GEZIRA JOURNAL OF AGRICULTURAL SCIENCE vol .15 (1)2017

Effect of compost and urea nitrogen on growth and yield of *sweet pepper (Capsicum annuum L.) and on some properties of the Gezira soil*

Manal M. Mahgoub[1], Altayeb M. Abdelmalik[2], Hashim M. Babiker[2] and Ahmed Eltayeb A. Mohamed[1]

[1]Department of Environmental Science and Natural Resources, Faculty of Agricultural Sciences, University of Gezira, Wad Medani, Sudan.
[2]Department of Soil and Water Science, Faculty of Agricultural Sciences, University of Gezira, Wad Medani, Sudan.

ABSTRACT

Compost is stable humus like product resulting from biological decomposition of organic matter under controlled conditions. The objective of this study was to investigate the combined effect of compost with urea nitrogen on some soil properties, growth and yield of sweet pepper. This study comprised a number of experimentations conducted over two consecutive seasons (2009/10-2010/11) at the Experimental Farm of the Faculty of Agricultural Sciences, University of Gezira and laboratories of CIRAD in France. Compost was applied at 0, 10 and 20 t ha^{-1} combined with N at 0, 43 and 86 kg ha^{-1} in the form of urea. The results showed that application of compost alone or in combination with urea nitrogen improved soil properties and hence growth and yield of sweet pepper. Improvement of those parameters was more pronounced when the urea and compost were combined, especially at the higher rates. Combination of urea and compost presumably improved availability of nitrogen from the organic source to sweet pepper and, therefore, positively affected growth and yield of the crop. The extent of improvement was less when urea nitrogen and organic manures were applied in the same season. Hence, it could be recommended to fertilize sweet pepper with compost and urea at the rate of 86 kg N/ ha.

INTRODUCTION

One of the greatest problems related to waste production is the disposal of these diverse quantities, especially the disposal of agricultural and animals waste. For an example, more than 8.5 billion broilers were raised for commercial sale in the U.S. in the year 2003. Out of this, about 78 million of birds died from diseases and natural disasters before they were marketable (USDA – NASS, 2007). In such conditions, farmers do not have enough available agricultural land on which they could dispose the produced manure in appropriate quantities. Moreover, there are many problems associated with the storage and use of raw manure such as odor, emission or leaching of hazardous compounds, health risk, loss of nutrients and difficulties of handling and application of these wastes (Basso and Ritchie, 2005).

An alternative approach for manure management is composting, which implies organic matter stabilization, sanitization regarding weeds and pathogens, deodorization, improvement of handling of the product and possibility of safe storage and transportation (Parkinson *et al.,* 2004). Recycling wastes into value added products such as soil conditioners can decrease disposal cost and recycle nutrients for maintaining and improving the soil quality and crop growth. Recycling of organic residues along with careful use of mineral fertilizers has been suggested to mitigate the environmental problems resulting from intensive agriculture (Tajeda and Gonzalez, 2003).

Arable land in the Sudan is estimated at 84 million ha, of which 17 million ha are utilized. About 12% of the total cultivated land is irrigated agriculture and 15 million hectares are rain-fed agriculture representing 89% of presently utilized land (Mohammed, 2008). The grazing lands constitute 40.4% of the total area of the Sudan. The pastoralists of Sudan own 90% of the national herds of livestock. According to recent estimates of livestock, there are about 40 million heads of cattle, 50 million heads of sheep, 43 million goats and 4 million camels, accordingly massive organic wastes are continuously being produced from both crops and animals. The amount is large and diverse, and has not yet been adequately studied or processed to be incorporated into the agricultural system. So the objective of this study is therefore to investigate the effect of compost and nitrogen fertilizer on growth and yield of sweet pepper crop and some soil properties of the Gezira State.

