Effect of cattle manure compost on soil available nutrients and growth, yield and yield components of snake cucumber *Cucumis melo* var. flexuosus

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Abstract. A field experiment was conducted on a farm in Shatt Al-Arab region, Basrah province, Iraq using 12 fertilizer management treatments for testing soil available nutrients and growth and yield of snake cucumber. The fertilization treatments included control (T_1); recommended chemical fertilization (T_2); uncomposted manure at level of 2% (T_3); uncomposted manure at level of 4% (T_4); uncomposted manure at level of 8% (T_5); composted manure for 2 months at level of 2% (T_6); composted manure for 2 months at level of 4% (T_7); composted manure for 2 months at level of 8% (T_8); composted manure for 3 months at level of 2% (T_9); composted manure for 3 months at level of 4% (T_{10}); composted manure for 3 months at level of 8% (T_{11}); and conventional fertilization included T_2 + T_4 (T_{12}). Cattle residue was composted under aerobic condition for 2 or 3 months in a plastic padded hall at moisture of 60%, or uncomposted, then applied by mixing method with 15 cm upper layer of soil. Results showed superiority in available N, P and K contents, shoot dry weight, fruits yield and yield components with the combined use of uncomposted manure and chemical fertilizers (conventional treatment, T_{12}). However, insignificant differences have been observed at all studied parameters in treatment T_5 receiving uncomposted manure at rate of 8% compared with T_{12}. The yields of snake cucumber were 18.10 and 15.96 Mgha^{-1} at treatments T_{12} and T_5, respectively. Lower nitrate content in fruits was found in treatment T_5 as compared with treatment T_{12}. Data also revealed that the best soil and plant parameters and lower nitrate content were obtained in plots received uncomposted manure as compared with composted ones. These results provide a good attention to use uncomposted manure as soil amendment which can replace the conventional fertilization to enhance crop yield and quality.

Key Words: composting, organic farming, available N, cattle residue, nitrate content.

Introduction. The organic matter content of cultivated soils in south of Iraq is usually less than 1% due to low precipitation, high ambient temperature, and low vegetative cover. This fact, coupled with conventional farming systems, has gradually reduced soil productivity as a result of degradation in physical properties and fertility status. So, the need for application of organic residues is therefore important for mitigation soil environmental conditions and increase plant yield and quality.

Incorporation of organic residues in soil is known to improve soil structure, enhanced fertility, increase microbial activity and moisture holding capacity (Arancon et al 2004). Randhawa et al (2005) reported that incorporation of organic material into soil is considered a good management practice because it stimulates soil microbial activity and increases soil fertility and quality through subsequent mineralization of plant nutrients. However, the effect of organic materials on soil and plant quality depends mainly on their initial characteristics such as C, N, P, lignin polyphenols, cellulose contents and the C:N ratio. These initial quality indicators related to the source of organic material, e.g. crop residues, sewage sludge, animal residues, green manure, or compost and to the state of material if used either fresh (uncomposted) or composted. John et al (2013) found that plant nutrient contents, pH, organic matter and moisture were varied among the various organic materials (poultry manure, municipal waste and palm oil ash).

Composting is defined as the microbiological conversion of biodegradable organic wastes to stable humus by indigenous micro flora, including bacteria, fungi and actinomycetes (Prasad & Power 1997). They also stated that major objectives in composting are to stabilize putrescible organic matter, to conserve as much of the plant nutrient and organic matter as possible and to produce a uniform, relatively dry product suitable for use as manure. A number of composting processes have been developed which mainly classified as either aerobic or anaerobic. Numerous studies have found that the different characteristics of composts were affected by method and period of composting (Serra-Wittling et al 1995; Abdulkareem 2010; John et al 2013). Prasad & Power (1997) reported that conventional methods of composting require long period to produce good compost, often 8 weeks or more and during this period the changes in temperature and pH are the dominant factors controlling the decomposition potential.

Inorganic fertilizer application in intensive agriculture systems have increased the yield and resulted fast profit, especially under vegetable systems. The high fertilizer inputs can lead to marked deterioration in soil and groundwater quality and the systems are clearly unsustainable (Zhu et al 2005). The excessive fertilization has been reported to have an influence on the phyto-nutritional quality of crops and reduction in the antioxidant levels, besides causing pollution (Verma et al 2015). Although the using of inorgaric fertilizers produce high yield in the first few years, but the intensive use results in soil degradation and nutrients imbalance. Due to the mentioned reasons and the rising cost of inorganic fertilizers, the use of organic fertilizers become the most important practice to reduce the rate of inorganic fertilizers or using alone as organic farming concept.

