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Effect of Organic and Inorganic Fertilizers Application on Soil and Cucumber (Cucumis Sativa L.) Plant Productivity

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Abstract The application of organic fertilizer combined with or without chemical fertilizer to soil is considered as a good management practices in any agricultural production system because it improves plant quality and soil fertility. The objective of the present study is to evaluate the effect of compost on cucumber (*Cucumis sativum L*.) productivity and soil properties. A greenhouse experiment was carried out in Tulkarm, Palestine, during the summer season of 2012. The results showed that the application of compost improving the soil characteristics; increasing soil productivity and organic matter content. Compost application can compensate use of chemical fertilizers, which have adverse environmental effects. The experimental results confirmed that the use of organic fertilizers increasing the crop productivity with compost (7005 kg / dunum, dunum is 0.1 ha) comparing with (6017 kg / dunum) with chemical fertilizers, on the other hand, increasing the soil fertility and saving water, were the water requirements was decreasing with using compost (180 m^3 / season) comparing with (213 m^3 / season) were chemical fertilizers used during the agriculture period.

Keywords Compost, Chemical fertilizer, Yield, Soil, Cucumber

1. Introduction

Cucumber (*Cucumis sativum L*.) is one of the major vegetable crops produced in Palestine. Estimated area cultivated with cucumber was 23,100 dunum (dunum is 0.1 ha) which constitutes 18.2% of the total area planted with vegetable crops in the West Bank [1].

Cucumber (*Cucumis sativus L.*) is an important vegetable and one of the most popular members of the *Cucurbitaceae family* [2]. It is thought to be one of the oldest vegetables cultivated by man with historical records dating back 5,000 years [3]. The crop is the fourth most important vegetable after tomato, cabbage and onion in Asia [4]. The need for renewable forms of energy and reduced cost of fertilizing crops, have revived the use of organic manures worldwide [5]. Improvement in environmental conditions and public health are important reasons for advocating increased use of organic materials [6, 7]. Organic manures can sustain cropping systems through better nutrient recycling and improvement of soil physical attributes [8]. The use of inorganic fertilizer has not been helpful under intensive agriculture because of its high cost and it is often associated with reduced crop yields, soil degradation, nutrient imbalance and acidity [9, 10].

The complementary use of organic and inorganic fertilizers has been recommended for sustenance of long term cropping in the tropics [11]. Nutrients from mineral fertilizers enhance the establishment of crops while those from mineralization of organic manures promoted yield when both fertilizers were combined [12].

The objectives of this study to assess the effect of using organic and chemical fertilizers on cucumber (*Cucumis sativum L*.) plants, productivity and soil fertility to promote the application of organic fertilizer and decreasing chemical fertilizer used to face the soil deterioration and preserve the natural resources.

2. Material and Method

Cucumber Experiment was conducted to comparison between organic and chemical fertilizers on cucumber (*Cucumis sativus L*) yield and some soil properties was studied in a field experiment at Thenaba farm, Tulkarm, located in the west bank, Palestine, during the summer seasons of 2012. The experiment was a completely randomized experimental design included two greenhouse one donum (1000m^2) for each, contains 25 rows and 1400 cucumber plants. The soil had a clay texture (67% clay), EC (1.9 dS m^{-1}), bulk density (1.4 g cm^{-3}) and organic matter

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8.2 g kg^{-1}, PO_4 19.5% and NO_3 11.4 N kg^{-1} on a dry weight basis.

The first treatment was greenhouse (G1) under the greenhouse conditions were chemical fertilizers used during the agricultural season. The second treatment was Greenhouse (G2) were the soil mixed with compost based on available N in the compost (recommendation of N fertilizer for cucumber). Cucumber seedlings with four leaves were transplanted by hand in rows with 1 m row spacing and 0.5 m seedling spacing. Drip irrigation systems were adopted in the experiment, based on the conventional schedule. The plants were grown with a 26/18 ℃ day/night temperature regimes. Other aspects of crop management followed conventional practices. Cucumber was starting harvested weekly on April during 2012.

Soil Measurements was dried at 70 ℃ to become constant weight and this weight was recorded. The dried soil samples were ground and sieved through 2.0 mm mesh. The total N was determined in compost by the kjeldahl method [13]. Nitrate was determined in the soil according to Singh [14]. Bulk density of compost was estimated as a ratio between oven dry weights to their volumes as g cm^{-3} as reported by Okalebo *et al.* [15]. Soil pH was measured in 1:2.5 (soil: water) suspension [16] and in a 1:5 ratio (compost: water) suspension for compost. Electrical conductivity (EC) was measured in the compost with a 1:10 (compost: water) ratio. Organic matter (OM) percent was calculated as: OM% = TOC (%) X 1.724. Total phosphorus was measured calorimetrically using a spectrophotometer after wet digesting the soil samples in concentrated H_2SO_4 + $HClO_4$ [17].

