SVU-International Journal of Agricultural Science
Volume 3 Issue (1) pp.: 53 -71, 2021
Print ISSN 2636-3801 | Online ISSN 2636-381X
Doi: 10.21608/svuijas.2021.57919.1070

RESEARCH ARTICLE

Biological reclamation of a calcareous sandy soil with improving wheat growth using farmyard manure, acid producing bacteria and yeast.

Farrag, H. M.* and Abeer A.A. Bakr
Soil and water Department, Faculty of Agriculture, South Valley University, Egypt

Abstract

Two pot experiments were performed in the Experimental Farm, Soils and Water Department, South Valley University, Qena, Egypt during two successive winter seasons (2018/2019 and 2019/2020). The main objective is to evaluate the effect of four addition levels of farmyard manure (FYM) (0, 10, 20 and 30 g/Kg of soil) combined with acid producing bacteria (APB) + molasses, yeast + molasses or their mixture on improving the chemical properties of a calcareous sandy soils and enhancing wheat growth. The results showed that, the results showed that with the increasing added level of FYM the soil pH and CaCO3 content were decreased and the soil EC, OM, total N and available P and K were increased. In addition, plant dry matter, N, P and K uptakes and use efficiencies were increased. Also, the application of APB + molasses, yeast+ molasses or their mixture with (FYM) were more effective than adding FYM alone in the improvement of calcareous soil properties and enhancement of wheat growth. It could be concluded that the best treatment in improving the calcareous sandy soil properties and increasing wheat growth, nutrients uptake and use efficiencies was the treatment of FYM with APB + yeast+ molasses especially when FYM was applied ate level 30 g/kg soil.

Keyword: Calcareous soil; Bacteria; Yeast; Availability; Uptake

Introduction

Calcareous soils generally have a high calcium carbonate content (CaCO3) that affects soil properties related to plant growth, its include the high pH, low CEC, low availability of plant nutrients such as phosphorous (P) and most micro nutrients, loss of nutrients via deep percolation, low organic matter (OM), and a nutritional imbalance between elements such as K, Mg and Ca as well as the soil crusting formation and its effect on seedling emergent. (Elgabaly, 1973; FAO, 2016; Aboukila et al. 2018; Wahba et al. 2019) These soils can be brought under cultivation after the use of certain amendments that lead to solubilize the existing insoluble fraction of CaCO3 and improve some of the bad properties of these soils (Ahmad et al., 1990; Qadir et al.,1992). Organic matter improves both the chemical and physical properties of these soils. Including, soil structure, moisture holding capacity, nutrient availability (macro and micronutrients), and CEC as well as promotes soil organisms and encrouges the growth of plants (Mussatto et al., 2006; Candemir and Gulser, 2007; Chaturvedi *et al.*, 2008; Abo-baker, 2017; Aboukila et al., 2018). Moreover, the addition of organic and bio-fertilizers had beneficial return to increase the population of microorganisms, particularly in the surface layer, which produces some substances that stimulate plant development (Abo-baker, 2011). Acid-producing bacteria through producing organic acids can help in reducing the soil pH and improving the properties of

***Corresponding author: H.M. Farrag,**
E-mail: hosnyfarraj@agr.svu.edu.eg
Received: January 13, 2021;
Accepted: February 2, 2021;
Published: February 2, 2021.

calcareous soils, it is may be due to, dissolve the calcium carbonate resulting in increasing the availability of phosphorous (Han and Lee, 2005; Westerman and Bicudo, 2005). Yeasts have affected not only microbial and plant growth, but they may also play a role in improving both the chemical and physical properties of the soil. The improve the soil structure, mineralization of organic matter and availability of nutrients in addition, they have the ability to reduce both calcium carbonate content and soil pH, solubilize insoluble phosphates, improve the soil health and enhance plant root in the rhizosphere (Zhang et al. 2000; Batha, 2011; Vieira, et al., 2016; Xi et al., 2019). Molasses which a viscous product resulting from refining sugarcane into sugar, contains several nutrients and is high in minerals. So, it probably affects growth rate at convenient amounts (Shteinberg et al., 1982; Abo-baker, 2017). This study aims to assess the potential using of farmyard manure with some biological treatments, consisting of acid-producing bacteria and yeast in improving the quality of calcareous sandy soils and enhancing the growth of wheat plant.

Materials and methods

Two pot experiments were done in the greenhouse of the Experimental Farm, Department of Soils and Water, South Valley University, Egypt. The experiments were carried out during two winter seasons (2018/2019 and 2019/2020), to study the effects of applying Farmyard Manure (FYM) at level of (0, 10, 20 and 30 g/Kg soil) alone, or combined with Acid Producing Bacteria (APB)+ molasses, yeast + molasses or their mixture on some chemical properties of a a calcareous sandy soils, nutrient availability, growth, nutrient uptake, and nutrient use efficiency of wheat (Giza 168 variety) plants. Some physicochemical properties of soil, FYM and molasses are shown in Table 1.