In general, yield increases in fields transitioning from conventional system to organic system, but to detect those higher yields usually require 3-5 years (USDA 1980; Altieri 1995). However, many studies obtained equal yields of vegetables in both organic system and conventional system (Stamatiadis et al 1999; Drinkwater et al 1995). Similarly, Bulluck et al (2002) found that differences in yield of melon, corn or tomatoes were not detectable on four of six farms in plots amended with alternative or synthetic fertilizer in 1996 and five of six farms in 1997.

For economic considerations (reduced labor and time) and/or neglecting the benefits of composting, the farmers in south of Iraq usually use fresh (uncomposted) organic materials as an organic source to improve soil fertility and to increase crop yield, especially for vegetable crops. Limited studies have been conducted in Iraq to test the use of compost in organic farming systems. Thus, the objective of this study was to investigate effect of uncomposted and composted cattle residue as an organic production system on availability of some essential nutrients in soil on growth and yield of snake cucumber, as large attributed plant in Basrah province, compared with conventional fertilization system. Such organic residues are readily available at low cost in, and around the study area.

Material and Method

Experimental site. This study was conducted in 2011 on a farm (33° 32' 19" N and 47° 50' 52" E) located in the Shatt Al-Arab region, east Basrah province, Iraq. The field was in arid region with low precipitations and approximately 3 km to the Shatt Al-Arab River. Vegetables are the predominant crops as the most commons: tomato, cucumber, snake cucumber, melon and eggplant.

Soil of the study field originated from fluvial deposits and classified as "coarse silty mixed active calcareous hyperthermic torrifluvents" (Khadhim 2017). Soil samples (0-30 cm) from the field were collected to obtain physical and chemical characteristics according to methods presented by Black (1965) and Page et al (1982); the results are shown in Table 1.

Table 1
Physical and chemical properties of soil used for cultivation of snake cucumber

Soil parameter	*Value*
pH	7.61
EC (dS m^{-1})	6.54
$CaCO_3$ (g kg^{-1})	380.00
CEC (C $mol^{(+)}$ kg^{-1})	46.80
Organic matter (g kg^{-1})	5.00
Total N (g kg^{-1})	0.28
Available N (mg kg^{-1})	74.67
Available P (mg kg^{-1})	16.53
Available K (mg kg^{-1})	104.00
Sand (%)	2.00
Silt (%)	56.00
Clay (%)	24.00
C:N Ratio	10.36

Compost preparation. The manure utilized for the experiment was derived from cattle litter collected from a nearby farm. The litter was placed in a plastic padded hall of (3 × 3 × 0.5 m) diameters. Water was applied at regular intervals to maintain moisture at 60% throughout composting. The compost heap was manually stirred every 7 days. The composting continued for 2 or 3 months. Then the compost was air-dried and used in the experiment. Another part of cattle litter was uncomposted by storing in low hills on plastic beds and covered by polyethylene sheet at room temperature till drying. A sample of composted and uncomposted manure was dried at 50°C and analyzed for routine analysis as described by Page et al (1982) and presented in Table 2.

Table 2
Chemical characteristics of composted and uncomposted cattle manure used in the study

Parameter	*Uncomposted manure*	*Composted manure for 2 months*	*Composted manure for 3 months*
pH	7.46	8.00	7.86
EC (dS m^{-1})	16.45	26.28	29.13
Organic C (g kg^{-1})	250.00	204.00	189.75
N (g kg^{-1})	10.86	15.00	16.50
P (g kg^{-1})	3.34	6.32	7.92
K (g kg^{-1})	9.00	7.03	4.60
C:N Ratio	23.02	13.60	11.50
C:P Ratio	74.85	32.27	23.95

Experimental design and treatment details. In order to evaluate the effects of manure on available soil nutrients and some growth parameter of snake cucumber, 12 treatments were tested in randomized block design with three replications as following: control (no fertilization) (T_1); recommended chemical fertilization of N + P + K at levels of 240 kg N ha^{-1} + 160 kg P_2O_5 ha^{-1} + 200 kg K_2O ha^{-1}, respectively (T_2); uncomposted manure at level of 2% based on soil dry weight (T_3); uncomposted manure at level of 4% (T_4); uncomposted manure at level of 8% (T_5); composted manure for 2 months at level of 2% (T_6); composted manure for 2 months at level of 4% (T_7); composted manure for 2 months at level of 8% (T_8); composted manure for 3 months at level of 2% (T_9); composted manure for 3 months at level of 4% (T_{10}); composted manure for 3 months at level of 8% (T_{11}); and conventional fertilization which usually used in study region for snake cucumber consists of T_2 + T_4 (T_{12}).

