Investigating the Recycling and Reusing the Garbage, Agricultural Wastes and Sewage as a Method to Combat Land Desertification in Kuwait State

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ABSTRACT

Soil quality is crucial for maintaining the vitality of the land, achieving agricultural productivity, and the activity of biomass, which is one of the main indicators of land vitality. Restaurant and residential organic waste can be put to use to make compost. Therefore, after composting the trash under field conditions, it is necessary to determine the appropriate rate of composting these materials that can be added to the lands of the State of Kuwait. The trash composted for the best time of 90 days under Kuwaiti conditions because to the difficult climatic conditions in the State of Kuwait, the scarcity of freshwater adequate for irrigating the lands, and the dependency on treated water. This shows that adding composted household trash in the State of Kuwait has no adverse effects on the quality of the soil.

Keywords: organic matter, waste, State of Kuwait, desertification.

INTRODUCTION

Kuwait State is consider one of the countries that the highest percentage of organic material wastes compared to the population, as one individual - in Kuwait - produces about 1.4 kilograms of waste per day. In addition, primitive methods usually, used to dispose of solid waste. So far, there are 4 landfill sites, still used in Kuwait and they are causing a vital problem to the environment and society health (Hussein, 2021). In fact, about 90 % of the produced waste finds its way to the scattered landfills for backfilling by primitive methods without waste sorting, in light of the pollutants and toxic fumes hidden by these wastes that threaten human health and cause environmental disasters (Al-Qassas, 1999).

In addition, Mohammadi, and Torkashvand, (2010) reported that the accumulation of solid waste carries an environmental disaster and causes emissions of toxic gases, unpleasant odors and perhaps some fires that negatively affect the environment which may causes healthy problems particularly, residents near landfill sites.

Organic matter increase the ability of soil to conserve water, where the organic matter can retain the equivalent of 20 times its weight in water, especially light texture such as sandy soil in Kuwait (Brinton, 2014). Organic matter contributes between 20-70 % of the Earth's cation exchange capacity (CEC) where the humic materials ranges between 300-400 meq/100g (Abdelrazek and Elkony, 1991). Therefore, the organic matter have an active role in aggregate stability, increase the facilitation of chelated elements for the plant and It can react with organic salts making complexes with clay minerals leading to reduce the leaching of organic matter (Cooperband, 2012 and Skrypchuk, et al., 2020).

Organic matter is a consider as the energy and nutrients supplier to the living organisms to increase their surviving ability in the soil as well as it has power to control the decomposition of pesticides in the soils (Abdelrazek. and Elkony, 1991).

Many factors help decomposition of organic matter, such as temperature, aeration, moisture content, pH, nutrients content, soil texture, construction, microbes and living organisms (Tateda, et al., 2012).

Because of the deficiency of organic matter for restoring vegetation cover and combating desertification. In addition, the presence of harsh climatic conditions and shortage of water resources for suppling the agricultural sector in Kuwait state. Therefore, the aim of this study is an attempt to reuse and recycle the organic wastes to organic compost used as a mean for combating desertification in Kuwait.

MATERIAL AND METHODS

Location

Kuwait State is located in the northeastern part of the Arabian Peninsula and has borders. The State of Kuwait covers a total area of 17,818 km² and its width is about 170 km from east to west and 200 km from north to south. Kuwait shares a border of 495 km with Saudi Arabia in the south and 195 km with Iraq in the north and west (Arab Organization for Agricultural Development, 2003) see map (1).

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Figure 1. A map showing the location of the State of Kuwait

Soil Analysis

The measured and determined chemical and physical parameters of soil samples were EC, pH, OM, Total N, and CEC depicted in Table 1 and 2. The pH of the saturated soil paste was measured using pH meter (Jackson, 1973), Total nitrogen content was determined by the Kjeldahl method (Page et al. 1982). The CEC (Cation exchange capacity) determined by the method of Richards (1954), and Mechanical analysis was determined using the pipette method, as cited by (FAO, 1970).

Compost Analysis

The chemical properties of compost that measured and determined were electrical conductivity (EC dSm^{-1}) of the saturated compost extracts measured using EC meter (Salcon, 1997), The p^H of the saturated compost paste determined using Beckman's pH meter (Petra and Barbara, 2002), The organic matter was determined, following Walkley and Black method as mentioned by (Bertran and Andreas, 1994), Available of elements such as phosphorus was determined calorimetrically by a spectrophotometer (Watanabe and Olson, 1965), The potassium measured by a flame photometer (Bertran and Andreas, 1994). Iron (Fe), manganese (Mn), and zinc (Zn), determined by atomic absorption spectrophotometer (Lindsay and Norvell, 1978).