The fertilizer regime was different between (*G1*) and (*G2*). The organic fertilizers (*G2*) were used contains compost as solid materials 600 kg/dunum added to the soil as line before agriculture and extract liquid organic fertilizers added during the agricultural period with irrigation water. On the other hand, (*G1*) were used different chemical fertilizers before and during the agricultural period as show in (Table1).

Table 1. Organic (compost) and chemical fertilizers used in agricultural period

Fertilizer	Components	Amount	Unit
Chemical fertilizers (G1)			
Ammonium sulphate	$(NH_4)_2SO_4$	36	kg
Phosphoric acid	H_3PO_4	25	litter
Iron chelates	Fe-EDDHA	1900	g
Shefer fertilizer	7,3,7 (NPK)	65	litter
composed fertilizer	11,8,22 (NPK)	28	kg
Organic Fertilizers (G2)			
Compost	Organic bulk	600	kg
Echostar	Organic carbon & nitrogen (mixed of carbon and nitrogen)	45	litter
Compost extraction	Organic materials	360	litter

3. Result and Discussion

3.1. The Effect of Fertilizers Regime on Soil

The effects of Organic protected agricultural area on living systems, particularly the effect on growth of plants have been the objective of numerous researchers. The soil experiment used originally clay soil texture, the results of soil analysis before and after planting shown in table (2). The results show that most soil characteristics were improvements after used compost were soil sample analysed. Based on compost properties, the compost appears to be the best suited as soil amendment. The characteristics of organic (composted) fertilizers was used in the experiment illustrated in table (3). In our results, compost addition was found to not only increase crop yield, but also to improve soil properties and fertility in terms of organic material content, permeability, available water capacity, air-filled porosity and the nitrogen increased in the soil with the increase of organic nitrogen applied as well as soil organic C [18]. Mathur, *et, al.* found that compost enhances the environmental sustainability of agriculture by decreasing chemical inputs and increasing soil organic matter. Adding different organic compost to the soil caused remarkable improvement of different growth characters and yield [19]. Also, Adrien [20], said the application of organic manures significantly increased levels of organic C and N and the formation of water-stable aggregates, as compared with application of chemical fertilizers.

Table 2. Some chemical composition of the soil samples before and after agricultural practices

Soil	pH	EC dS m^{-1}	NO_3 %	K %	Na %
Before	7.4	1.9	11.4	1.4	3.6
After	7.0	1.8	44.2	5.2	3.0
	PO_4 %	**C/N ratio**	**OM g/kg**	**Bulk Density g cm^{-3}**	**N g/kg**
Before	19.5	7.4	8.2	1.4	2.1
After	30.7	25.8	45.7	1.00	4.6

Table 3. The characteristics of organic fertilizers which used in the experiment

Compost analysis	
pH	6 to 7
C/N ratio	22
Particle size (inch)	< 1/2
Electrical conductivity (mmho/cm)	2.5
Moisture content %	50
Organic Matter	47%
Total phosphor	2 %
Organic carbon	38%
Total potassium	0.32%
N-NO_3	300PPm
N-NH_4	200PPM
nematode	nil
Bacteria coli	nil

In general, chemical fertilizer application rates in intensive agricultural systems have increased dramatically during recent years in Palestine, especially in greenhouse vegetable production systems. Because of higher yields and income, the highest chemical fertilizer inputs can lead to marked deterioration in soil and groundwater quality and the systems are clearly unsustainable. However, the use of inorganic fertilizers alone may cause problems for human health and the environment that means the excess use of chemical fertilizers in agriculture can lead to nitrate accumulation into plant parts especially on edible parts. Abd El-Hamied [21], found that the nitrate accumulation in editable plants is a problem when eaten. Part of the ingested nitrate may be converted to nitrite causing methaemoglobinaemia or even to carcinogenic nitrosamines the determination of nitrate and nitrite in food stuffs become increasingly important because of the concern over excessive human dietary intake of these species, causing a health hazard.