Field was ploughed thoroughly twice and divided to 3 blocks. The individual plots within block were prepared according to the treatments at row size of 7 × 0.4 m. The distance between the rows was 2 m. Manure was applied by mixing method with 15 cm upper layer of the row at the time of sowing. Urea was used as nitrogen source with three doses; after 15, 60 and 90 days of sowing. Triple superphosphate and potassium sulfate were used as phosphorus and potassium sources with one dose at the time of sowing. All the chemical fertilizers were applied by banding method. Seeds of snake cucumber (*Cucumis melo* var. flexuosus) of "local" variety were sown on March 20, 2011 reciprocally in bands at both sides of the row with a distance of 0.5 m between bands. All standard local practices were followed all over growth period. Plants were harvested on July 13, 2011.

Sampling and analysis. Soil samples (0.30 cm) were collected on June 17, 2011 from the center of each plot, air-dried and ground to pass through a 2 mm sieve for the chemical measurements of available N, P and K. For available N, samples were extracted with 2M KCl according to Bremner & Keeney (1966), and then available N was determined by micro kjeldahl according to method of Bremner & Edwards (1965). For available P, samples were extracted with 0.5M $NaHCO_3$ (Bray 1) then P was determined spectrophotometrically according to method of Murphy & Riley (1962). While available K was extracted with 1N NH_4OAc and determined by flame photometer (Page et al 1982).

Ten plants in the center of each plot were randomly selected at full maturity stage for determination of N, P and K concentrations in leaves and fruits as well as nitrate content in fruits, shoot dry weigh and yield components. The fourth leaf from the top of each plant was selected, and then oven dryed at 70°C, then digested by 4% $HClO_4$ + H_2SO_4 as described by Cresser & Parsons (1979). N, P and K concentrations were assayed in digest according to methods of Bremner (1970) for N, Murphy & Rilay (1962) for P and Page et al (1982) for K. Concentrations of N, P and K in fruits were determined as the same methods as of leaves. Nitrate content in fruit was determined spectrophotometrically after extracting with 2% of acetic acid solution coupling with HCl according to method adapted by Miller (1998). Shoot dry weight was taken from the removal shoot part and oven drying at 70°C till constant weight. Fruit dry matter was determined from difference in weights before and after oven drying of selected fruits at 70°C. Fruit volume was assayed by soaking the fruit in water. Number of fruits per plant was counted. Total fruits yield was recorded for all plants in the plot.

Statistical analysis. All the obtained data were subjected to statistical analysis of variance (ANOVA) using $SPSS_{(11)}$ program, and the significant differences (RLSD≤0.05) among the means were conducted for each parameter.

Results and Discussion

Soil available nutrients. Compared with control treatment (T_1), all fertilization treatments increased the soil available nutrients, except for soil P at T_2 treatment (Table 3). The application of manure combined with chemical fertilizers (T_{12}) had significantly ($p \leq 0.05$) higher effect on soil N, P, K content. Chemical fertilization alone (T_2) also had significant effect on soil N and K reserves. Increasing level of manure increased soil N, P and K at all composting periods (uncompasted, composting for 2 months and composting for 3 months).

This findings clearly supports that application of organic manure alone or combined with chemical fertilizers has positive impacts on soil available nutrients. These results are similar with those reported by Mandal et al (2013) and Guo et al (2016) where application of organic manure or organic manure combined with chemical fertilizers could greatly increase available P and K and total N in soil and they attributed this increase to the rich nutrients composition of the used manure. The finding indicated that nutrients which are normally applied by commercial fertilizers, are supplemented in organic manure and increase in soil by increasing manure level. Rosen & Eliason (2002) indicated that one ton of fresh manure can provide the soil by 5, 2 and 5 Ib acre^{-1} of N, P_2O_5 and K_2O, respectively. Furthermore, this increase may be attributed to a slow release of nutrients from manure and reducing nutrients losses due to volatilization, leaching, precipitation and fixing as a result to lowering soil pH, increasing cation exchange capacity (CEC) and bonding elements.