Table (2) shows the quality of the resulting compost. The compost contain 20.64% OM and 12% OC (to obtain organic matter by multiplying 1.72), and the total humus percentage is 16%, while C/N ratio reached 10. These indicators appeared that the potential capacity of the organic matter and the ability to hold water and major nutrients such as nitrogen, phosphorous, potassium and microelements such as copper, zinc, molybdenum with the ability of biomass and enzymes to work under the organic matter efficiently and highly.

Table 1. The physical characteristics of the organic wastes and the sandy soil in Kuwait state

Parameter	Compost	Soil
Color	Dark Brown	yellow
Soil texture	……	Sandy soil
Sand%	……	97.0
Silt%	……	1.7
Clay%	……	1.3
Bulk density(Mg/m^3)	0.71	1.6

Table 2. Chemical characteristics of the municipal solid waste and the sandy soil in Kuwait state

Parameter	municipal and waste	Soil
pH	7.6	8.46
EC(dS m^{-1})	3.1	0.7
OM (%)	20.64	0.19
Organic carbon (%)	12	0.10
Total N (%)	1.2	0.1
C/ N	10	N.D
CEC(c mol/Kg^{-1})	92	9.00
Total humus (%)	16	N.D
Microbial Biomass(mg/Kg^{-1})	1830	N.D
Available Zn (mg/Kg^{-1})	608	N.D
Available Copper (mg/Kg^{-1})	179	N.D
Available Cadmium (mg/Kg^{-1})	19	N.D
Germination index (%)	95	N.D

N.D= not determine

Compost Preparation

A layer of vegetable residues and wastes of household and restaurant (15 cm thickness) was worked and covered with another layer of materials and replicated by the same sequence until a height of about 1 m inside the boxes(European Compost Network ,2010)

The water added to the compost until it is wet enough and water added regularly. The hay remixed using a hatching fork after 3 weeks, then again after five weeks. Harvesting compost made after in 100 days. Boxes for 100 days as aerobic conditions. The material turned for 0, 10, 20, 30, 40, 60, 70, 80 and 100 days. Samples (one Kg) taken, dried at 65ºC, passed after grinding through a 0.2 mm sieve and stored desecrator. All samples conducted in tripletail for composting boxes and all samples analyzed over 100 days. In addition, the content flipped from time to time (Atiyeh, et al 2011).

The compost temperature increases due to the microbial activity, and the change is noticeable within a few hours of forming a windrow (Khalil and Elkony 2020). The temperature usually increases rapidly to 50 to 60°C during the period of the active composting stage. The temperature gradually drops to 40°C as the composting activity slows down and the curing stage begins. About 385,000 acres of land considered potentially arable in Kuwait. However, it is, completely covered by permanent pastures (Rane, and Singh, 2001).

Statistical Analyses Method

Obtained results statically analyzed according to (Steel and Torrie, 1981). The least significant difference at 0.05 level of probability (LSD 0.05) used to detect the differences between lettuce, tomato, potato, turnip Alfalfa Zea mays, Barley, Sorghum, Watermelon, cucumber and Shrimp sources of compost.

RESULTS AND DISCUSSION

Table (3) showed that the percentage of organic matter in household and restaurant waste is closed to farm and fish waste, where the percentage exceeds 50%, it was found when composting with compost that the best amount added per acre is 20 tons per acre, and this depends on the quality of the waste and the efficiency of the composting process. The highest of mean microbial biomass 138 (µgg^{-1}Soil) when fertilizing sandy soil with this amount, it gives significant results $L.S.D_{0.05}$ 10.01. Composting of Vegetables Straw Temperature, show temperature variations during composting. Initially, the heat was generated and temperature increased rapidly during the first 10 days from 35 to 55ºC (mesophilic stage 1). The temperature then remained > 65ºC for at least the five days (thermophilic stage) necessary for achieving sanitation through reduction of pathogen population below levels that threaten the health and to kill all weed seeds and diseases cussing organisms. The temperature then remained almost at an average of 55ºC for about 15 days after which it gradually decreased to reach atmosphere levels after 100 days (maturity stage). It was slow and long period about 65 days with no measurable temperature changes. This temperature considered ideal achieving maximum rates of decomposition.

The results in Table (4) show the average percentage of waste in the different governorates of the State of Kuwait, which are (Al-Asimah, Jahra, Hawally, Farwaniya, Mubarak Al-Kabeer and Al-Ahmadi**).** Mean Waste was 43% at the significance level 6.02.

