50kg organic-N/fed) caused significant increases in grains and straw yields and one-one-1000 grain weight. Also , increasing inorganic N-levels from 60 to 120 kg N/fed recorded significant stepwise increases in wheat grains, straw yields and one-one-1000 grain weight. The results showed that application of organic nitrogen sources in combination with inorganic nitrogen recorded significant effect on wheat grain and straw yields and weight of one-one-1000 grain. They recorded 1.049, 0.985 and 0.962 t/fed of wheat grains, 1.685, 1.610 and 1.595 t/fed of wheat straw and 31.43, 31.0 and 30.57 g for one-1000 grain weight; respectively. The results showed that the higher wheat grain yield (1.458 t fed-1) was produced by application of CM in combination with (90 kg N f-1), whereas application of FYM in combination with (90 kg N f^{-1}) produced (1.311 t fed^{-1}) and OW in combination with (120 kg N fed^{-1}) produced (1.276 t fed^{-1}). The results clarified that the rate (50kg organic-N/fed) of application of organic sources significantly contributed to increase grain and straw yields as well as one-one-1000 grain weight by 28.08%, 12.03% and 8.97%, respectively as compared to the treatment of non-using organic sources. On the other hand; application of inorganic N-fertilizer by 120 kg N fed^{-1} alone significantly contributed to increase grain and straw yields as well as one-one-1000-grain weight by 38.0%, 33.44% and 10.16%; respectively as compared to the treatment received 60 kg N fed^{-}

Table (4): Effect of fertilizer treatment on wheat yield and its components [1].

Main Plots Org. Sources	Sub-plots Org. Rates	Sub-Sub- plots N-Levels	Grain yield t fed^{-1}	Straw yield t fed^{-1}	One- 1000- grain wt. (g)
CM	0	0	0.498	0.849	27.36
		60	0.734	1.311	28.69
		90	1.022	1.868	30.11
		120	1.216	1.997	32.65
	50	0	0.789	1.345	30.42
		60	1.234	1.986	32.25
		90	1.458	2.113	35.51
		120	1.441	2.016	34.43
Average CM			1.049	1.685	31.427
FYM	0	0	0.501	0.856	27.42
		60	0.737	1.345	28.72
		90	1.028	1.987	30.14
		120	1.218	2.001	32.44
	50	0	0.669	1.116	30.11
		60	1.122	1.568	31.11
		90	1.311	2.003	34.34
		120	1.298	2.009	33.68
Average FYM			0.985	1.610	30.995
OW	0	0	0.511	0.866	27.44
		60	0.747	1.355	28.70
		90	1.047	1.958	30.17
		120	1.248	2.067	32.14
	50	0	0.601	1.024	29.40
		60	1.002	1.498	30.60
		90	1.268	1.997	31.11
		120	1.276	2.001	35.01
Average OW			0.962	1.595	30.571
Average Rates		0	0.876	1.538	29.67
		50	1.122	1.723	32.33
Average N-Levels		0	0.594	1.009	28.69
		60	0.929	1.510	30.01
		90	1.189	1.987	32.23
		120	1.282	2.015	33.06
LSD $_{0.05}$					
Org. Sources(A)			0.007	0.113	0.04
Org. Rates(B)			0.005	0.082	0.01
N-Levels(C)			0.005	0.085	0.01
Interactions					
AXB			0.008	0.14	0.015
AXC			0.009	0.15	0.012
BXC			0.007	0.12	0.010
AXBXC			0.012	0.21	0.016

The significantly promotive effect of the combination of organic and inorganic nitrogen on wheat grain and straw yields as well as one-one-1000 grain weight could be related to the potential role of organic manures in changing the soil quality after manure addition that linked to the effect of OM content on soil structure and biological activity (Bronick and Lal, 2005; Tisdal and Oades, 1982). Meanwhile; Shaaban (2006) reported that higher grain yield was recorded with (80 kg organic (chicken) N+ 40 kg inorganic N) and added that the data were at par with other treatment that received 25% N applied from organic sources and 75% from mineral nitrogen.