Table 3

Effect of fertilization treatments on N, P and K concentrations in soil, leaves, and fruits, and accumulative NO_3^- in fruits of snake cucumber

Treatment	*Soil N (mg kg⁻¹)*	*Shoot N (g kg⁻¹)*	*Fruit N (g kg⁻¹)*	*Soil P (mg kg⁻¹)*	*Shoot P (g kg⁻¹)*	*Fruit P (g kg⁻¹)*	*Soil K (mg kg⁻¹)*	*Shoot K (g kg⁻¹)*	*Fruit K (g kg⁻¹)*	*Fruit NO_3^- - N (mg kg⁻¹)*
T_1	41.10	18.55	21.00	10.00	1.26	1.74	100.00	11.87	20.30	211
T_2	79.90	24.50	26.60	9.30	1.80	1.65	150.00	14.02	22.45	485
T_3	68.93	28.00	31.27	13.02	1.34	2.80	397.17	13.85	30.39	337
T_4	89.30	27.09	32.20	56.08	1.56	2.90	404.50	18.38	30.39	367
T_5	90.90	32.90	37.33	60.84	1.79	2.92	408.50	20.03	34.16	369
T_6	67.37	25.90	25.20	17.51	1.14	2.69	380.67	12.64	29.13	397
T_7	59.53	25.90	26.60	43.75	1.48	2.69	383.33	17.27	30.00	395
T_8	78.33	24.97	28.47	67.86	1.39	2.62	377.83	16.30	32.60	399
T_9	61.10	25.90	28.00	23.99	1.17	2.67	377.83	11.93	31.50	370
T_{10}	62.67	23.10	30.33	26.32	1.34	2.72	383.33	9.42	29.40	377
T_{11}	76.77	23.80	25.20	50.01	1.42	2.52	391.50	11.00	28.85	399
T_{12}	100.00	35.50	37.20	69.66	1.55	2.90	418.00	27.51	31.39	460
LSD ($p \leq 0.05$)	10.05	2.85	0.50	NS	0.09	0.35	11.15	8.56	3.69	11.55

NS - non-significant.

The effect of composting period on soil available nutrients, as regards to application levels, is presented in Figure 1. Uncomposted manure showed the highest N, P and K concentrations of 83.04, 43.31 and 403.39 mg kg^{-1} respectively, while the composting manure for 3 months had the lowest N, P and K concentrations of 66.84, 33.44 and 384.23 mg kg^{-1}, respectively. These findings reveal that increasing the composting period will result decreased amount of available nutrients in soil.

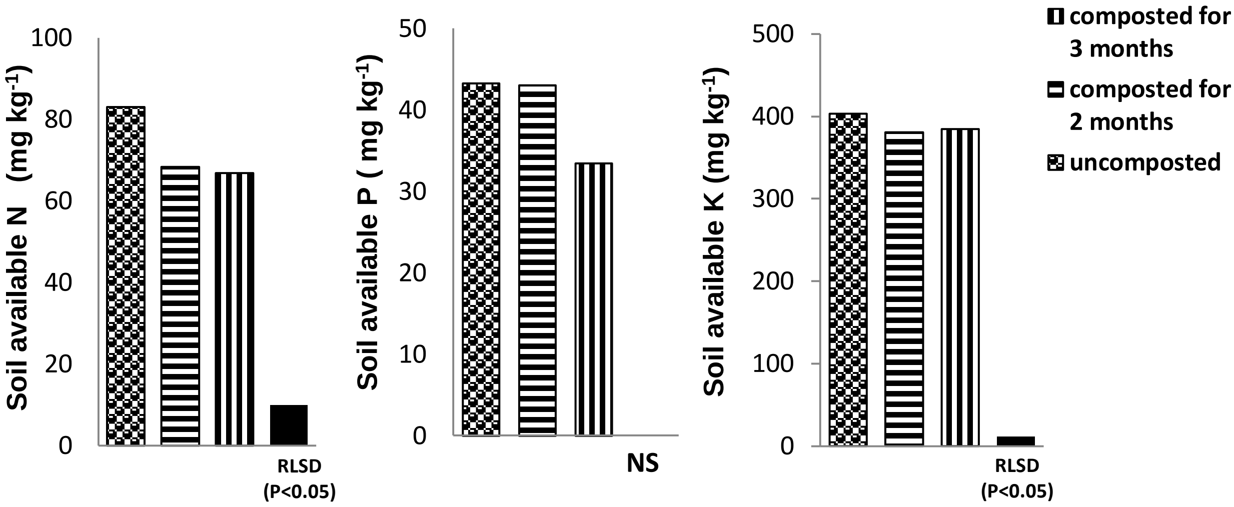

Figure 1. Effect of composting period on available N, P, and K in soil planted with snake cucumber.

