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RESEARCH ARTICLE

DESERT SOIL CONDITIONING AND RECLAMATION FOR AGRICULTURAL PURPOSE

[1*]Sathiraju Venkata Satyanarayana and [2]Asma Hashil Salim Al-Fulaiti

[1]Department of Built and Natural Environment, Caledonian College of Engineering, Muscat, Oman
[2]Project Student, Department of Built and Natural Environment,
Caledonian College of Engineering, Muscat, Oman

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ABSTRACT

Any area which experiences average annual rainfall less than 600mm becomes desert in due course. The average annual rainfall of Sultanate of Oman is 100mm. That is how the Sultanate of Oman lands became desert soils. The climate change and temperature affect the growth and yield of food grains crops. The climate from October to February is very pleasant and best suitable for agriculture. The evapotransmission losses of plants are minimum. The aim of this research project is to convert desert land suitable for agricultural purpose. The desert soil samples were collected from AL Wahiba. The soil was conditioned by adding cow dung, vermin compost, chemical fertilizers and biochar. Water was sprinkled occasionally to maintain soil moisture 15 to 20 %. The corn seeds are planted at a distance of 300mm each. The growth of corn plants was very encouraging.

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INTRODUCTION

The Sultanate of Oman the irrigated land for agricultural purpose is nearly 10%. The desert land occupies the lion's share. The population is increasing steadily. By 2050 the predicted population of Oman will be 9.1 million. It is double to the present population of 4.5 million. The Oman could be able to produce very limited quantity food grains, fruits, and vegetables. It was predicted that by 2050, the Sultanate of Oman has to import all the food grains from other countries. The Oman's food security will be at risk in case of price rise in the international market. The growth and yield of the food grains may come down due to climate change, over exploitation of agricultural land and addition of excess quantity of chemical fertilizers. The Sultanate of Oman have Bawshar sands, the Empty Quarter desert, AL Wahiba desert, Ramlat Tawq are some of the deserts that . Oman must realizes that the desert territories that has must be exploited and turned into agricultural land and conquer the people's needs of food in the future. (Martina, 2011). The physical properties of soil are improved by adding poultry manure 10 tones/ha followed by cow dung 30 tones/ha. It was observed that the leaf length and width were increased. The organic manures greatly influenced soil chemical properties like pH, nitrogen, phosphorous and organic carbon (Senjobi, 2013).

Corresponding author: **Sathiraju Venkata Satyanarayana,**
Department of Built and Natural Environment, Caledonian College of Engineering, Muscat, Oman.

Cow dung increases soil organic matter content, improved water infiltration and water holding capacity as well as Increase cation exchange capacity (Raj *et al*., 2014,). Cow dung increases the growth and yield of maize crop (Tanimu *et al*., 2013.In Sultanate of Oman the wheat production reached to the highest record of 3000 tones during 1973 to 1975. Hence government needs to put efforts to increase the wheat production. This will be an attempt to reach self-sufficiency in food grains production (Mbaga, 2014). Vermicompost is produced by digesting the biodegradable material with the help of earthworms.It was observed that the soil organic matter was increased by 6.2%. The plant can absorb the nutrients very easily (Blancheta *et al*., 2016). Cotton gin trash biochar showed the greatest potential to increase soil organic matter and plant nutrients. Biochar can be applied to the soil as a potential organic matter source without delivering any negative side effect (Zhang *et al*., 2016). Biochar addition obviously improves degraded and arid soil physicochemical properties. (Martina *et al*., 2011).Vermicompost has higher N availability than the conventional compost on weight. Several other plant nutrients e.g. phosphorus (P), potassium (K), sulfur (S) and magnesium (Mg), were significantly increased by adding vermicompost (Chauhan and 2009). The concentrations of cow urine 5, 10, and 15% were effective against the growth of the fungus which exhibited the significant inhibition in the growth of fungal plant pathogens. Whereas minimum inhibition was recorded with 5 percent concentration of cow urine in

Rhizoctonia solani (48.60%) followed by Fusarium oxysporum (54.76%) and Sclerotium rolfsii (55.38%). It was concluded that the cow urine has antifungal activities and inhibits the growth of fungi (Hamaky *et al*., 2015). Soil fertility can be increased by adding saw dust, wood residues, sewage sludge, animal manures, as these amendments stimulate the microbial activity which provides the nutrients (N, P) and organic carbon to the soil (Sheoran *et al*., 2010).

MATERIALS AND METHODS

Composite soil samples were collected at 0-30cm depth from AL Wahiba desert which is in AL Sharqiya. The soil samples were analyzed for pH, Na, K, CL, Ca, EC, P and Mg by using saturated soil paste .In a beaker 300 grams of desert soil was taken and water was added and stirred continuously till the soil becomes like a paste. The saturated paste was kept for 24 hours. After 24 hours, the soil paste was filtered using Whatman No 1filter paper. The filtrate was used to analyze the nutrients by using Inductively Coupled Plasma Spectrometer. The filtrate also used to measure the pH by using pH meter and EC by using conductivity meter. Desert soil porosity was determined by using the constant head method; in which a constant level of water, called head, is kept above the soil surface. Water holding capacity is directly proportional to the porosity. Cow dung, organic manure and biochar were added to increase water holding capacity of the desert soil.

Sodium Absorption Ration (SAR) was calculated by using the below formula.