Table 3. Microbial Biomass in sandy soil amended with different levels of municipal solid waste compost from Kuwait municipal station

Treatments tons/acre	Composting time, days					
	10	20	30	40	50	60
	Microbial Biomass (ugg^{-1}Soil)					
Control (sand only)	83	49 d	45	36	34	15
2.5	85	100 c	102	85	87	55
5	110	130 b	133	100	105	62
10	130	155 a	162	135	115	84
20	120	138 b	122	121	100	64
Mean	105.6	114.4 c	112.8	95.4	88.2	56
L.S.D$_{0.05}$	9.08	10.01	7.03	6.07	5.21	3.22

Table 4. The percentage of organic matter in compost produced from household and restaurant wastes in the State of Kuwait

Governorates of the State of Kuwait	Waste (%)					OM (%)				
	R1	R2	R3	Mean/ government %	L.S.D$_{0.05}$	R1	R2	R3	Mean/ government %	L.S.D$_{0.05}$
Capital (Kuwait city: capital and seat of government)	11	12	13	12	1.8	56	53	55	55	3.2
Jahra: largest governorate	42	43	44	43	6.02	60	60	60	60	6.5
Hawalli.	9	10	11	10	0.86	48	42	60	50	3. 9
Farwaniyah	9	14	11	12	1.7	47	41	59	49	5.4
Mubarak Al-Kabeer.	10	13	13	11	098	59	39	46	48	4.8
Al-Ahmadi.	8	14	14	12	1.9	37	67	40	48	4.6
Mean all government				16.7					51.7	

L.S.D$_{0.05}$ R1, R2, R3 Replicate

Al-Asimah organic matter percentage 60% the least significant difference 6.5 Al-Asimah Kuwait. The percentage of fertilizer is part of the total percentage of solid waste in the State of Kuwait, as shown in Table (4) Waste (%) 12, 43. 10,12,11,12 in each government in Kuwait.

The data in Table (5) shows the percentage of the organic matter in the compost resulting from the waste of homes and restaurants in the Kuwait State, where the soft substance, compared to the rest of the solid creations of paper, glass. The farms contain the largest proportion of this waste compared to the proportion of the organic matter in the compost resulting from fish waste, especially shrimp and prawns. The State of Kuwait is famous for producing large quantities and where the organic matter constitutes ranged from 60.2% to 151.36% with high level of morale as shown in last significance difference 3.3 at 0.05, Table (5).

Table 5. The percentage of organic matter some farms in compost produced from the straw of plant and fish production in the State of Kuwait

Plants	OM, (%)	Plants	OM, (%)
Lettuce plant	67.08	Sorghum halepense	103.2
Tomato plant	72.24	Watermelon	68.80
Potato	80.84	Eggplant	60.2
Turnip plant	73.96	Cucumber	68.8
Medicago sativa	111.80	Shrimp	94.6
Sorghum bicolor	120.4	Dendrobranchiata	77.4
Hordeum vulgare	151.36	**L.S.D a<0.05**	**3.3**

Fig (2) All biological activity does not always result in complete oxidation of C to CO_2 (CO_2 evolved may be slightly low). Individual tests e completed over a four – days periods though there are no restrictions on the number of tests capable of completing.

The soil organic matter or carbon cycle is based on continually supplying carbon in the form of organic matter as a food source for microorganisms, the loss of some carbon as carbon dioxide, and the build-up of stable carbon in the soil (a process called assimilation) that contributes to soil aggregation and formation.

Fig (2) shows the assessment of the soil content of organic matter starting from 1965 to 1995, as it gives a wide range of fertility and water retention, and this is what the lands of the State of Kuwait need. Especially since it contains 97% sand, as it is a severe sandy land that has lost water and nutrients, as it needs to add organic matter in a scientific and balanced way. Organic matter changes over a longer period, as shown in Fig (2), and is the most important indicator of biological activity in the soil, in addition to the positive effect of the major and minor elements NPK, Zn, Co, and Mo. Composition of soil macro- fauna under forest, fallow, and grass vegetation. Microbial biomass (bacteria and fungi) is a measure of the mass of the living component of soil organic matter.