The rate of N and P mineralization during the organic materials decomposition are known to be mainly affected by the C:N an C:P ratio and by the initial concentrations of N and P of the organic materials. However, the results of the present study showed that the rate of mineralization is correlated best with other parameters such as electrical conductivity (EC), pH and K content (Table 2). These effects may be explained by initial high EC of manures composting for 2 and 3 months (26.28 and 29.13 dSm^{-1}) as compared with low EC of uncomposted manure (16.45 dSm^{-1}) (Table 2), and a possible increase of soil EC, then decrease in availability of nutrients due to the negative effect of EC on decomposition of manure by soil microbes. Increasing soil EC through compost application was reported by Ouda & Mahadeen (2008) who attributed this increase to the high salts and HCO_3^- contents of manure. On the other hand, many studies reported that application of organic materials had positive effect on soil EC (Lakhdar et al 2010; Mahdy 2011). Laura (1977) and Al-Jaberi (1989) reported a significant decrease in decomposition of organic materials at high level of soil salinity. Abdalaali (2011) also observed a decrease in N, P and K availability at high level of soil salinity under unmulching condition.

The reduction of soil nutrients availability with increasing the period of composting (Figure 1) may also related to high values of pH, as compared to low value of pH of uncomposted manure (Table 2) which resulting in an increased soil pH, then decreased availability of N, P and K. In addition, the biochemical components of organic materials such as soluble C, cellulose, total polyphenols and the balance among N, P and K in the organic matter are more beneficial for controlling the activities of decomposing microflora, which then affecting nutrients release. Previous studies have reported that soluble C, cellulose and lignin have a greater influence on decomposition than the simple C:N ratio (Mohanty et al 2011). Among the plant quality parameters total K proved to significantly affect the inorganic N returns from plant materials at various soil sampling times during incubation (Omari et al 2016). Pramanik et al (2007) suggested that method and period of composting is highly related to the mobilization of insoluble nutrients and activity of beneficial microorganisms in soil due to controlling the soluble C added to soil and affecting soil aggregation and water content. The observed high value of K content in uncomposted manure as compared with composting manures (Table 2) interprets the high soil content of available K and may affected N and P contents.

Nutrient concentrations in shoot and fruits. The effect of fertilizer management on shoot and fruit concentrations of N, P and K are presented in Table (3). All the fertilizer treatments increased the concentrations of N, P and K in shoot and fruits of snake cucumber compared with the control (T_1). Except for the shoot P, the combination of manure with chemical fertilizers (T_{12}) or the application of uncomposted manure at rate of 8% (T_5) showed the highest N, P and K concentrations, with non-significant differences ($p \leq 0.05$) between the two treatments. The highest shoot N and K of 35.50 and 27.51g kg^{-1}, respectively were associated with (T_{12}), while the highest fruits N, fruits P and fruits K of 37.33, 2.92 and 34.16 g kg^{-1}, respectively were associated with (T_5). Relative to the control, the chemical treatment (T_2) increased N, P and K in shoot by 32, 43 and 18% respectively and increased N and K in fruits by 27 and 11%, respectively. In general, the increasing rate of manure increased the concentration of nutrients in shoot and fruits for most of the composting periods. These results are consistent with those of Li et al (2000), Mahmoud et al (2009), Mohammed (2009) and John et al (2013) who reported an increase in plant nutrients content following compost application as compared with chemical fertilizers application. They also observed an increase in nutrient contents with increasing compost level. Mahmoud et al (2009) observed an increase in N-uptake by cucumber plant by 81 and 75% for combination treatment and compost treatment alone, respectively as compared with chemical fertilization treatment.

The synergistic effect of manure added with chemical fertilizers was most effective in nutrients uptake by plant, as reflected in the slow release of inorganic nutrients as well as reducing nutrients losses from chemical fertilizer. In our study, the T_{12} and T_5 treatments showed the better synchrony of N, P and K availability in soil with such nutrients concentrations in snake cucumber leaves and fruits (Table 3). Cooper (2008) stated that N content of leaves is a good function of N availability in soil. Similar to the results of this study, El-Sowfy & Osman (2009) showed high correlations between available content of N, P and K in soil and their concentrations in leaves and bulbs of onion plants after application of poultry manure.