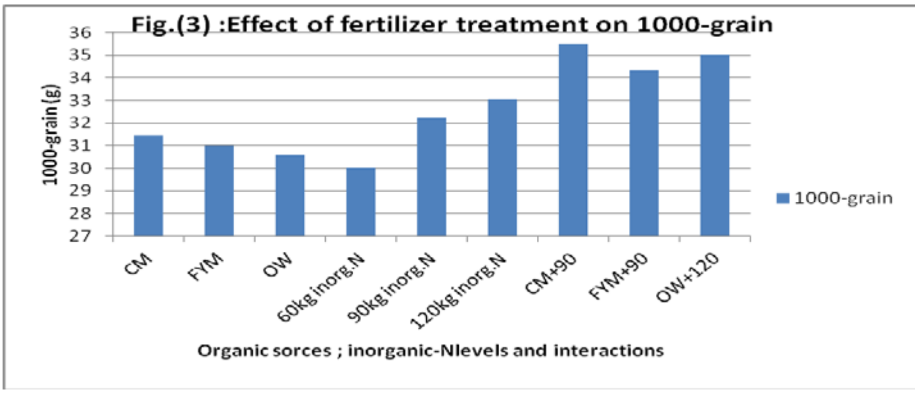




2-Effect of fertilizer treatments on N, P and K uptake in grains and straw:

Data in Table (5) represent the effect of organic sources viz. CM, FYM and OW and different levels of inorganic N alone or in combination on N, P and K uptake in wheat grains and straw. The results indicated that CM was significantly the best effective organic N source on N, P and K uptake in wheat grains and straw, however, FYM was significantly similar to CM in K uptake in wheat grains and N and K uptake in wheat straw and by the same way, FYM was significantly similar to OW in its effect on N and K uptake in wheat grains and straw. Data in the same table confirmed that applying organic sources by the higher rate significantly caused promotive effect on N, P and K uptake in wheat grains and straw and similarly applying inorganic N-levels by (90 kg N/fed) significantly recorded the highest N, P and K uptake in wheat grains and straw. We could state that applying CM in combination with 90 kg N/fed significantly yielded the most significantly favorable N, P, K uptake in wheat grains and straw**.**

We could mention that the high rate of organic N sources in combination with inorganic N-level (90 kg N/fed provided wheat plants in this trial with the most favorable condition for the crop to have high yield and N, P and K uptake in grains and straw. Similar results were obtained by Iqbal*et al* (2002) and Idris *et. al.,* (2001) who reported that combination of organic and inorganic N resulted in greater N-uptake than those obtained when each was applied singly.



3-Effect of fertilizer treatments on organic matter and available nutrients in soil after harvest;

Data in Table (6) effects of CM, FYM and OW, their rates of application and different levels of inorganic N alone and in combination on organic matter, total N and available N, P and K contents in the soil under investigation. The results identified that all organic N sources used in the current investigation were similar in respect of organic matter content remained in the experimental soil after harvest. This effect was extended to the rate of application of such sources and the level of inorganic N fertilize added in the experimental soil. The results showed that there was no significant difference between CM and FYM in their effect on total N% remained in the experimental soil after harvest and each of them was significantly better than OW in total N% in the soil after harvest. Moreover, the rate of application of organic N sources and the different inorganic N-levels added to the soil have insignificant effect on the same parameter. Importantly, CM recorded the best significant effect on the available N, P and K in the experimental soil after harvest and the same trend of the effect of the rate of application of such organic N sources and the different levels of inorganic N fertilizer added to the experimental soil had the same impact on this parameter. It is worthy to note that when CM was applied at the higher rate in combination with inorganic N level (90 kg/fed), the experimental soil gained the highest amounts of N, P and K as well as the highest amount of organic matter that will support the subsequent crop.

These results are standing on some facts as follows:

1-The organic N sources represent a slow release fertilizer feeding the growing plant throughout its life and the great effect of such fertilizer is shown at the mature stage of the plant and an appreciable part of the organic matter applied remains in the soil after harvest in favor of the successive crop.