MATERIALS AND METHODS

Experimental sites and soil description

The Experimental Farm of the Faculty of Agricultural Sciences, where this experiment was conducted is located at the University of Gezira, Wad Medani, Sudan (14° 24′ N, 33° 29′ E and 407m masl).The field was situated within the dry zone of the Sudan, with a short rainy season that extends from June to September with an average of 300 mm annual rainfall, mean maximum and mean minimum temperatures were 43°C and 24°C, respectively, and annual evapotranspiration was 2500 mm (Adam and Abdalla, 2008). The soil was a cracking clay, alkaline, non saline, non sodic and its clay fraction was dominated by smectites with low organic matter (0.5%) and very low total nitrogen (300 mg kg^{-1}). Available phosphorus was 3 mg kg^{-1} whereas total P range of 500 – 700 mg P kg^{-1}. The soil consisted of heavy and very slowly permeable clay. The soil is calcareous in matrix with calcium carbonate content averages to about 5% (Table 1).

Compost preparation

In order to prepare compost, a pit of 4 x 3 x 3 m was made. The composting process started on 25/08/09. Wheat straw and cow manure were placed in the pit. Eight alternating layers consisted of four layers of cow manure alternating with four layers of wheat straw. One kg of urea was added along with ½ kg triple superphosphate (TSP) to each layer, to enhance decomposition. Sixty four liters of water were added to each layer. The pit was covered using two plastic covers (6 x 4 m) each and finally was covered with soil. Two weeks later, the pit was opened and the organic materials were mixed thoroughly and water was added at about 80 liters, covered again with the plastic cover and soil. One month later, the pit was reopened and the compost was mixed and watered with 80 liters and covered by plastic and soil. After another month, the pit was reopened to be aerated and mixed again with forty liters of water. Two weeks later, the pit was reopened for mixing and aeration, but this time it was left without cover to dry. The compost was then dug out of the pit and spread for two weeks for further drying under the sun. Each plot was treated by placing the compost in a small furrow on the top of the ridge and then covered with soil at the rates of 0, 10 and 20 t/ha. **Treatments and experimental design**

The land was prepared using disc plow followed by disc harrow and ridging at 80 cm. Nine treatments were arranged in a randomized complete block design with three replicates. The subplot size was 10 x 10.5m. Treatments consisted of compost at 0, 10 and 20 t ha^{-1} air dry compost and urea at 0, 43 and 86 kg N ha^{-1} in a factorial experiment. The compost was applied three weeks before transplanting sweet pepper. After application of the compost the land was irrigated twice; just after application of the compost and two weeks later. For all treatments, triple superphosphate (TSP) was applied in a band at a rate of 43 kg P_2O_5 ha^{-1}. Sweet pepper, (*Capsicum annuum* L.) California Wonder cultivar was used as a test crop. **Nursery planting and transplanting of sweet pepper**

Sweet pepper seeds were planted in trays and small plastic cups filled with a soil mix of sand and clay at 1:1 ratio on 3/11/ 09. They were put under a partial shade at the nursery. The plants were irrigated lightly at least twice a day. Transplanting was carried out on January 15, 2010 by putting one plant in a hole at 30 cm distance between holes. The transplanting process was carried out late in the afternoon as recommended, and then was immediately irrigated. The test crop was weekly irrigated either early in the morning or in the evening. Weeding was done as deemed necessary.

Collection of data for growth and yield parameters

Yield is a contribution of a number of factors including number of leaves per plant, plant height and plant population for estimating these yield parameters. Five plants were selected randomly from each subplot tagged and used for measuring plant height and number of leaves per plant. Three months after transplanting, sweet pepper crop was harvested six times; approximately each ten days. Fresh weight as well as dry weight of fruits were recorded, using a sensitive balance. Number of fruits per plant was counted before weighing. After fresh weight was determined, the fruits were transferred to an air-forced oven at 70º C for 48 hours to determine the dry weight of fruits. The fruits were then ground and kept for further analyses. Immediately after harvesting of sweet pepper crop, soil samples were taken by auger at 0-30 cm depth.

Treatments and experimental design for the residuals

The crop of the first season was removed and the land was prepared as in the first season. As in the first season, nine treatments were arranged in a randomized complete block design with three replicates. The subplot size was 10x10.5m splited into two equal sub-sub-plots. Treatments, consisted of compost at the rates of 0, 10 and 20 t ha^{-1} air-dry compost and urea at 0, 43 and 86 kg N ha^{-1}, in a factorial experiment. The compost was applied for one sub-subplot while the other was left untreated to test for its residual effect from the first season. The cumulative effect of compost of the two seasons was tested by the added dose in the second season.

