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IMPACT OF ORGANIC AND INORGANIC FERTILIZERS ON SOME SOIL PROPERTIES AND PLANT GROWTH.

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ABSTRACT

A field experiment was carried out at the Experimental Station, Faculty of Agriculture, Cairo University, Giza, Egypt, during 2013& 2014 summer seasons. The field experiment was laid out in a Randomized Complete Blok Design with three replicates. The experiment involved the following five treatments: (Control) 100% mineral-N (T_1), 100% organic as compost (6 ton fed^{-1}) (T_2), 75% organic (4.5 ton fed^{-1}) plus 25% mineral-N (**(**T_3), 50% organic (3.0 ton fed^{-1}) plus 50% mineral-N (T_4) and 25% organic (1.5 ton fed^{-1}) plus 75 % mineral-N (T_5).This investigation was conducted to study the effect of inorganic and organic nitrogen with different combination between them on yield of sorghum and soil properties. The results showed that the bulk density and pH values in soil was reduced by increasing the organic manure rates, while total porosity was increased by addition of organic fertilizer.. Available N, P and K in soil were increased significantly by different addition rates compared with control. The available nitrogen was significant increased with T_2 treatment than other treatments. Available phosphorus and potassium in soil were significantly affected at T_3 treatment compared with the others treatments. Available Fe, Mn and Zn were affected by application of compost only and combined with mineral fertilizers, where the available Fe, Mn and Zn in soil increased with T_2 treatment compared with the others treatments. The statistical analysis revealed that T_3 treatment at first cut gave the highest values of both fresh and dry weight compared with other treatments. The results showed that nitrogen, phosphorus and potassium uptake by plants were significantly increased with T_3 treatment was the best one at the first cut.

Keywords : Organic nitrogen , inorganic fertilizers , combination , sweet sorghum yield, soil properties

INTRODUCTION

Organic farming practices have been associated with improved soil properties through a number of considerations including the addition of soil organic matter, increased earthworm population, biodiversity, soil fertility etc. , Pulleman *et al.*,(2004). Moubarak, *et al.,* (2007) reported that organic amendments significantly produce dry mater yield. Similarly, contents of N, P, K, Mg, Ca, S and trace elements were significantly higher with application of organic fertilizer compared to in organic fertilizers. Muhammad and Khattak,(2009) reported that organic manures may increase soil fertility and thus the crop production potential possibly by changes in soils physical and chemical properties including nutrient bio-availability, soil structure, water holding capacity , soil pH and activity of microbial community.

Rehan *et al.,* (2004) revealed that added compost influenced the total soluble salts and their composition in saturated soil paste extract. EC values were higher by using salty compost than those of using slight salt compost.

Also,they found that the soil pH decreased of both surface and subsurface soil layers increased considerably at the end of the first season (after faba bean) due to compost application.

Hammad *et al,* (2006) showed that integration of composted rice straw plus nitrogen fertilizer increased the availability of Fe, Mn and Zn in tested soil.

El-Sebaey (2006) found that the addition of composted manure (50 kg N /fed^{-1}) + Inoculation gave higher values of N, P and K uptake than the full does (100kg N/fed^{-1}) of inorganic N- fertilizer or organic manure. Bashandy, Samah (2007) observed that NPK uptake of crops grown on date palm waste compost was significantly higher than that of crops grown on the untreated soils. Khaled *et al.,* (2011) reported that organic manure substantially improved shoots and root dry weights. This improved growth was mainly due to increased soil nutrient availability and uptake by plants. Muhammad *et al.,* (2014) found that total dry matter yield of sorghum significantly affected by the application of different organic materials composted. This investigation was conducted to study the effect of inorganic nitrogen (in form of ammonium nitrate 33.5 %) and organic nitrogen (in form of animal compost) with different combination among them on yield and yield quality of sorghum.

MATERIALS AND METHODS

A field experiment was carried out at the Experimental Station, Faculty of Agriculture, Cairo University, Giza, Egypt on May15th in both seasons (2013 and 2014). This investigation was conducted to study the effect of inorganic nitrogen (in form of ammonium nitrate 33.5 %) and organic nitrogen (in form of animal compost) with different combination among them on yield and yield quality of sorghum. Some chemical properties of used compost are shown in Table 1

Soil samples from the upper 30 cm layer of soil were taken from farm of research station, where air dried, crushed and prepared to physical and chemical properties determination as shown in Table 2.