The uncomposted manure treatments most affected N, P and K in shoot and fruits of snake cucumber, followed by the composting manure for 2 months treatments, while the lowest N, P and K value were observed at the composting manure for 3 months treatments (Table 3). This was true, since the increasing available nutrients should be ensuring their uptake by snake cucumber plants. The uncomposted manure incorporation with soil increased available N, P and K as compared with composted manures (Figure 1), which subsequently enhanced nutrients supply and use efficiency. Similar results were obtained by Matsumoto et al (1997) who found that N and K uptake by plant were higher in fresh barnyard manure than in ripe barnyard manure and they attributed this results to decreasing of N and K from manure during the composting process.

Nitrate accumulation in fruits. Fertilization had a significant effect on nitrate content of snake cucumber fruits compared with control (Table 3). Fruits of plant treated with chemical fertilizers alone (T_2) or in combinatin with manure (T_{12}) had the highest nitrate content of 485 and 460 mg kg^{-1}, respectively. When the plant was treated with manure alone, the nitrate content of fruits was decreased. Nitrate of fruits increased with increasing manure level, at all composting periods. Similar findings were observed by Mouramoto (2000) and Hosseny & Ahmed (2009) who found that nitrate concentrations in spinach and lettuce organically grown were less than the ones conventionally grown. Nitrate accumulation in plant, especially editable plants, is considered to be a public health problem. Nitrate rapidly reduces to nitrite in the body which oxidizes the blood haemoglobin, and another concern is that nitrite may react with compounds in the stomach to produce nitrosamines (IFA & UNEP 2000).

The increases of nitrate in the plots treated with chemical fertilizers was attributed to the supply of readily available nitrate from mineral N fertilizer in contrast to slow release of nitrate in the plot treated with manure. Furthermore, the high contents of carbohydrate, free amino acids, and soluble phenolics found in plant treated with organic fertilizers, will coupled with nitrate in the tissues to develop the dry matter accumulation in presence of carbon, leading to reduce the free nitrate content (Hanafy et al 2002).

Uncomposted manure treatments showed the lowest nitrate content in snake cucumber fruits as compared with the composted manure treatments. The mean values were 355, 397 and 382 mg kg^{-1} for uncomposted manure, composted manure for 2 months, and composted manure for 3 months, respectively (Table 3). This may be explained by the high plant growth and maximum photosynthesis produced at the uncomposted manure resulting lower nitrate content. The high the plant growth of snake cucumber (Table 4) the less is the nitrate content in fruits (Table 3). According to Woese et al (1995), conventionally produced or fertilized vegetables have a higher nitrate content and a lower content of dry matter compared with organically produced or unfertilized vegetables. Treatment T_5 receiving uncomposted manure at rate of 8% showed significantly lower value of nitrate accumulation as compared with conventional treatment (T_{12}). The percent decrease over T_{12} (20%) illustrated the superiority of treatment T_5 in improve fruits quality.

Most of the critical values of nitrate content in plant tissues reported range from 0.07 to 0.20% (Bergareche & Simon 1989). Wright & Davison (1964) however has reported that forages containing over 0.45% nitrate should be considered potentially toxic. According to WHO (1978), the recommended limit of nitrate content in vegetables is 700 mg kg^{-1} fresh matter. In the present study, nitrate contents in fruits of snake cucumber did not reach the potentially toxic levels and they were at a safe level.

Growth, yield and yield components. There was an obvious response for each of the growth and yield parameters of snake cucumber to the application of manure, chemical fertilizer, or their combination as compared to control treatment (Table 4). The values of fertilization treatments ranged between 6.74-15.50 Mg ha^{-1}, 6.90-18.10 Mg ha^{-1}, 121-287 cm^3 and 8-13 fruit $plant^{-1}$ for shoot dry weight, fruits yield fruit volume and fruit number plant-1 respectively, while the values of control treatment were 3.43 Mg ha^{-1}, 400 Mg ha^{-1}, 108 cm^3 and 6 fruit $plant^{-1}$, respectively. Treatment T_{12} receiving uncomposted manure with chemical fertilizers showed significantly higher values of plant growth and yield parameters as compared with other treatments. However, this treatment did not resulted significant differences for treatment T_5 receiving uncomposted manure at the rate of 8% in fruits yield, fruit volume and fruits number parameters. The percent increase of T_{12} over T_5 for fruits yield was 13% illustrated the slight difference in total fruits yield. A significant higher value of shoot dry matter, fruits yield, fruit volume and fruit number were recorded in T_2 treatment as compared with control treatment (Table 4). At all of the composting periods, the values of the studied parameters tended to increase with increasing the rate of applied manure up to either 4 or 8%, but the differences were significant at the rate of 8%, except that of fruits yield and fruits number parameters at 2 months composting period.