RESULTS AND DISCUSSION

Soil analysis

The Gezira soil, as part of the central clay plain of the Sudan, suffers from low levels of organic carbon (O.C) and consequently organic matter (O.M) and total nitrogen (Table 1). The continuous decomposition of organic matter in cultivated soils of arid and semi-arid regions may lead to soil degradation with a consequence of inability to ensure sustainable production. In recent years, the use of organic amendments has become popular and efficient for the improvement and/or restoration of soil O.M. The results showed that, Gezira soil had a low level of nitrogen, so the addition of this element to the soil is necessary for profitable production. Soil organic matter with reasonable amounts of nitrogen and the cycling processes of soil nitrogen can be regarded as means of supplying mineral nitrogen from the soil to growing plants.

Table1. Some physical and chemical properties of the soil of the experimental site analyzed at CIRAD, France.

Item (%)		Item		Exchangeable cations (cmol kg^{-1} soil)		Item ($mgkg^{-1}$ soil)	
O.C	0.39	pH paste	7.8	K	0.9	Total P	235
N	0.039	EC_e	1.0 dSm^{-1}	Na	0.9	Avail. P	4.5
$CaCO_3$	2.70	B.D	1.47gcm^{-3}	CEC	57.00		
Soil Moisture (air dry)	0.47						
C:N	10.0						

Effect of compost and urea nitrogen fertilizer on plant height Application of compost at the lower and higher rates accompanied with nitrogen at the lower rate (43 kg ha^{-1}) significantly ($P \leq 0.05$) increased, plant height (Table 2). Plant height was 21.19, 21.71 and 26.17 cm as compost was added at 0, 10 and 20 ton ha^{-1}, respectively. Furthermore, application of compost at the lower and higher rate accompanied with nitrogen at the higher rates (86 kg ha^{-1}) significantly ($P \leq 0.05$) increased plant height (Table 2). Application of compost at 10 and 20 ton ha^{-1} gave plant height of 21.98 and 29.22 cm, respectively, whereas plant height was 21.28 cm at 0 ton ha^{-1} compost (Table 2).This might be attributed to the fact that, compost from organic wastes increased soil organic matter content and accordingly improved soil physical as well as chemical properties. Generally, added compost to the soil at different rates either low or high significantly ($P \leq 0.05$) increased plant height. These results were in line with those of Osman (1999) who stated that addition of FYM and nitrogen increased biological yield of sorghum by influencing plant height at stem elongation stage. Addition of O.M is known to improve both physical and chemical properties of the soil, as well as its nutritional status.

Table 2. Effect of compost and urea nitrogen fertlizer on plant height (cm)

Compost (ton/ha)	N rates (kg/ha)	First season	Second season
0	0	19.09 e	28.87
	43	21.19 de	39.3 f
	86	21.28	40.2 ef
10	0	20.90 d	40.8 def
	43	21.71cde	41.3 de
	86	21.98 cd	41.9 d
20	0	23.89 bc	43.4 c
	43	26.17 b	45.9 b
	86	29.22 a	50.1 a
SE±		0.85	0.50
CV%		9.2	3.09

Means in columns followed by the same letter (s) are not significantly different according to Duncan´s Multiple Range Test (P≤ 0.05).