Table 1. Some chemical properties of used compost

Characters	Values	Total contents (%)	Values
EC (dSm^{-1}) (1 : 10)	4.68	N %	1.70
pH (1 : 10)	7.22	P	0.002
O M %	44.15	K	0.200
O C %	25.67	Total contents.(mg/kg)	
C/N ratio	15.1	Fe	29.77
Moisture content %	14.40	Mn	27.83
		Zn	7.80

Table 2. Some physical and chemical properties of the experimental soil before cultivation.

Physical properties							Value
Clay (%)							36.5
Silt (%)							38.4
Sand (%)							25.1
Texture class							Clay loam
SP (%)							52
F.C (%)							28
Chemical properties							
Organic matter (%)							0.97
$CaCO_3$ (%)							8.80
EC (dSm^{-1}) at 25 ˚C (soil water suspension)							1.72
pH (1:2.5 soil water suspension)							7.79
Available nutrients ($mgkg^{-1}$)							
N	p	k	Fe	Mn	Zn		
69.0	6.25	491	3.26	0.22	0.13		
Soluble cations(meq/L)				Soluble anions(meq/L)			
K^+	Na^+	Mg^{++}	Ca^{++}	$SO4^=$	Cl^-	HCO_3^-	$CO_3^=$
0.23	7.67	3.70	5.40	3.10	12.7	1.20	-

The experiment was done on May15th in both seasons. Each plot (4X3m.) was sown with 200g grains of sorghum variety Dorado. The surface irrigation was done. The Equal three doses of nitrogen were added according to the planned design. The experiment was conducted in field including the five treatments of different combinations of organic manure and mineral N:

T1) 100% mineral -N (control).

T2) 100% organic (6 ton fed $^{-1}$) without any mineral fertilizer.

T3) 75% organic (4.5 ton fed $^{-1}$) plus 25% of recommended-N.

T4) 50% organic (3.0 ton fed $^{-1}$) plus 50% of recommended-N.

T5) 25% organic (1.5 ton fed $^{-1}$) plus 75 % of recommended-N.

Three cuts of sweet corn (sorghum) were fresh weighted; dried at 70Ċ in electric oven and weighted the dry plant material of each was ground and prepared for nutrient contents and uptake.

Compost pH in (1: 10 compost: water suspension), total soluble salts in

(1: 10) carbon method, were determined according to Page et al. (1982). Total nitrogen in compost samples, were determined using Keldahl digestion method as described by Jackson (1973).Total phosphorus, potassium, iron, zinc, and manganese were determined in the extract described by Brunner and Wasmer (1978). Phosphorus was measured spectrophotometrically, potassium by flame photometer and micronutrients by atomic absorption instrument.

Partical size distribution was carried out by pipette as described by Gee and Bauder (1986).Bulk density and total porosity was determined according to (Jackson, 1973). Saturation percent (S.P) was determined according to Hesse (1971). Calcium carbonate was estimated volumetrically using the Collin's Calcimeter (Sparks, 1996). Electrical conductivity (E.C.) was measured in soil paste using the method described by Page et al., (1982). Soluble cations: Ca^+ and Mg^+ were measured by versinate method, while Na^+ and K^+ were measured using Flame photometer, according to Page et al., (1982). soluble anions: CO_3^- , HCO_3^- and Cl^- were determined titrimetrically according to Page et al., (1982).pH value was determined in (1 : 2.5 soil-water suspension) using a glass-electrode pH-meter (Page et al., 1982) . Organic matter content was determined according to the Walkley and Black titration method (Sparks, 1996). Available nitrogen in the soil samples was extracted with 2.0 N KCL, according to Hesse, (1971) and determined by using micro-kjeldahl apparatus. Available phosphorus and Available potassium were determined by using according to Sparks, (1996)

Available micronutrients (Fe, Mn , Zn) were extracted by "NH_4HCO_3–DTPA" according to Soltanpour (1985) and determined by using Atomic Absorption Spectrophotometer Perkin Elmer, Model 2308**.**

The wet digestion method was used according to determine nitrogen Phosphorus and potassium in plant as described by Page. *et al.*,(1982). The obtained data were statistically analyzed according to the methods described by Snedecor and Cochran (1980) using computer M. Stat. program.

