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COMPARATIVE STUDY BETWEEN SOME ORGANIC FERTILIZER SOURCES AND AMMONIUM NITRATE ON CORN AND SOIL PROPERTIES

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ABSTRACT

An experiment was conducted during 1998 season in the experimental farm of Mallawy Agriculture Research Station, El-Menia Government to investigate the comparative effect of some organic fertilizer sources (filter mud cake FMC, farm yard manure FYM and sewage sludge SS) and ammonium nitrate (33.5%) as inorganic fertilizer on corn (*Zea mays* L.) and soil properties. Three levels of each fertilizer source were used, 1500, 3000 and 4500 kg/fed from both FMC and S.S 10, 20 and 30 m^3/fed. FYM 60, 90 and 120 kg N/fed. ammonium nitrate (33.5%).

The results revealed that a positive influence of the addition of all organic fertilizer sources, not only on soil properties but also on the mineral nutrition of plants and yield production. A pronounced increase in soil content of O.M., avail. P and K ppm as a result of increasing fertility levels of organic fertilizer sources, whereas pH level slightly decreased. Sewage sludge application promoted growth in maize compared with the application of other organic or inorganic fertilizer. Farmyard manure has shown considerable increase in plant content of both K % and P ppm than other organic or inorganic fertilizer due to higher soil microbial and biological activity in FYM treatments.

INTRODUCTION

It is well known that addition of organic manures has shown considerable increase in crop yield and exert significant influence on physical, chemical and biological properties of soil. Moreover, the higher cost of chemical fertilizers coupled with their limited production mad it imporative that a part of fertilizer may be substituted with recycling of organic wastes. Continuous use of fertilizers deteriorates the soil fertility and fertilizer use efficiency (Gaur and Sadasivan, 1981). Organic manures have been recorded to enhance the efficiency and reduce the requirement of chemical fertilizers. Hence to maintain the sustainable productivity of maize an experiment was carried out to study the comparative effect of some organic fertilizer sources (filter mud cake, farmyard manure and sewage sludge) and ammonium nitrate (33.5% N) on productivity of *Zea mays* and soil properties. Saleh (1996) reported that application of FMC could successfully improve physical properties of both clay and sandy soils. However, higher rates of the material are needed in the case of coarse-textured soils. Raman *et al*. (1996) reported that the addition of pressmud cake to soil resulted in significantly higher grain and straw yields of sorghum crop.

Rameshwar and Singh (1998) reported that the direct effect of FYM during the first year of experimentation in maize improved the growth parameters like plant height, dry matter accumulation and LAI at different growth stages and ultimately reflected on the grain yield of maize. Christodoulakis and Margeris (1996) reported that sewage sludge application promoted growth in both maize and sunflowers compared with the application of inorganic fertilizer, plant height of maize increased by 77% in the sludge treated pots compared with 25% in plants fertilized with complesal.

Mohammad and Battikhi (1997) reported that incorporation of sewage sludge significantly decreased soil pH and increased electrical conductivity and organic matter. Sludge application increased extractable P, and concentration of micronutrients and heavy elements in the soil. The concentration of N, P, Fe, Zn and Mn in barley grain and straw were significantly increased at 40 and 60 t/ha sludge applications rates.

MATERIALS AND METHODS

An experiment was done in field during 1998 season in the experimental farm of Mallawy Agriculture Research Station, El-Menia Government using maize (*Zea mays* L.) to investigate the comparative effect of some organic fertilizer sources (filter mud cake, farmyard manure and sewage sludge) and ammonium nitrate (33.5% N) as inorganic fertilizer.

The experiment design was split plot with four replications. The main plots were devoted to different fertilizer sources as follows:

Organic sources: FYM, FMC and S.S and inorganic fertilizer: ammonium nitrate (33.5% N). The sub-plots were assigned for three levels of each fertilizer sources as:

C_1 C_2 and C_3

FYM 10, 20 and 30 m^3/fed.
FMC 1500, 3000 and 4500 kg/fed.
S.S. 1500, 3000 and 4500 kg/fed
Amm. nit. 60, 90 and 120 kg N/fed

Each sub-plot was 42 m^2 in size including 6 ridges, 6 m. long, the two outer ridges were used as border.