Effect of compost and urea nitrogen fertilizer on number of leaves Irrespective of nitrogen fertilizer level, number of leaves per plant was increased significantly (P≤0.05) with further increase in compost level (Table 3). Application of compost alone to the soil at 10 ton ha^{-1} and 20 ton ha^{-1} showed an average number of leaves of 27.73 and 37.22 per plant, respectively, compared to 26.25 of the control (Table 3). Application of compost at 10 and 20 ton ha^{-1} accompanied with nitrogen at 43 kg ha^{-1} increased, significantly (P≤0.05), the average number of leaves per plant (Table 3). Compost added at 0, 10 and 20 ton ha^{-1} resulted in the average number of leaves of 25.89, 28.90 and 39.89/plant respectively. Nevertheless, adding compost at 10 and 20 ton ha^{-1} accompanied with 86 kgN ha^{-1} increased, significantly (P≤0.05) the average number of leaves (Table 3). Application of compost at 10, 20 ton ha^{-1} resulted in an average number of leaves of 33.1 and 42.29 per plant, respectively. The average number of leaves was 26.47 at 0 ton ha^{-1} compost and 86 kgN/ha (Table 3). These results were in agreement with those of Qualls (2004) who stated that addition of compost to the soil is expected to alter the content and nature of soil organic matter over a relatively long time range, and this in turn should change the soil properties and performance of plants and crops planted on these soils. In Sudan, Osman (1999) reported that, addition of FYM significantly increased number of spikelets per head, number of grains per spikelet and number of grains per head.

Table 3. Effect of compost and fertilizer nitrogen on number of leaves.

Compost (ton/ha)	N rates (kg/ha)	First season	Second season
	0	51.4 g	26.25 c
0	43	53.9 f	25.89 c
	86	50.5 g	26.47 c
	0	56.1 ef	27.73 c
10	43	57.1 e	28.90 c
	86	73.5 d	33.09 bc
	0	88.7 c	37.22 ab
20	43	91.5 b	39.89 ab

	86	96.9 a	42.29 a
SE±		0.75	2.76
CV%		4.26	21.16

Means in columns followed by the same letter (s) are not significantly different according to Duncan´s Multiple Range Test (P≤ 0.05). **Effect of compost and urea nitrogen fertilizer on biomass content of sweet pepper plant**

Results in Table 4 showed that the addition of compost significantly (P≤0.05) increased the average fresh weight of sweet pepper plant. This might be attributed to the fact that application of compost to soils improved both physical and chemical properties of the soil which in turn affected positively plants grown on these soils. This might also be attributed to the fact that, low amounts of plant available N may be an important factor in enhancing the direct effects of composts. Therefore, soil fertility improvement would be much more effective if fertilization with mineral N follows compost application (Weber *et al* 2007).

In the Sudan, Ibrahim (1995) reported a significant increase in grain yield of sorghum in response to compost and urea application. The same trend of compost effect that was observed on plant fresh weight was also found for plant dry weight. The average of plant dry weight was increased by 18.1% when compost was added at 20 ton ha^{-1} without urea nitrogen fertilizer (Table 4).

Combination of compost at 10 and 20 ton ha^{-1} with nitrogen fertilizer at 43 kg ha^{-1} considerably promoted the average of plant dry weight by 11.5% and 21.7%, respectively, compared to the control (Table 4). Furthermore, the corresponding increment of the previous rate of compost with nitrogen at 86 kg ha^{-1} was 18.6 % and 19.4%, respectively.

Table 4. Effect of compost and urea nitrogen fertilizer on biomass content of sweet pepper.

Treatment		Biomass (g)			
		First season		Second season	
Compost (ton ha^{-1})	N rates (kg/ha)	Fresh weight	Dry weight	Fresh weight	Dry weight
0	0	465.5 f	115.0 cd	449.1 i	118.5 g
	43	425.9 g	114.2 cd	460.6 h	121.1 f
	86	465.8 f	117.1 c	473.1 g	124.7 e
10	0	479.5 e	111.1 d	513.8 f	127.1 d
	43	489.1 d	127.3 b	527.8 e	127.1 d
	86	531.8 c	138.8 a	539.9 d	132.c
20	0	545.1 b	135.8 a	546.9 c	134.2 b
	43	554.8 a	139.0 a	561.9 b	135.1 b

	86	555.3 a	139.8 a	573.3 a	139.9 a
SE±		2.787	1.486	2.18	0.63
CV%		8.05	9.07	4.78	1.58

*Means in columns followed by the same letter(s) are not significantly different according to Duncan's Multiple Range Test (P ≤ 0.05).