RESULTS AND DISCUSSION

1. Soils properties as affected by organic and mineral fertilizers:

a) Physical properties:

Bulk density and total porosity of soil:

The analysis reveal that the bulk density(BD) values were reduced by increasing the compost rates, where the compost alone effected on bulk density over than combined with mineral .Results in Table 3 could be enhanced with Sarkar et al. (2003), who reported that application of organic fertilizers alone decreased the bulk density.

Total porosity in soil

Data show that total porosity (TP) values were increased by increasing organic manure addition rates, where the T_2 and T_3 gave highest values of total porosity compared with other rates (Table 3). Generally, the reduced of bulk density values led to increase of total porosity in soil. Such increase is an indication of soil aggregation in forms leading to improved soil structure and increased porosity. This result could supported with those obtained by Habtamu (2015) who showed that integrated application of organic and inorganic fertilizers improved soil total porosity and decreased bulk density by 26.1% in 0 - 30 cm soil depth.

b) Chemical properties:

Soil salinity (EC), pH and organic matter:

Data of soil salinity (EC) after sorghum cultivation expressed are presented in Table 3. The results show that the higher rate of manure application treatment was of the highest EC values significantly, while by increasing mineral raised significantly EC values only in T_1 more than other treatments. this result is in agreement with Badawi, (2003) who reported that electrical conductivity values (EC) increased by application of different types and rates of composted plant residues.

These results reveal that the treatment of compost alone affected soil pH more than combined with mineral fertilization, where soil pH values reduced with high addition rates of organic manure compared with mineral fertilizers only or combined. Gehan, (2006) found that application of compost and different mineral nitrogen fertilizer rates, decreased slightly the pH values in tested soil.

The results indicate that the organic matter content increased significantly by increasing compost, the most effective treatment which decreased bulk density (BD) was addition of organic materials which must have enhanced soil aggregation which increase the apparent soil volume and consequently decrease bulk density. Modaihsh *et al*, (2005) found that application of composts at the highest rates increased the organic matter content in tested soil.

Table 3. Some physical and chemical properties of the experimental soil at the end of the experiment.

Treatments	Chemical properties			Physical properties	
	EC dS/m	pH	O.M %	BD	TP
T1	1.45	8.18	1.13	1.58	4.24
T2	1.71	7.77	1.80	1.35	18.20
T3	1.48	7.87	1.53	1.39	15.76
T4	1.44	8.02	1.39	1.43	13.33
T5	1.38	7.85	1.33	1.50	9.09
mean	1.49	7.93	1.44	1.45	12.12
L.S.D. at 0.05	0.0834	0.098	0.110	0.018	0.248

Available NPK in soil

Results reveal that available nitrogen amounts in soil were increased significantly by different addition rates compared with control, where the T2 treatment was significantly highest value Table 4 . While results indicat that available P and K were significantly affected at T_3 treatment than the other treatments. Generally, available NPK increased by compost application which have direct effect of compost and nutrients associated with .Khaled *et al.*, (2011) found that the N, P and K concentrations in stover of zea maize pronounced increased with increasing rates of compost and organic farm in soil.

Available Fe-Mn-Zn in soil

Data reveal that application of compost only or combined with mineral fertilizers were increased available Fe, Mn and Zn amount compared with control Table 4. Also, available Fe, Mn and Zn values were increased by increasing the application rate organic manure. These results could be enhanced with those obtained by Mostafa ,et al. (2001) who found that the application of organic manures consistently increased availably Fe, Mn and Zn contents in soil.

Modaihsh .,et al (2005) showed that application of composts at the various rates increased the available Zn in the tested soil. Hammad *et al.*, (2006) showed that integration of composted rice straw plus nitrogen fertilizer increased the availability Fe, Mn and Zn in tested soil.

Table 4. Available concentration of some nutrients in soil after cultivation (mg kg^{-1}) .

Treatments	Available concentration (mg kg^{-1})					
	N	P	K	Fe	Mn	Zn
T1	70.50	5.37	523.33	3.63	0.89	0.47
T2	109.83	9.46	542.00	3.83	1.00	0.52
T3	85.00	10.88	587.00	4.37	1.15	0.51
T4	77.50	8.92	551.17	3.40	0.96	0.46
T5	64.17	7.50	572.50	3.25	0.78	0.39
Mean	81.4	8.40	555.2	3.69	0.96	0.47
L.S.D.at 0.05	2.010	1.380	12.510	0.359	0.111	0.096

2. Fresh and dry weight

Data in Table 5 show that fresh and dry weight values of sorghum plants were affected by different application rates of organic and inorganic fertilizers.