* Farmyard manure from animal farm at Mallawy.

* Filter mud cake is a by-product of sugar industry from sugar cane in Abo-Kurkas, El-Minia Government. It is largely composed of organic material mixed with inorganic (mineral) fraction.

* Sewage sludge is a dewatered sludge from a sewage purification El-Minia Government. Table (1) show some chemical properties of FMC, FYM and S.S used in the treatments.

Soil properties were measured in six soil samples representing the used soil before receiving any treatments and shown as average in Table (2).

Sowing date was at the last week of May using maize (Giza 2 cultivar), the other cultural practices were carried out as usual in maize fields.

Table (1): Average of some chemical properties of organic fertilizer source used in the treatments (as a mean of six samples).

Organic fertilizer source	pH*	EC** dS/m	O.M. %	T.C. %	T.N. %	C/N ratio	Avail. P ppm	Avail. K ppm
FMC	6.4	2.13	66.85	38.37	3.15	12.18	2.81	125.15
FYM	6.73	2.75	11.17	6.47	0.43	15.0	0.35	110.18
S.S.	6.11	4.3	47.55	27.55	2.15	12.8	2.15	68.81

Table (2): Average of some physical and chemical properties of the soil used in the experiment before receiving any treatments (as a mean of six samples).

Soil texture	$CaCO_3$ %	Organic matter %	pH*	EC** dS/m	T.N. %	Avail. P ppm	Avail. K ppm
Clay loam	2.65	1.28	8.15	0.63	0.022	5.2	134.8

*** pH in a sample: water suspension 1:25**
**** EC in a sample: water extraction 1:5.**

Plant samples (leaves) were taken during the growth season for estimating some nutrient content.

At maturity stage twenty representative plants from the inner ridges of each sub-plot were taken at random to record, plant height cm, number of ears/plot and ear weight/plot. Twenty ears randomly chosen from each sub-plot were kept in a sunny dry place till fully dried and used to determined the following trials, ear length in cm, ear diameter in cm, number of grain/2 rows.

After harvesting representing soil samples were collected to determined some soil properties at the end of the experiment.

Chemical composition of plant leaves and soil samples were determined according to the method described by Chapman and Pratt (1961).

Statistical analysis was done according to the procedures outlined by Snedecor and Cochran (1967).

RESULTS AND DISCUSSION

The results obtained will be discussed under the following headings:

I - Effect of different fertilizer sources on growth parameters and yield of maize:

Data in Table (3) reveal that growth parameters and yield of maize attributes, viz. plant height in cm., ear weight/plot in kg, number of ears/plot,

ear length in cm. and number of grain/2 rows, were conspicuously influenced by different fertilizer sources, whereas ear diameter in cm. remained unaffected. These results are in line with those obtained by Baron *et al*. (1995) on wheat, Christodoulakis and Margaris (1996) on corn and Rameshwar and Singh (1998) on maize and wheat in sequence

Table (3): Mean values of vegetative growth parameters and yield of *Zea mays* (Giza 2) as affected by using different fertilizer sources.

Plant parameters	Fertilizer sources				L.S.D.	
	FMC	FYM	SS	Amm. Nit	0.05	0.01
Plant height in cm.	245.00	230.83	247.50	231.66	5.99	8.61
Ear weight/plot in kg	29.25	29.41	31.79	26.16	3.77	5.10
Number of ears/plot	110.08	105.08	112.75	99.16	7.27	9.82
Ear length in cm.	23.58	24.41	26.91	23.41	2.05	3.22
Number of grain/2 rows	70.50	70.66	76.83	69.66	4.30	5.82
Ear diameter in cm.	20.92	21.42	23.33	21.17	N.S.	N.S.