Increases in shoot dry weight and yield of cucumber plant through manure application as compared with chemical fertilization were also reported by Mohammed (2009), Azarmi et al (2009) and Eifediyi & Remison (2010). They attributed this increase to the increase of organic matter in soil which subsequently improve physical, chemical and biological properties as well as the better impact of manure on the essential nutrient dynamics and availability. Mahmoud et al (2009) also observed that the shoot dry weight and the average cumulative cucumber yield were higher of 36% and 61% with treatment of 75% mineral N + 25% organic compost relative to treatment of 100% mineral N and higher of 172% and 383% relative to treatment of 100% organic compost. In the present study, the resulting high available N, P and K contents coupled with higher contents in leaves and fruits through manure application treatments (Table 3) resulted a higher growth and yield of snake cucumber (Table 4).

Table 4
Effect of fertilization treatments on shoot dry weight, fruits yield and yield components of snake cucumber

Treatment	*Shoot dry weight (Mg ha^{-1})*	*Fruits yield (Mg ha^{-1})*	*Fruit dry matter (%)*	*Fruit volume (Cm^3)*	*Fruit number (fruit plant^{-1})*
T_1	3.43	4.00	6.63	108	6
T_2	6.74	6.90	6.36	228	8
T_3	9.76	10.66	6.88	164	19
T_4	9.02	10.76	7.62	265	10
T_5	12.88	15.96	7.98	286	12
T_6	8.60	8.40	6.80	157	9
T_7	8.43	7.20	7.30	152	10
T_8	10.67	9.37	7.78	282	10
T_9	5.67	6.30	7.75	121	9
T_{10}	6.36	8.55	7.00	138	10
T_{11}	9.59	8.53	7.15	200	12
T_{12}	15.50	18.10	7.76	287	13
R.LSD ($p \leq 0.05$)	1.07	2.25	NS	23.30	2.00

NS - non-significant.

It is clear from the results of our study that the insignificant differences between T_{12} and T_5 treatments in total fruits yield and yield components mean the incorporation of uncomposted manure at level of 8% can replace the conventional fertilization, so would provide an economic benefit and will preserve natural sources, despites of the doubling manure dose at T_5 treatment. The manure used is readily available in such areas with low cost. Using of manure alone can lead to minimize the deterioration in soil and grand water quality, then improving fruits quality with less contaminants, especially of the editable plants as fresh vegetables. El-Sowfy & Osman (2009) reported that the better total onion bulb yield would be obtained by applying poultry manure in a suitable rate to alleviate the possible fears of chemical pollution for such vegetable crop and environmental risks. They also reported that using of organic manure decreases the needed amount of chemical fertilizers, which leading to higher yield and better quality with a relatively lower cost. Previous studies were obtained lower NO_3^-, Na^+ and free amino acids in fruits of vegetables, as well as lower number of plant-pathogenic microorganisms such as *Phytophthora* and *Pythium* species in soil at organic fertilization as compared with conventional fertilization (Bulluck et al 2002; Al-Redhaiman & Al-Shenawy 2005; Mahmoud et al 2009). In our study, the significant lower contents of nitrate in fruits harvested from manure treatments as compared with treatments including chemical fertilizers (Table 3), illustrated the role of manure to produce a better quality of fruits.

The insignificant differences in yield between T_5 and T_{12} treatments were in accordance with the results obtained by Drinkwater et al (1995) on tomato and Stamatiadis et al (1999) on broccoli, who found that vegetable fields under organic system produced yields equal to yields under conventional system. Drinkwater et al (1998) also found little difference in yields between conventional and organic production systems. However, Vogtmann et al (1993) showed that compost treatments resulted in lower vegetable yields compared with chemical fertilizer in the first 2 years, then they found no different after the third year. According to a report of USDA (1980), the crop yields are often lower in organic management system than in conventional system at the first 3 years after transitioning from conventional to organic management. Altieri (1995) also pointed out that increasing yield during the transitioning from conventional to organic systems requires 3-5 years to detect. The lower yields in the first few years on organic farms have been attributed to the negative effects of conventional practices on the soil microorganisms that mineralize soil organic matter, or that control soil-borne pests, so gradual changes in microbial community structure could be responsible for increasing yields over time (Martini et al 2004). In this respect Bulluck et al (2002) stated that field soils on organic farms were more productive than conventional fields probably due to the beneficial effects on soil properties of long-term organic amendments.