It was noticed that the fresh and dry weight values affected by different rates, where (T_3) gave the highest values of both fresh and dry weight compared with other treatments. Generally the fresh and dry weight values were increased at (T_3) compared with the control.

Regarding to the cuts of sorghum plants, data appear that fresh and dry weight values of sorghum plants was increased with 1 st Cut compared with the other cuts, where the order was 1stCut > 2ndCut > 3rdCut.

Concerning the interaction between application rates and cuts, statistically analysis revealed that there was significant effect among them of both fresh and dry weight. Where (T_3) at 1stCut gave the highest values of both fresh and dry weight compared with other treatments. These results almost agree with that obtained by Abo-El-Soud et al (2006) and Gehan (2006) reported that the use of compost at the rate of 20m^3/fed (OM) in combination with the high rate of nitrogen fertilizer had significantly affected the dry matter content. Muhmmad *et al.,* (2014) found that total dry matter yield of sorghum significantly ($p \leq 0.05$) affected by the application of different organic materials.

Table 5. Fresh and dry weights of sorghum as affected by organic and mineral fertilization (ton. /fed^{-1}).

Treatments	Fresh weight (tonfed^{-1})			Mean	Dry weight (tonfed^{-1})			Mean
	1 stCut	2ndCut	3rdCut		1 stCut	2ndCut	3rdCut	
T1	27.30	24.92	19.92	24.05	5.95	5.20	4.73	5.29
T2	28.63	28.95	17.68	25.08	6.85	5.38	4.09	5.44
T3	30.77	25.69	22.96	26.47	7.52	5.19	4.90	5.87
T4	28.91	28.84	19.71	25.82	5.91	5.58	4.45	5.31
T5	28.25	26.39	21.98	25.54	6.69	5.49	4.07	5.42
Mean	28.77	26.96	20.45		6.95	5.30	4.45	
L.S.D. at 0.05 levels	Treatments (T) = 0.479				Treatments (T) = 0.354			
	Cuts (C) = 0.371				Cuts (C) = 0.274			
	Interaction (T×C) = 0.831				Interaction (T×C) =0.615			

Nitrogen, phosphorus and potassium uptake by plants

Data in Table 6 show the means of nitrogen and phosphorus uptake in sorghum plants affected by different application rates of compost and mineral fertilizers.

With respect to the application rates, the results show that nitrogen and phosphorus uptake values in plant increased by different addition rates of organic only or combined with mineral fertilizers, (T_3) treatment produced significantly higher value in both nitrogen and phosphorus uptake compared with the others, the order of nitrogen was $T_3 > T_2 > T_4 > T_5 > T_1$, while phosphorus concentration the order was $T_3 > T_4$, T_2 and $T_5 > T_1$ where the T_3, T_2 and T_5 statistically as the same.

Regarding the cuts of sorghum plants, it was found that nitrogen and phosphorus uptake values significantly increased at first cut compared with others, the order was first cut > second cut > third cut in both of nitrogen and phosphorus uptake.

Concerning the interaction between rates and cuts, the results show that nitrogen and phosphorus uptake by plants were significantly increased with (T_3) treatment at first cut better than other treatments.

Also, data reveal that potassium uptake by plants was significantly affected by using organic only or combined with mineral fertilizers, where the potassium uptake ranges from 124.5 to 209.2 mg/kg plant,

With respect to the application rates, the results show that potassium uptake by plants increased by different addition rates of organic only or combined with mineral fertilizers, (T_4) treatment was gave significantly high value compared with others, where the order was$T_3 > T_2 > T_4 > T_5 >$ control.

It was found that potassium uptake by was plants affected by different cuts of, sorghum plants where the first cut gave high value compared with the other cuts, the order was first cut > second cut > third cut .