3.2. The Effect of Fertilizers on Water Requirement and Plants Productivity

Organic fertilizers can be substituted for commercial fertilizers; however, information is sparse on the interaction of irrigation quantity and nutrient source on cucumber *(Cucumis sativus L.)* production. In our study evaluated nutrient source and quantity of irrigation (water requirement) and yield of cucumber grown under protected agriculture. Our results show that clearly different water requirements between soil and plant treated with chemical fertilizers (*G1*) and soil and plant treated with organic fertilizers (*G2*) during the agricultural period as show in Figure 1. Were the water requirements was higher (213 m^3/ season) were chemical fertilizers (*G1*) used more than organic fertilizers (180 m^3/ season) (*G2*) during the three months of agriculture period, it means that the type fertilizers used (chemical or organic fertilizers) gives directly effects on water requirements.

These results indicated that use of compost fertilizers could save water with an average of 8, 12, 13 m^3/month respectively, and 33m^3 for the agricultural season of the applied water to cucumber crop.

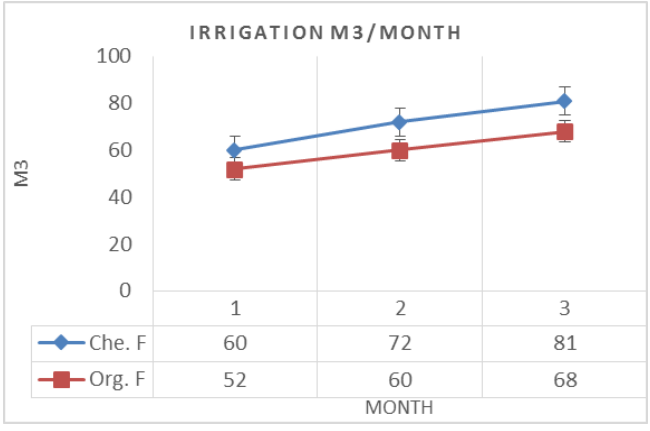

Figure 1. Water requirements for cucumber plants treated with chemical and organic fertilizers during agricultural period

Mady, A. indicated that levels of compost fertilizers could save water with on average of 14, 12.79, 29.07 and 444.19% of the applied water to cucumber crop under water stress treatments of 40, 60, 80 and 100 % from field capacity, respectively and might be due to increase of field capacity, Permanent wilting point percentage and available water by adding compost fertilizer while, bulk density was opposite [22].

Also, Mamo, *et, al.* found that the extract Compost addition was found to not only increase crop yield, but also to improve soil fertility in terms of organic C and N content, permeability, plant available water capacity and air-filled porosity [23].

Vegetative Growth and yield of the Cucumber Plants affected by the fertilizers regimes were different results shown in figure 2. The results show that using chemical fertilizers regime gives early harvested during the first month were gives 197 kg/ donum comparing with 90 kg / donum were used organic fertilizers regime.

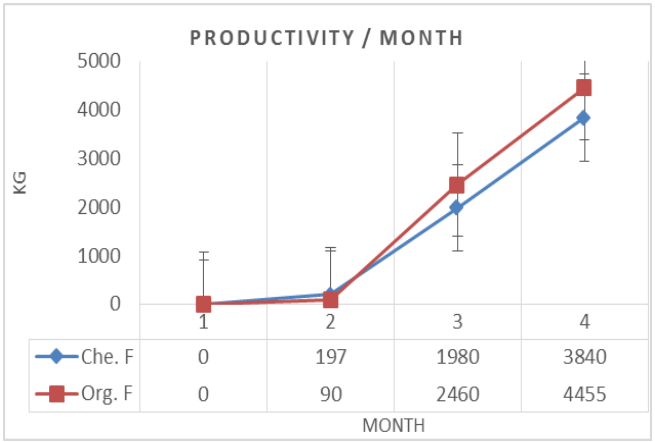

Figure 2. Crop productivity for cucumber plants treated with chemical and organic fertilizers during agricultural period

El-Sheikh, *et, al.* showed that adding organic manure at the rate 45 kg/540 m^2 at each irrigation significantly resulted in higher yield than chemical fertilizer treatments[24].

Aly, studied the effect of applying organic and chemical fertilizers on cucumber yield and fruit characteristics. He found that organic treatment (10 m^3 compost/540 m^2) gave significantly greater early, exportable and total yield than inorganic (chemical) treatment [25].

But with increasing time organic fertilization had increasing effect on the productivity, were the second and third months gave highest productivity, were in the third month treated with compost compared to chemical fertilizers used were 4455 and 3840 kg respectively, with sum of productivity for the agricultural season found that the productivity were higher in treatment with compost (7005 kg/dunum) comparing with (6017 kg/ dunum) treatment with chemical fertilizers as shown in figure 3, that means the organic fertilizers need enough time to analyses in soil and give good and natural effect.