Data given in Figure 2 shows that the uncomposted manure plots had higher shoot dry weight and total fruits yield of snake cucumber compared to composted manure plots. The mean values of shoot dry weight were 10.55, 9.23 and 7.20 Mg ha^{-1} and the mean values of total fruits yield were 12.46, 8.32 and 7.79 Mg ha^{-1}, for uncomposted manure, composted manure for 2 months, and composted manure for 3 months, respectively, with significant differences among the values, except the values between composted manure for 2 and 3 months treatments of total fruits yield. This can be explained by both the differences in the soil available nutrients (Figure 1) and nutrients content in shoot and fruits (Table 3). The effect of composting period on shoot dry weight and fruits yield (as well as yield components) was as a same trend as observed for soil available nutrients and nutrition status in plant, as follows: uncomposted manure > composted manure for 2 months > composted manure for 3 months. This behavior indicated that uncomposted cattle manure is the most suitable media for snake cucumber growth in area under study. As a contrast, the significant low yield of snake cucumber was obtained by plants received composted cattle manure. Furthermore, as an economic considerations, the use of uncomposted manure can decreases the needed amount that incorporated in soil as compared with the composted one because of the reduction volume of raw materials during the compost preparation. Stanchev et al (1990) reported that the reduction in manure weight during the composting processes is ranging between 20-30%. They attributed this reduction to loss of CO_2, methane, and water vapor, resulting a significant loss in dry matter.

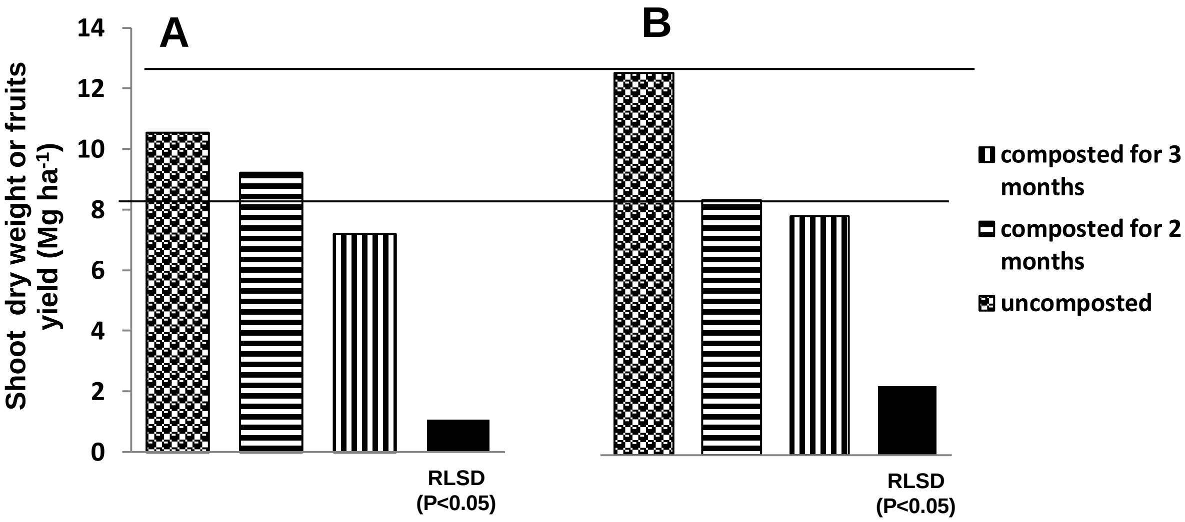

Figure 2. Effect of composting period on shoot dry weight (A) and fruit yield (B) of snake cucumber.

Conclusions. It could be concluded that the application of uncomposted cattle manure in combination with recommended chemical fertilizers improved soil available nutrients and nutrition status for snake cucumber resulting a higher growth and yield. However, the application of uncomposted manure at level of 8% solely gave insignificant differences of soil and plant parameters compared with conventional treatment. So, this evidently illustrated the possibility of using this treatment as a first step of in alternative practical strategy, which can provide favorable conditions to improve growth, yield and quality of snake cucumber with a relatively lower cost.

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