2-2-The remaining OM in the experimental soil will contribute to soil fertility through exchangeable bases such as Ca, Mg, K that will modify soil EC and consequently improving soil condition in favor of the growing plant (Abu-Zahra and Tahboub, 2008).

Table (5): Effect of fertilizer treat.on N, P and K uptake in wheat grains and straw

Main Plots Org. Sources	Sub-plots Org. Rates	Sub-Sub-plots N-Levels	N	P	K	N	P	K
			Uptake in grain (kg fed^{-1})			Uptake in straw (kg fed^{-1})		
CM	0	0	11.87	2.43	3.22	3.211	0.742	0.456
		60	25.09	5.75	7.80	7.759	1.558	1.135
		90	37.06	6.12	8.68	9.563	1.681	1.244
		120	45.97	6.28	10.38	10.459	1.858	1.495
	50	0	11.22	2.35	3.26	3.144	0.689	0.562
		60	39.92	7.21	10.21	9.285	2.147	1.459
		90	55.09	8.10	12.26	11.849	2.109	1.653
		120	55.23	8.12	12.23	12.588	2.262	1.750
Average CM			35.18	5.80	8.5	8.48	1.63	1.22
FYM	0	0	11.45	2.62	3.45	2.987	0.723	0.521
		60	30.39	5.86	7.80	7.883	1.594	1.143
		90	37.55	6.16	8.68	9.454	1.669	1.142
		120	40.79	6.33	10.38	10.482	1.896	1.394
	50	0	11.38	2.44	3.24	3.111	0.811	0.542
		60	35.01	6.74	10.21	8.964	1.991	1.402
		90	38.26	6.97	12.26	10.382	2.006	1.406
		120	50.65	7.59	11.67	11.269	2.005	1.583
Average FYM			31.94	5.58	8.46	8.06	1.57	1.14
OW	0	0	10.89	2.67	3.62	3.258	0.736	0.611
		60	30.95	5.84	6.97	7.852	1.536	0.998
		90	37.26	6.20	8.73	8.807	1.635	1.247
		120	40.02	6.35	8.70	10.437	1.872	1.248
	50	0	11.65	2.55	3.57	3.112	0.812	0.321
		60	29.89	6.22	8.24	8.038	1.738	1.130
		90	31.25	6.34	9.14	9.537	1.755	1.270
		120	47.93	6.70	10.08	10.717	1.904	1.409
Average OW			29.98	5.36	7.36	7.72	1.50	1.03
Average Rates		0	29.94	5.21	7.36	7.68	1.45	1.05
		50	34.79	5.94	8.86	8.5	1.69	1.21
Average N-Levels		0	11.41	2.51	3.39	3.137	0.752	0.502
		60	31.88	6.27	8.54	8.30	1.76	1.211
		90	39.41	6.64	9.96	9.93	1.81	1.327
		120	46.77	6.90	10.57	10.9	1.96	1.48
L S D 0.05	Org. sources(A		4.10	0.28	1.01	0.60	0.06	0.13
	Org. Rates(B)		4.43	0.17	0.49	0.24	0.09	0.05
	N-Levels(C)		1.18	0.9	0.19	0.44	0.05	0.06
	AXB		N.S	0.30	0.84	0.42	0.16	0.12
	AXC		N.S	0.12	0.34	N.S	0.12	N.S
	BXC		1.67	0.10	0.28	0.75	0.10	0.12
	AXBXC		N.S	0.17	0.48	1.07	0.17	0.17

Table (6): Effect of fertilizer treatments on organic matter and major nutrient elements in Soil after harvest