Effect of compost and urea nitrogen fertilizer on number of fruits per plant

The average number of fruits per plant was 1.33 in the control treatment (Table 5). At 0 kg N /ha, adding compost at 10 ton ha^{-1} significantly (P≤0.05) increased the average number of fruits per plant to 2.9 in the second season, whereas adding compost at 20 ton ha^{-1}, the average number of fruit was greatly increased to 4.5. in the second season too. Application of compost at 10 ton ha^{-1} accompanied with 43 kg N /ha increased the average number of fruits to 2.33 in the first season and 3.60 in the second season. Application of compost at 20 ton ha^{-1} increased the average number of fruits per plant to 3.53 in the first season and 4.80 in the second season. (Table 5). The production of fruits was 2.83 when compost at 10 ton ha^{-1} was mixed with nitrogen at 86 kg ha^{-1}. The corresponding production at 20 ton ha^{-1} was 4.00 in the first season. This increment of fruit production was probably due to the positive effects of compost as a soil amendment and nitrogen as they improved soil physical and chemical properties which in turn affected positively plant growth. In the Sudan, results of experiments carried out at the Gezira Research Station showed positive effects on yield of cotton and wheat when compost prepared from cotton residues in combination with urea were applied to the soil (Ali, 1992; Ali *et al.*, 1993).

Table 5. Effect of compost and urea nitrogen fertilizer on number of fruits per plant

Compost (ton/ha)	N rates (kg/ha)	First season	Second season
0	0	1.33 d	2.7 cd
	43	1.46 d	2.0 d
	86	1.63 d	2.3 d
10	0	2.03 cd	2.9 cd
	43	2.33 cd	3.6 bc
	86	2.83 bc	3.9 bc
20	0	2.43 b	4.5 b
	43	3.53 a	4.8 ab
	86	4.00 a	5.8 a
SE±		0.31	0.38
CV%		18.33	21.22

*Means in columns followed by the same letter(s) are not significantly different according to Duncan's Multiple Range Test (P ≤ 0.05).

Effect on fruit fresh weight per plant

Adding compost to the soil without urea nitrogen fertilizer, significantly (P≤0.05) increased the average fresh weight of sweet pepper fruits per plant (Table 6). The fresh weight per plant was 249.03g and 501.87g first season and second season respectively in the control treatment

(Table 6). At 0 kg N/ha, application of compost at 10 ton ha^{-1}, increased average weight to 387.63g in the first season and 620.23g in the second season. Moreover, when compost was applied alone at 20 ton ha^{-1}, average fresh weight was increased to 729.78g in the first season and 848.88g in the second one. Combination of compost at 10 ton ha^{-1} with 43 kg N/ha considerably increased average weight to 434.65 in the first season and 644.52 in the second season. Furthermore, the average of fruit fresh weight was increased to 734.77g and 894.45g in the first and second seasons, respectively, when compost at 20 ton ha^{-1} was combined with 43 kg N /ha. The interaction of compost at 10 ton ha^{-1} with 86 kg N /ha significantly increased average fruit fresh weight (471.18 g) in the first season whereas it reached up to 697.35 in the second season. Application of compost at 20 ton ha^{-1} with 86 kg N/ha considerably increased the average fruit fresh weight to 894.58 g and 952.18 g in first and second season, respectively (Table 6). It is clear that compost applied at 10 and 20 ton ha^{-1} significantly increased fruits fresh weight per plant. Moreover, application of compost together with both 43 or 86 kg N /ha increased yield of fruits of sweet pepper more than application of either compost or nitrogen fertilizer alone. This might be due to the positive effect of mineral nitrogen on organic matter mineralization. These results are in line with those of Broken *et al.* (2002) who found that addition of compost to the soil as a soil conditioner and nutrients significantly increased maize yield.

Table 6. Effect of compost and nitrogen fertilizer on fruit fresh weight

Treatment		Seasons	
Compost ton /ha	N rates (kg/ha)	First season	Second season
0	0	249.03 e	501.87 f
	43	264.63 e	513.92 ef
	86	276.23 e	598.22 e
10	0	387.63 d	620.23 d
	43	434.65 c	644.52 cd
	86	471.18 c	697.35 c
20	0	729.78 b	848.88 b
	43	734.77 b	894.45 b
	86	894.58 a	952.18 a
SE±		35.7	4.500
CV%		16.5	17.97

*Means in columns followed by the same letter(s) are not significantly different according to Duncan's Multiple Range Test ($P \leq 0.05$).