Aly, [26] added that average fruit weight, length, diameter, length / width ratio, fruit firmness, T.S.S., total sugars,

chlorophyll and ascorbic acid content were significantly increased by using compost of organic materials over the inorganic treatment. Tara *et al*., adding, different organic compost to the soil caused remarkable improvement of different growth characters and yield [27].

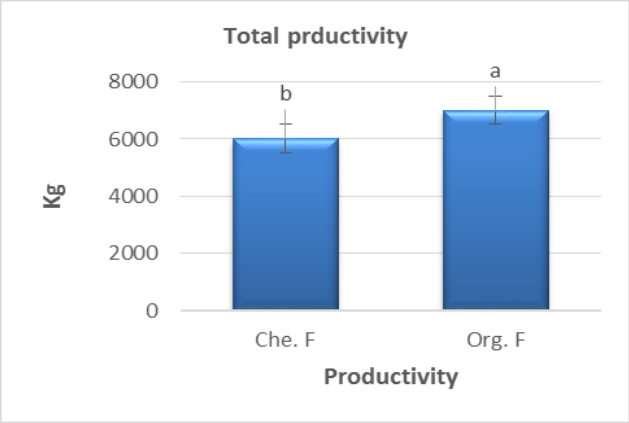

Figure 3. Average cucumber yield treated with chemical and organic fertilizers at the end agricultural period

Mady, concluded that in order to produce higher yield and high quality of cucumber by irrigation at 80% from field capacity with 2.05 or 1.30 kg/m^2 of compost [28].

Wang Ying *et al*. said, Amino acid fertilizers can promote crop growth, strengthen resistance, improve soil conditions and increase crop yields [29]. WANG Xue-jun *et al*., studied the effects of conventional fertilizer with soluble fertilizer containing amino acids on yield and economic benefit of cucumber .The results showed that the additional application of soluble fertilizer with amino acids could increase the cucumber yield [30].

4. Conclusions

Cucumber grown in optimal weather and soil conditions requires both water and nutrient availability. Irrigation systems are essential to apply water in arid regions; however, optimal use of water and organic nutrients to meet crop requirements is essential to achieve maximum yield productivity. Toward to use compost fertilizers could save water with agricultural season of the applied water to cucumber crop.

Compost application is the best management system in sustainable agriculture for increasing soil fertility, cucumber yield and decrease the cost of N mineral fertilizers. On the other hand, the excess use of nitrogen fertilizers in agriculture can lead to soil deterioration, nitrate accumulation in the plants and groundwater pollution.

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REFERENCES

[1] Statistical Bulletin, Palestinian Ministry of Agriculture (PMA), Ramallah, Palestine, (2000), 150.

[2] Thoa, DK. (1998). Cucumber seed multiplication and characterization. AVRDC/ARC Training Thailand. Research Report .Bangkok.

[3] Wehner TC, Guner N. (2004). Growth stage, flowering pattern, yield and harvest date prediction of four types of cucumber tested at 10 planting dates. Proc. xxvi IHC. Advances in Vegetable Breeding (Eds) J.D Mc.Creight and E. J Ryder Acta. Hort., 637, ISHS 2004.

[4] Tatlioglu T (1997). Cucumber (*Cucumis sativus L.*) In: Kailov, G and Bo Bergn, (Eds.). Genetic improvement of vegetable crops. Oxford Pergamon Press. pp. 197-227.

[5] Ayoola OT, Adeniran ON (2006). Influence of poultry manure and NPK fertilizer on yield and yield components of crops under different cropping systems in South West Nigeria. Afr. J. Biotechnol., 5 1336-1392.

[6] Ojeniyi, S.O. (2000). Effect of goat manure on soil nutrients and okra yield in a rain forest area of Nigeria. Appl. Tropical Agric., 5:20-23.

[7] Maritus CHT, Vleic PLG (2001). The management of organic matter in tropical soils. What are the priorities? Nutrient cycling in Agroecosystems.61:1-6.

[8] El-Shakweer MHA, El-Sayad EA, Ewees MS (1998). Soil and Plant analysis as a guide for interpretation of the improvement efficiency of organic conditioners added to different soils in Egypt. Communicationin soil science and plant analysis. 29:2067-2088.

[9] Kang BT, Juo ASR (1980). Management of low activity clay soils in tropical Africa for food crops production pp129-133 In: Terry ER, KA Oduro and S Caveness (eds.) Tropical Roots crops. Research strategies for the 1980s.Ottawa, Ontario IDRC.