Main plots Org. sources	Sub-plot Organic rates	Sub-Sub-plots N-levels	OM %	Total N%	Available N	Available P	Available K
					ppm	ppm	ppm
CM	0	60	0.13	0.01	11.97	7.65	172
		90	0.12	0.01	17.60	7.80	173
		120	0.14	0.01	17.70	7.50	171
	50	60	0.31	0.02	22.35	21.80	264
		90	0.32	0.02	22.20	21.75	266
		120	0.29	0.02	22.50	21.80	262
Average CM			0.22	0.02	19.99	14.72	218
FYM	0	60	0.12	0.01	17.70	9.55	175
		90	0.13	0.01	17.50	9.35	175
		120	0.39	0.01	17.85	9.75	175
	50	60	0.23	0.02	19.30	13.90	313
		90	0.23	0.02	19.30	14.20	307
		120	0.22	0.02	19.30	13.60	320
Average FYM			0.22	0.02	19.49	11.73	244
OW	0	60	0.13	0.01	17.15	7.70	173
		90	0.12	0.01	17.00	7.45	176
		120	0.13	0.01	17.30	7.95	170
	50	60	0.14	0.01	17.35	8.80	180
		90	0.15	0.01	17.35	8.85	175
		120	0.14	0.02	17.35	8.75	185
Average OW			0.13	0.01	17.25	8.25	177
Average rates		0	0.16	0.01	17.50	8.30	173
		50	0.22	0.02	19.65	14.83	252
Average N-Levels		60	0.21	0.01	18.17	11.01	211
		90	0.18	0.01	18.97	12.12	214
		120	0.18	0.01	18.58	11.56	213
Org. sources(A)		L S $D_{0.05}$	N.S	0.001	0.05	0.21	5.29
Organic rates(B)			N.S	0.001	0.11	0.29	4.83
N-Levels(C)			N.S	N.S	0.10	0.13	2.12
AXB			N.S	0.002	0.20	0.50	8.36
AXC			N.S	N.S	0.17	0.24	N.S
BXC			N.S	0.001	0.14	0.19	N.S
AXBXC			N.S	N.S	0.24	0.34	N.S

RECOMMENDATIONS

In the light of the research results and analysis of representative samples of the experimental fields in the two seasons and tabulated data, the following recommendations could be concluded:

1-Chicken manure, farmyard manure and organic wastes play an effective role in modifying soil quality particularly sandy soils to get high yield and to maintain soil fertility.

2-It is wise to apply chicken manure or farmyard manure in combination with mineral nitrogen in sandy soils to make benefit from the amount of organic matter and major nutrient elements N, P and K that brought to the soil by such fertilizers after harvest.

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تأثير بعض المصادر العضوية على محصول القمح وخصوبة التربةفى الأرض الرملية

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أجريت تجربتان حقليتان بقرية عبد المنعم رياض،البستان محافظة البحيرة في موسمين متتاليين 2009/2008 -2010/2009 لتقدير تأثير بعض المصادر العضوية وهى سماد الدواجن، السماد البلدي والمخلفات العضوية(مخلفات المدن) سويا مع مستويات مختلفة من السماد النيتروجيني المعدني 60، 90، 120 كجم ن/فدان على محصول القمح ومكوناته تحت نظام الري بالرش السائد في المنطقة وتقييم إلى أى مدى تؤثر المعاملات السمادية على حالة خصوبة التربة بالحقل التجريبي . وقد أشارت النتائج إلى أن إضافة مصادر النيتروجين العضوي سويا مع النيتروجين المعدني تؤثر معنويا على محصول القمح من الحبوب والقش ووزن الألف حبه وكان هذا التأثير المعنوي لهذه المصادر العضوية على النحو التالي:

سماد الدواجن > السماد البلدي > المخلفات العضوية بإستثناء التأثير المعنوي لسماد االبلدى و المخلفات العضوية على محصول القمح من القش حيث كانا متماثلان. وأدى إضافة سماد الدواجن سويا مع النيتروجين المعدني بمعدل 90 كجم ن/فدان إلى أفضل تأثير معنوي لإمتصاص عناصر النيتروجين والفوسفور والبوتاسيوم في الحبوب والقش ، وعند إضافة سماد الدواجن بمعدل (2طن/فدان) سويا مع النيتروجين المعدني بمعدل 90 كجم ن/فدان إكتسبت التربة أعلى كمية من عناصر النيتروجين والفوسفور والبوتاسيوم وكذلك ارتفعت نسبة المادة العضوية بعض الحصاد مما يدعم المحصول اللاحق.

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