Sodium Absorption Ratio = $Na^{+} / [(Ca^{2+} + Mg^{2+})/2]^{0.5}$

The soil was conditioned by applying poultry manure, cow dung vermin compost, biochar and clay. The clay soil was added to reduce soil porosity and to increase water holding capacity of desert soil. For 1 kg of desert soil 80.5 g of clay was added to get optimum water holding capacity. Cow dung was added to improve physical properties of soil, chemical properties, plant growth, and to increase soil fertility. The amount of cow dung required depends up on the amount of nutrients that the soil has. Minimum 10% cow dung is required. The desert soil, clay and cow dung were mixed and watered. Waited for 2 days then compacted the soil. The corn seeds were steeped in water at 97°C for 5 seconds to improve seed germination and seedling emergence .The growth and yield of corn, onion and fenugreek were observed. Water was added quantitatively and recorded. After 1 month, plant growth was recorded.

RESULTS

Desert Soil contains 86% of sand, 4.4% of clay and 9.6% of silt. The desert soil texture before conditioning was as shown in Fig 1.

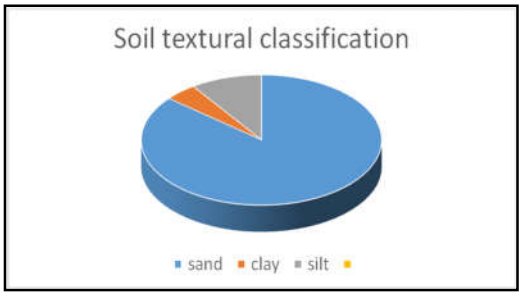

Fig. 1. Desert soil texture before conditioning

Soil Permeability was analyzed by using constant head method before conditioning of desert soil conditioning. The values are as shown in Table 1 and Fig 2.

Table 1. Desert Soil Permeability before conditioning

Permeability mm/2m	Time in min per 2m
10	12:00
12.8	12:02
14.9	12:04
16.5	12:06
18.5	12:08
20	12:10
22.7	12:12
25.2	12:14
27.5	12:16
29.7	12:18

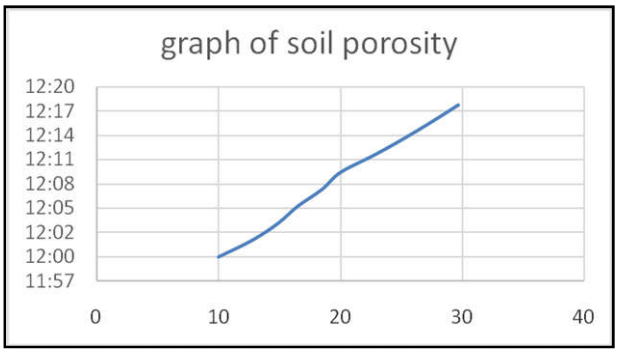

Fig. 2. Desert Soil Permeability before conditioning

Soil Permeability was analyzed by using constant head method after conditioning of desert soil conditioning. The values are as shown in Table 2 and Fig 3.

Table 2. Desert Soil Permeability after conditioning

Permeability mm/2m	Time in min per 2m
10	12:00
10.5	12:02
11.5	12:04
12.5	12:06
13.7	12:08
14.9	12:10
15.1	12:12
16.3	12:14
17	12:16
17.2	12:18

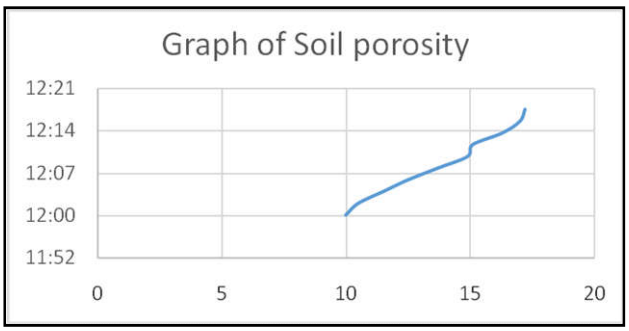

Fig. 3. Desert soli porosity after conditioning

The desert soil pH and electrical conductivity after conditioning are as shown in Table 3.

Table 3. Desert soil pH and conductivity values after conditioning

Desert Soil	pH	EC (ms/cm)
After conditioning	8	0.26

The soil primary and secondary nutrients were analyzed by using Inductively Coupled Spectrometer before and after addition of cow dung. The values are as shown in Table 4.

Table 4. Primary and secondary nutrients of desert soil before and after adding cow dung

Soil elements	Before adding cow dung (PPM)	After adding cow dung (PPM)
Ca	45.6	46.9
Fe	0.0729	0.0929
K	334	490
Mg	45.4	60.7
Na	345	360
Zn	0.019	0.030
Ag	0.0375	0.0399

The corn seeds are planted with 30 cm distance from each seed. The growth was observed and recorded. The growth of corn plants are as shown in Table 5.

Table 5. The growth of corn plants in 5 weeks duration

Duration after planting	Growth of corn plants (cm)
Week-1	8.5
Week-2	19
Week-3	29
Week-4	40.2
Week-5	53.9

The growth of fenugreek is as shown in Table 6.

Table 6. The growth of fenugreek in 5 weeks duration

Duration after planting	Growth of fenugreek plants (cm)
Week-1	3.5
Week-2	6
Week-3	8.2
Week-4	9.7
Week-5	11.2

DISCUSSION

The soil pH was 8.0 after soil conditioning. The permeability of the soil was reduced from 29.7 mm to 17.2mm. As a result the water holding capacity of the desert soil was increased.

As the results have shown in Table 5, the growth of corn plant is increasing steadily. It was observed the growth of corn in week-1 is 8.5 cm and at week 5 it was 53.9cm. The growth of fenugreek was from 3.5 cm to 11.2 cm in the fifth week.

Conclusion

It was observed that the desert soil conditioning for agricultural purpose can be achieved. The addition of cow dung, vermicompost and biochar facilitated the plant growth. The water requirement plays a vital role for plant growth.

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