II - Effect of different fertilizer levels on growth parameters and yield of maize:

Increasing fertility levels as shown in Table (4) resulted in consistent and significant increase in plant height in cm. and number of grains/2 rows. Whereas other growth parameters of maize crop could not reach the level of significance with increasing different fertility levels.

Table (4): Mean values of vegetative growth parameters and yield of *Zea mays* (Giza 2) as affected by different fertilizer levels.

Plant Parameters	Fertilizer levels			L.S.D.	
	C_1	C_2	C_3	0.05	0.01
Plant height in cm.	226.25	245.50	247.50	11.13	15.08
Ear weight/plot in kg	28.62	28.18	29.28	N.S.	N.S.
Number of ears/plot	106.62	106.25	107.43	N.S.	N.S.
Ear length in cm.	23.75	24.81	25.43	N.S.	N.S.
Number of grain/2 rows	65.38	72.06	78.31	4.22	5.72
Ear diameter in cm.	20.56	21.94	22.63	N.S.	N.S.

III - Effect of different fertilizer sources on some nutrients contents in maize leaves:

The results in Table (5), clearly show highly increase in leaves content of both K % and P ppm of *Zea mays* plants fertilized by FYM than maize plants fertilized by other sources. Whereas N (%)could not reach the level of significance as a result of using different fertilizer sources.

The considerable increase in plant content of both K % and P ppm with FYM treatments than other organic or inorganic fertilizer treatments plant is due to higher soil microbial and biological activity in FYM treated soil. This in harmony with the trends noticed by Sing *et al*. (1997).

Table (5): Some nutrients, in *Zea mays* leaves as affected by different fertilizer sources.

Component	Fertilizer sources				L.S.D.	
	FMC	FYM	SS	Amm. Nit	0.05	0.01
N%	1.26	1.42	1.25	1.27	N.S.	N.S.
K %	1.263	1.39	1.22	1.312	0.12	0.18
P ppm	22.44	25.44	20.22	18.33	4.74	7.17

IV - Effect of different fertilizer levels on some nutrients content in maize leaves:

The increase in fertility levels Table (6) clearly reflected a consistent and significant increase of K % content in maize plant leaves, whereas N % and P ppm contents could not reach the level of significance with using different fertility levels.

Table (6): Some nutrients, in *Zea mays* leaves as affected by different fertilizer levels.

Component	Fertilizer levels			L.S.D.	
	C_1	C_2	C_3	0.05	0.01
N %	1.255	1.337	1.315	N.S.	N.S.
K %	1.251	1.268	1.366	0.079	0.109
P ppm	20.665	20.83	23.608	N.S.	N.S.

V - Effect of different fertilizer sources and levels on some soil properties at the end of the experiment:

Data in Table (7) reflect a pronounced increase in soil content of organic matter, avail. P and K ppm as a result of increasing fertility levels, whereas pH level slightly decreased in case of using all organic fertilizer sources. In addition as shown in Table (7), highly increases in soil of avail. P and K (ppm) and OM (%), whereas pH level slightly decreased due to the application of all organic fertilizer sources than the case of using inorganic fertilizer. Similar trends were found by a number of investigators, Baron *et al*. (1995), Sharkadi (1995), Mohamed and Battikhi (1997) and Haynes and Naidu (1998).

Table (7): Average of some soil properties at the end of the experiment as affected by different fertilizer sources and levels.

Fertilizer		pH*	EC**	O.M.	T.N.	Avail.	Avail.
Sources	levels		dS/m	%	%	P ppm	K ppm
FMC	C_1	8.13	0.61	1.35	0.025	6.5	153.6
	C_2	8.12	0.61	1.38	0.028	6.8	175.9
	C_3	8.10	0.60	1.43	0.028	8.3	204.5
FYM	C_1	8.15	0.64	1.33	0.025	5.8	137.7
	C_2	8.13	0.64	1.35	0.025	6.3	156.5
	C_3	8.13	0.66	1.45	0.028	6.5	158.9
S.S.	C_1	8.13	0.64	1.31	0.028	6.4	162.8
	C_2	8.13	0.67	1.38	0.028	6.6	186.5