Fig (3) the microbial biomass decomposes plant and animal residues and soil organic matter to release carbon dioxide and plant available nutrients

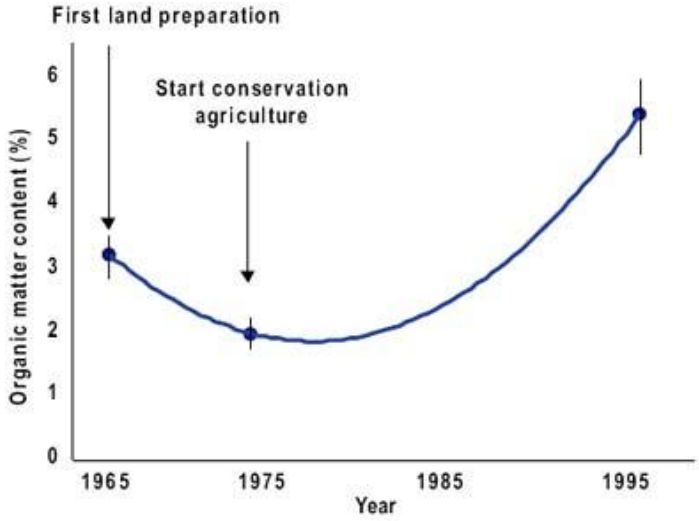

Fig.2. Evaluation of organic matter content of soil in Kuwait

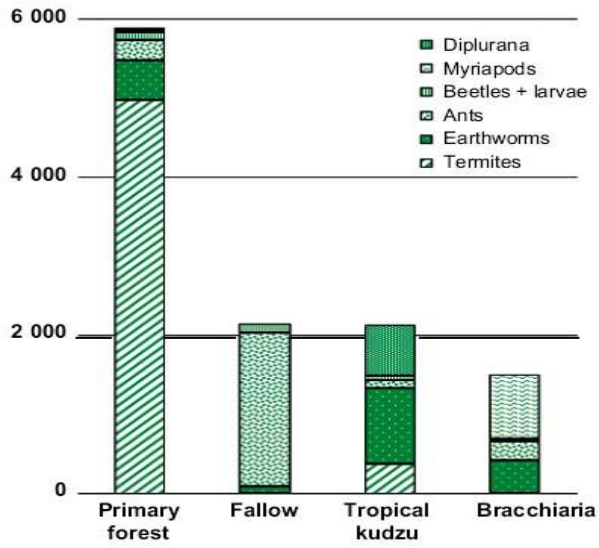

Fig 3. the microbial biomass decomposes

RECOMMENDATIONS AND SUGGESTIONS

1. Adoption approaches to enhance the transfer technology of combating desertification using the soft wastes generated from homes, hotels and farms for fertilizing agricultural lands in the Kuwait State become necessary.

2. Paying attention to the composting of all available wastes to improve the fertility of Kuwait's soils.

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الملخص العربي

البحث في تدويرواعادة استخدام القمامة والمخلفات الزراعية والصرف الصحى كوسيلة لمكافحة التصحر في دولة الكويت

سعد عبد الصمد السيد عبد الرازق ، خالد عبد الله الناقة

تعتبر جودة التربة من اهم العوامل التى تؤدى الى الحصول على انتاجية مرتفعة للمحاصيل ومع استمرار جودة حيوية ونشاط الاراضى وتأهلها للقيام بدورها، و نشاط الكتلة الحيوية التي تعتبر من الدلائل الكبرى على تلك الحيوية والنشاط.

وهناك فوائد وايجابيات لما تنتجه المنازل والمطاعم من مخلفات عضوية تستخدم فى انتاج سماد المكمورات (الكمبوست)وتتوقف كفاءة ونضج وثبات السماد الناتج على نوع المخلفات وكفاءة كمرها.

لذلك فان الهدف من هذا البحث هو التعرف على افضل معدل يمكن اضافته الى اراضى دولة الكويت من المخلفات المكمورة التي تحت ظروف الحقل. ونظرا لظروف المناخ القاسية بدولة الكويت وقلة المياه العذبة الصالحة لرى الاراضى والاعتماد على المياه المعالجة، فقد تم كمر المخلفات لمدة ٣٠، ٦٠،٩٠ يوم، تحت ظروف دولة الكويت ، وكانت افضل فترة كمر للمخلفات عند ٩٠ يوم حيث انزيمات التربة مثل اليوريز والفوسفاتيز تكون متصاحبة مع تحلل الكتلة الحيوية للخلايا وذلك فى فى نهاية دورة حياة تلك الخلايا. يتضح من ذلك انه لايوجد اي تاثير سلبى على جودة الاراضى عند اضافة سماد مكمور من مخلفات المنازل و المطاعم والمزارع بدولة الكويت.