Effect of compost and urea nitrogen fertilizer on soil moisture content, soil pH, soil organic matter (SOM)

It appears from Table 7 that moisture content of the soil was significantly ($P \leq 0.05$) increased by application of compost. Carter and Stewart (1996) and Franzluebbers (2002) reported that addition of organic matter improved soil properties such as aggregation, water-holding capacity, hydraulic conductivity, bulk density, fertility and resistance to water and wind erosion. It has been reported by many workers that plant available water in coarse, medium, and fine textured soils increased with increasing rates of organic manures. Addition of compost to the soil increases water holding capacity due to increase in surface area of the soil colloids.

Results showed a slight effect of compost on soil pH, which increased as compost rate increased (Table 7). These results suggest a high buffering capacity of the Gezira soil. Mohammed (1993) reported that the addition of manure alone or with nitrogen did not cause a significant effect on soil pH. Changes in soil pH in a soil with a high buffering capacity, such as that of the Gezira, requires large additions of organic matter for a longer time. Under specific conditions, compost has been found to affect soil pH even when applied at a low rate of 10 tons per hectare. Results of Lomte *et al.* (1999) showed that application of organic amendments increased soil pH, but because of the high soil buffering capacity of the Gezira soil it may probably need high level of application of manure and for a longer time to affect soil pH. Application of compost increased SOM, and this increment is highly connected with compost rate (Table 7). These results are in line with many studies such as De Jager *et al.* (2001) and Palm *et al.* (2001). They reported that the improvement of soil fertility requires the input of stabilized or manure organic waste or compost. Compost as an organic amendment is used to improve soil physical condition and/or plant nutrition. Generally, crop residues, organic manure and compost from organic waste have been used to increase SOM content and accordingly to improve soil properties (Celik *et al*, 2004).

Effect of compost and urea nitrogen fertilizer on soil organic carbon (SOC), total nitrogen (TN) and C: N ratio

Results revealed that compost added to the soil increased organic carbon (SOC) (Table 7). This is true because application of compost would obviously increase soil organic carbon. In the Sudan, Dawelbeit (1996) reported an increase in SOC in response to farmyard manure application to Gezira soils.

The results showed that application of compost significantly increased TN in the soil compared to those without applied compost (Table 7). The increase of TN indicated that compost supplied this nutrient into the soil (Soumare *et al.*, 2002). Adani *et al.* (2006) stated that the increase in soil carbon, nitrogen and CEC by amending with compost is confirmed in most cases. Mineralization of organic matter in added compost leads to stepwise release of nutrient elements, particularly nitrogen. In the Sudan, Ali (1998) reported that, most soil nitrogen is in organic form which is unavailable to higher plants and hence this nutrient must be conserved and carefully managed so as to be mineralized by soil microorganisms to ammonium and nitrate ions. Table 7 shows that, application of compost to the soil significantly increased C:N ratio especially at high rates of compost. That may be attributed to the high organic carbon maintained in the soil upon compost application. These findings are in agreement with those of Ali (1998) who found increases in soil C:N ratio up to 18 due to addition of compost to Gezira soil. Organic carbon in compost would most likely increase C:N ratio, especially in soils such as those of the Gezira where total N is very low.

Table 7. Effect of compost and urea nitrogen fertilizer on some soil properties.

Treatment						
Compost (ton ha-1)	Nitrogen (kg/ha)	Moisture content (%)	pH	Organic carbon (%)	Total nitrogen (%)	C:N ratio
	0	6.14 e	8.4 e	0.58 c	0.37 c	13.05 f
0	43	6.35 d	8.4 de	0.58 c	0.38 c	13.54 f
	86	6.41 d	8.4 cde	0.67 bc	0.39 bc	15.04 e
	0	6.47 cd	8.5 cde	0.73 abc	0.46 abc	15.17 de
10	43	6.55 cd	8.5 bcde	0.73 abc	0.48 abc	15.59 de
	86	6.64 bc	8.5 bcde	0.75 abc	0.54 ab	15.73 cd
	0	6.67 bc	8.56abc	0.75 abc	0.56 a	16.58 ab
20	43	6.77 b	8.6 ab	0.87 ab	0.58 a	16.27 bc
	86	7.23 a	8.7 a	0.91 a	0.58 a	16.93 a
SE±		0.05	0.05	0.06	0.05	0.20
CV%		0.34	8.4 e	0.58 c	0.37 c	13.05 f