[10] Obi ME, Ebo PO (1995).The effect of different management practices on the soil physical properties and maize production in severely degraded soil in /Southern Nigeria. Biol. Res. Technol., 51: 117-123.

[11] Ipimoroti RR, Daniel MA, Obatolu CR (2002). Effect of organic mineral fertilizer on tea growth at Kusuku Mabila Plateau Nigeria. Moor J. Agric. Res., 3: 180-183.

[12] Fuchs W, Rauch K, Wiche HJ (1970). Effect of organic fertilizer and organo mineral fertilizing on development and yield of cereals. Abrecht- Thaer. Arch., 14:359-366.

[13] Ahn, Y.S., 1987. Plant analysis for evaluating plant nutrition test and plant analysis. RDA& FFTC/ ASPAC.

[14] Singh, I.P., 1988. A rapid method for determination of nitrate in soil and plant extracts. Plant and Soil. 110: 137-139.

[15] Okalebo, J.R., K.W. Gathua and P.L. Woomer, 1993. Laboratory methods of soil and plant analysis: Aworking manual. TSBF Program, Soil Science Society of East Africa, Technical Publication No. 1, UNESCO, ROSTA, Kenya.

[16] Page, A.L., 1982. Methods of Soil Analysis. Part. 2. Chemical and microbiological properties (2nd ed.), Amer. Soc. Agron. Inc. Soil Sci. Soc. Amer. Inc. Madison. Wisconsin U.S.A. properties. Agron. J., 98: 1471-1478.

[17] Cotteine, A., M. Nerloo., G. Velghe and L. Kiekens, 1982. Biological and analytical aspects of soil, pollution. Lab. of analytical Agro. State Univ. Ghent-Belgium.

[18] Mathur, G., G. Owen, H. Dinel, M. Schnitzer, 1993. Determination of compost biomaturity. Biol. Agric. Hortic., 10: 65-85.

[19] Tara, A., O. Brien, V.B. Allen, 1996. Growth of peppermint in compost. J. Herbs, Spices Med. Plants, 4: 19-27.

[20] Adrien, N.D., 2006. Mixed paper mill sludge effects on corn yield, nitrogen efficiency and soil properties. Agron. J., 98: 1471-1478.

[21] Abd El-Hamied, A., 2001. Evaluation of nitrite, nitrate and nitrosamine compounds in Upper Egypt vegetables. Alex. Sci. Exch. J., 22(3): 323-332.

[22] Mady, A. Aand Derees, Abd. H. 2006. Effect of water stress and application of compost on water use efficiency and productivity of cumumber in plastic house under trickle irrigation system, Misr J. Ag. Eng., 24(1): 182-197 Irrigation and Drainage.

[23] Mamo, M., C.J. Rosen, T.R. Hallbach and J.F. Moncrief, 1998. Corn yield and nitrogen uptake in sandy soils amended with municipal solid waste compost. J. Pro. Agri., 11: 469-475.

[24] El-Sheikh, T. M.; S.Z. Abd El Rahmen and S.M. Dessouky (1993). ffect of polyethylene wrapping on keeping quality and storage of cucumber fruits, Zagazis J. Agric, Res. 20 (2): 78

[25] Aly, H.H. (2002). Studies on keeping quality and storageability of cucumber fruits under organic farming system in plastic-housess. M.Sc. Thesis, Hort. Dept. Cairo Univ. Egypt.

[26] Aly, H.H. (2002). Studies on keeping quality and storageability of cucumber fruits under organic farming system in plastic-housess. M.Sc. Thesis, Hort. Dept. Cairo Univ. Egypt.

[27] Tara, A., O. Brien, V.B. Allen, 1996. Growth of peppermint in compost. J.Herbs, Spices Med. Plants, 4: 19-27.

[28] Mady, A. Aand Derees, Abd. H. 2006. Effect of water stress and application of compost on water use efficiency and productivity of cumumber in plastic house under trickle irrigation system, Misr J. Ag. Eng., 24(1): 182-197 Irrigation and Drainage.

[29] WANG Ying, SHI Zhen-sheng, WANG Zhi-bin, LI Feng-hai, 2008. Absorption and utilization of amino acids by plant and application of amino acids on agiculture. Soil and Fertilizer Sciences in China. -01.

[30] WANG Xue-jun1, H.A.N. Guang-jin, DONG Xiao-xia1, SUN Ze-qiang1, ZHENG Dong-feng, 2011. Effect of Soluble Fertilizer Containing Amino Acids on Yield and Economic Benefit of Cucumber. Shandong Agricultural Sciences.