Regarding the interaction between application rates and cuts, the results reveal that the best values of potassium uptake by plants were obtained by using T_4 at first cut. These results almost could be supported by those obtained by El-Sebaey (2006) found that the addition of compost manure (50 kg N fed^{-1}) +

Inoculation gave higher values of N, P and K uptake than the full does (100kg N fed^{-1}.) of inorganic N-fertilizer or organic manure. Also, Hanan. *et al.,* (2013) found that organic fertilizers, (water hyacinth compost) gave the highest mean values of total NPK uptake of sorghum plants

Table 6. Nitrogen, phosphorus and potassium uptake(mg/kg^{-1}) by sorghum plants as affected by organic and mineral fertilization.

Treat.	Nitrogen uptake (mg/kg^{-1})			Mean	Phosphorus uptake (mg/kg^{-1})			Mean	Potassium uptake (mg/kg^{-1})			Mean
	1st Cut	2nd Cut	3rd Cut		1st Cut	2nd Cut	3rd Cut		1st Cut	2nd Cut	3rd Cut	
T1	79.41	68.25	63.18	70.28	20.2e	20.25	17.67	19.39	150.8	124.5	129.7	135.0
T2	92.28	74.25	57.4	75.65	25.88	25.09	15.98	22.32	181.7	171.4	124.6	159.2
T3	115.0	63.75	63.23	80.67	21.36	33.77	17.83	24.32	203.2	143.3	157.0	167.8
T4	93.68	70.56	55.68	73.31	29.06	21.60	19.05	23.23	209.2	154.8	89.55	151.2
T5	85.39	76.68	51.86	71.31	31.31	19.89	15.29	22.16	177.8	148.3	117.5	147.9
Mean	93.76	70.70	58.27		25.57	24.12	17.16		184.5	148.5	123.7	
L.S.D. at 0.05 levels	Treatments (T) = 2.862 Cuts (C) = 2.862 Interaction (T×C) =4.954				Treatments (T) = 1.374 Cuts (C) = 0.3735 Interaction (T×C) =2.381				Treatments (T)=1.411 Cuts (C) = 1.093 Interaction (T×C) =2.445			

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"تاثير الاسمدة العضوية والغير عضوية على بعض خواص التربة ونمو النبات "

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اجريت تجربة حقلية بمحطة بحوث كلية الزراعة جامعة الفاهرة خلال موسمى 2013 -2014 تضمنت التجربة تحليل احصائى تام العشوائية . حيث اشتملت التجربة على 5 معاملات وثلاث مكررات المعاملات هى معدنى 100% NPK (T_1) كنترول) ، سماد عضوى 100%(T_2) ، سماد عضوى 75% + 25% معدنى (T_3) ، سماد عضوى 50% + 50% معدنى(T_4) ، سماد عضوى 25% + 75% معدنى(T_5) .

تهدف الدراسة الى تقيم تاثير السمادالعضوى والمعدنى سواء كان منفردا او مختلطا على خواص التربة و محصول نبات السورجم .

اظهرت النتائج انخفاض فى قيم كلا من الكثافة الظاهرية وحموضة التربة انخفضت مع زيادة معدلات السماد العضوى ، بينما المسامية الكلية قد زادت مع اضافة السماد العضوى .

كما وجد ان هناك زيادة معنوية فى النيتروجين والفوسفور والبوتاسيوم الميسرباضافة المعدلات المختلفة من الاسمدة مقارنة بالكنترول . حيث اظهرت النتائج وجود زيادة معنوية للنيتروجين الميسر مع معاملة 6طن كمبوست لكل فدانمقارنة بالمعاملات الاخرى. بينما فى حالة الفوسفور والبوتاسيوم لوحظ ان معدل الاضافة 4.5 طن كمبوست للفدان + 25 % معدنى اعطت اعلى قيم مقارنة بالمعاملات الأخرى .

كما أن العناصر الصغرى(الحديد، المنجنيز،البوتاسيوم) الميسرة فى التربة زادت زيادة معنويا باضافة معاملة الـ 6طن كمبوست للفدان مقارنة بالمعاملات الاخرى .

وأضحت النتائج أن الوزن الجاف والرطب تاثر معنويا بالاضافات العضوية والمعدنية المختلفة مقارنة بالكنترول ، وكانت افضل المعاملات مع اضافة 4.5 طن كمبوست للفدان +25% معدنى .

النيتروجين والفوسفور البوتاسيوم الممتص بواسطة النبات زاد معنويا وكانت أفضل المعاملات هى إضافة 4.5 طن كمبوست للفدان + 25 % معدنى وذلك عند الحشة الاولى .