*Means in columns followed by the same letter(s) are not significantly different according to Duncan's Multiple Range Test (P ≤ 0.05).

CONCLUSIONS

* Results obtained from this study showed the positive effect of compost on some soil properties and on sweet pepper growth and yield parameters. * Compost applied alone or in combination with urea nitrogen improved soil properties and hence growth and yield of sweet pepper.

* Improvement of soil properties, growth and yield of sweet pepper was more pronounced when the urea and compost were combined, especially at the higher rate for both of them.

* The combination of urea and an organic source of nitrogen (compost) improved presumably nitrogen mineralization and therefore its availability to sweet pepper which had a positive effect on growth and yield of the crop.

* The extent of improvement, however, was much less when urea nitrogen fertilizer and compost were applied in the same season.

REFERENCES

Adam, S.H. and A.H. Abdalla. 2008. Meteorology and Climatology. Khartoum University Press, UNESCO Chair of desertification.

Adani, F., P. Genevien, G. Ricca, F. Tambone and E. Montoneri. 2006. Modification of soil humic matter after 4 years of compost application. Waste Management 27: 319-324

Ali, N.A. 1992. Effect of organic fertilization urea on cotton growth under Sudan Gezira Conditions Annual Report. Season 1992/1993.

Ali, N.A, S.H. Salih, B.A., Ahmed, B.A. Ibrahim, M.G., Mohamed and O., A. Abelwahab. 1993. Effect of organic fertilization on wheat production under Sudan conditions. Nile Valley

Regional Program for Cool Season Food Legumes and wheat Annual Report 1992/93 ICARDA. Allepo, Syria

Ali, N.A. 1998. Organic fertilizer in Sudan. First Scientific Conference, September 1998. LWRC, ARC, Wad Medani, Sudan.

Basso, B., and J.T. Ritchie. 2005. Impact of compost, manure and inorganic fertilizer on nitrate leaching and yield for a 6-year maizealfalfa rotation in Michigan. Agriculture, Ecosystem and Environment 108: 329-341.

Broken, W., A. Muhs and F. Neese. 2002. Changes in microbial and soil properties following compost treatment of degraded temperate forest soils. Soil Biology and Biochemistry 3:403-412.

Carter, M.R., and B.A.Stewart. 1996. Structure and Organic Matter Storage in Agricultural Soils. Boca Raton, Florida,USA.

Celik, I., I. Ortas and S. Kilic. 2004. Effect of compost, mycorrhiza, manure and fertilizer on some physical properties of Chromoxerert soil. Soil and Tillage Research 78:59-67.

Dawelbeit, S.E. 1996. Effect of addition of organic fertilizer on the concentration of some of the micronutrients in the Gezira soils, Annual Report, Agricultural Research Cooperation, Wad Medani, Sudan.

De Jager, Onduru, A. D. Van, M.S. Wijk, J.Vlaming and G.N. Gachini. 2001. Assessing sustainability of low external input farm management system with the nutrient monitoring approach: A case study in Kenya. Agricultural System 69: 99-118.

Franzluebbers, A.J. 2002. Water infiltration and soil structure related to organic matter and its stratification with depth. Soil and Tillage Research Journal. 66: 97-205.

Ibrahim, B.A. 1995. Organic manures. New Halfa Research Station. Annual Report. 1994/1995.

Lomte, M.H., M. Ateque, P.R. Bharambe and P.K. Kawarkhe. 1999. Influence of sorghum-legume association on physio-chemical properties of soil. Journal of Maharashtra, Agricultural Universities 18(3): 388-390.