	C_3	8.13	0.67	1.38	0.030	7.5	192.7
Ammonium .nitrate	C_1	8.15	0.63	1.30	0.024	5.7	135.1
	C_2	8.15	0.64	1.31	0.024	5.8	135.2
	C_3	8.15	0.64	1.31	0.024	5.8	135.2

*** pH in a sample: water suspension 1:25**
**** EC in a sample: water extraction 1:5.**

CONCLUSIONS

From the previous results and discussion we can concluded the following:

1 - A positive influence could be obtained of the addition of organic fertilizers, not only on soil properties but also on the mineral nutrition of *Zea mays* plants and yield production. However, there was no direct correlation, except in certain cases, between the level of fertilizers added and the fixed parameters.

2 - It can be concluded that the efficiency of FYM on increasing plant content of some nutrient than other organic or inorganic fertilizer is due to higher soil microbial and biological activity in FYM treated soil.

3 - Sewage sludge application promoted growth in maize compared with other organic or inorganic fertilizer.

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دراسة مقارنة بين بعض مصادر السماد العضوى ونترات الأمونيوم على محصول وصفات نباتات الذرة الشامية وخواص التربة المنزرع بها

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أقيمت تجربة فى المزرعة البحثية بمحطة البحوث الزراعية بملوى عام 1998 وذلك لدراسة مقارنة تأثير استخدام بعض مصادر السماد العضوى مثل طينة المرشحات (ناتج مصنع قصب السكر بأبو قرقاص) ، والسماد البلدى (ناتج محطة الانتاج الحيوانى بمزرعة ملوى) ، والبودريت (ناتج الصرف الصحى بمحافظة المنيا) مقارنة بالسماد الكيماوى (نترات الامونيوم 5ر33% آزوت) تحت ثلاث مستويات سمادية وذلك على انتاجية والتركيب المعدنى لمحصول الذرة الشامية (جيزه 2) وخواص التربة المنزرع بها.

كان تصميم التجربة قطاعات منشقة مرة واحدة . وكانت معاملات التجربة كالتالى :

المصدر السمادى	مستويات التسميد
سماد بلدى	10 ، 20 ، 30 م3/ف
طينة المرشحات	1500 ، 3000 ، 4500 كجم / ف
بودريت	1500 ، 3000 ، 4500 كجم / ف
نترات أمونيوم (5ر33%)	60 ، 90 ، 120 وحدة آزوت / ف

أوضحت النتائج المتحصل عليها الآتى :

1 - كان لاستخدام مصادر التسميد العضوى تاثير ايجابى ليس فقط على صفات التربة ولكن ايضا على المحصول ومحتوى أوراق نبات الذرة الشامية من العناصر الغذائية .

2 - تلاحظ وجود زيادة مضطردة فى محتوى التربة من نسبة المادة العضوية وكل من الفوسفور والبوتاسيوم الميسر (جزء فى المليون) وذلك مع زيادة معدل التسميد العضوى بينما حدث انخفاض طفيف فى رقم الحموضة للتربة نتيجة ذلك .

3 - كان للبودريت افضل الأثر على نمو نباتات الذرة الشامية مقارنة بكل من المصادر العضوية الاخرى أو السماد الغير عضوى .

4 - تلاحظ وجود زيادة معنوية فى محتوى أوراق نباتات الذرة الشامية من كل من النسبة المئوية للبوتاسيوم وتركيز الفوسفور جزء فى المليون فى حالة المعاملات التى تم تسميدها بالسماد البلدى عنه فى حالة المعاملات الاخرى سواء تم تسميدها بالمصادر العضوية الاخرى أو السماد الغير عضوى ويعزى ذلك لارتفاع وشدة النشاط الميكروبى والبيولوجى فى حالة التربة المسمدة بالسماد البلدى ، عنه فى حالة استخدام المصادر السمادية الاخرى .