Mohammed, A.A. 1993. Effect of farmyard manure on soil fertility, microbial activity and wheat grain yield. M.Sc. Thesis, University of Gezira, Medani, Sudan.

Mohammed, A.O. 2008. Economic comparative study between zero tillage and traditional mechanized farming systems in Agadi rain-fed area, Blue Nile State, Sudan. M.Sc. Thesis, Department of Agricultural Economics, Faculty of Agricultural Sciences, University of Gezira, Wad Medani, Sudan.

Osman , I.O. 1999. Effect of farmyard manure and nitrogen on nutrient availability and sorghum (*Sorghum bicolor* L.) yield components. M.Sc. Thesis, University of Gezira, Medani, Sudan.

Palm, A.C., C.N. Gachengo, R.J. Delve, G. Cadisch and K.E. Giller. 2001. Organic inputs for soil fertility management in tropical agroecosystem: application of an organic resource database. Agriculture, Ecosystem and Environment Journal 83: 27-42.

Parkinson, R., P. Gibbs, S. Burchett and T. Misselbrook. 2004. Effect of turning regime and seasonal weather conditions on nitrogen and phosphorus losses during aerobic composting of cattle manure. Bioresource Technology 91: 171-178.

Qualls, R.G. 2004. Biodegradability of humic substance and other fractions of decomposing leaf litter. Soil Science Journal 68: 1705-1712.

Soumare, A., Demeyer, M., Tack and M. G.Verloo. 2002. Nutrient availability in the surface horizons of Malian tropical agricultural soils. Tropic cultural 20: 58-65.

Tajeda, M. and J.L. Gonzalez. 2003. Effect of application of a compost originating from crushed cotton gin residues on wheat yield under dry land conditions. European Journal of Agronomy 19: 357-368.

USDA-NASS. 2007. Census of Agriculture. Volume 1, Geographic Area Series Census, U.S. State Data, USDA-National Agricultural Statistics Service.

Weber, J., A. Karczewska, J. Drozd, M. Licznar, S. Licznar, E. Jamroz and A. Kocowicz. 2007. Agricultural and ecological aspects of a sandy soil as affected by the application of municipal soil waste composts. Soil Biology and Chemistry 39: 1294-1302.

الخلاصة

يعتبر السماد العضوي (الكمبوست) مادة عضوية ثابتة تشبه الدبال ناتجة عن التحلل الاحيائي للمادة العضوية تحت ظروف يمكن التحكم فيها. تشمل أهداف هذه الدراسة بحث أثر الكمبوست مع سماد اليوريا علي بعض خواص التربة وعلي نمو وإنتاجية محصول الفلفل الأخضر. تتكون الدراسة من عدد من التجارب اجريت خلال موسمين متتاليين (10/2009 , 201011/ (CIRAD)) في المزرعة التجريبية بكلية العلوم الزراعية – جامعة الجزيرة والمركز القومي لتنمية وبحوث المحاصيل واضيف سماد اليوريا في مستويات بدولة فرنسا (التحاليل المعملية). اضيف الكمبوست في مستويات 0, 10 و 20 طن للهكتار 0, 43 و 86 كجم نيتروجين للهكتار. أظهرت النتائج أن اضافة الكمبوست منفرد أو مع سماد النيتروجين حسّن من خواص التربة مما أدي الي زيادة نمو وانتاجية المحصول. أظهرت النتائج ايضا أن النمو والانتاجية تكون أفضل عند اضافة الكمبوست مع سماد اليوريا خاصة في المستويات الأعلى للكمبوست والنيتروجين. ربما يدل ذلك علي أن النيتروجين المعدني المضاف زاد من معدل معدنة النيتروجين العضوي مما ادي الي الاثر الايجابي علي نمو وإنتاجية المحصول . تؤدي هذه الممارسات الفلاحية الي تقليل تكلفة الإنتاج للمحاصيل البستانية وتحافظ علي بيئة زراعية صديقة. توصي الدراسة باستخدام الاسمدة العضوية مثل الكمبوست لإنتاج المحاصيل البستانية مثل الفلفل الأخضر بغرض الصادر أو الاستهلاك المحلي.