Applied Organic manure and Bacterial and Yeast Strains

FYM was collected from the Animal Production Farm, South Valley University, Egypt. Molasses was obtained from Deshna Sugarcane Factory, Qena, Egypt. The studied microorganisms have included APB (*Paenibacillus polymyxa*; previously *Bacillus polymyxa*), and natural yeast (*Seccharomyces cerevisiae*) active dry were obtained from microbiological resources center, Faculty of Agriculture. Ain Shams University.

Experimental Modeling and Treatments:

The pot experiments were prepared in a completely randomized design using plastic plant pots of 40 cm height and 30 cm diameter with a drainage aperture in the bottom. Each pot was filled with 8 kg of a calcareous sandy soil. The treatments that were applied in this study are shown in Table (2).

Pot Experiments

The air - dried FYM was used at a level of 0, 10, 20 and 30 g/kg soil (0, 80, 160, and 240g/pot) respectively. In each pot, the soil was completely mixed with the farmyard manure, then 20 seeds of wheat were sown. For the APB treatments, 50 mL of a liquid inoculum of APB (10 x107 cells mL^{-1}) were diluted in one liter of distilled water. 10 mL of the diluted inoculum were added to the pot. Moreover, 20 mL of diluted molasses solution (50 g/L) were applied into the pots of APB+molasse treatments. Also, one g of dry yeast was dissolved in one liter of the diluted molasses solution (50 g/L).

Table (1) some selected soil farmyard manure (FYM) and molasses properties used in the study.

Soil property	Value	(FYM) property	Value	Molasses property	Value
Sand (%)	87	pH (1:10)	8.4	pH (1:20)	5.3
Silt (%)	8	EC (1:10), (dS/m)	6.35	EC (1:20), (dS/m)	5.22
Clay (%)	5	Organic matter (%)	39.52	Total N (%)	0.45
Texture	Sand	Organic carbon (%)	22.04	Total P (%)	0.074
pH (1:2.5)	8.18	Total N (%)	1.13	Total K (%)	2.17
EC (dSm-1)	2.07	C/N ratio	19.5	Calcium (%)	0.65
Calcium carbonate (%)	11.88	Total P (%)	0.91	Sodium (%)	0.18
Organic matter (%)	0.98	Total K (%)	0. 74	Sulfur (%)	0.45
Total N (%)	0.032				
Available P (mg/ kg)	7.14				
Available K (mg /kg)	241.5				

Table (2) The different treatments used in the experiments

Treatment No.	Treatment content
T0	Control
T1	Yeast+ Molasses
T2	APB + Molasses
T3	APB + Yeast+ Molasses
T4	FYM 10g/kg soil
T5	FYM 10g/kg soil + Yeast+ Molasses
T6	FYM 10g/kg soil + APB + Molasses
T7	FYM 10g/kg soil + APB + Yeast+ Molasses
T8	FYM 20 g/kg soil
T9	FYM 20 g/kg soil + Yeast+ Molasses
T10	FYM 20 g/kg soil + APB + Molasses
T11	FYM 20g/kg soil + APB + Yeast+ Molasses
T12	FYM 30 g/kg soil
T13	FYM 30 g/kg soil + Yeast+ Molasses
T14	FYM 30 g/kg soil + APB + Molasses
T15	FYM 30g/kg soil + APB + Yeast+ Molasses

APB =Acid producing bacteria and FYM = Farmyard manure

Then 20 ml of this mixture were added to the pots of yeast+ molasses treatments. Moreover, 10 mL of the dilute APB inoculum, and 20 mL of the yeast and molasses mixture were applied to the pots of APB + Yeast+ molasses treatments. All pots were directly irrigated after applying all treatments. The control treatment was carried out without applying any amendment to the pots. Each microorganism treatments were replicated three times during the experiment time. At the time of planting, the pots were fertilized by superphosphate (15.5% P2O5) at a level of 200 kg/fed (2.4g / pot). In addition, ammonium nitrate (33.5 % N) at a level of 364 kg/fed (4.3 g / pot) and potassium sulphate (48% K2O) at a level of 50 kg/fed (0.6 g / pot) were applied after two weeks from planting. All experimental treatments and agricultural practices for growing wheat that were applied at the first season were also carried out in the second season. After 70 days from planting, the plants were harvested from each pot, plants washed using deionized water, air dried for two days and oven-dried at 70 ^{o}C for 48 hrs, then the plant dry weight was recorded. Plant samples for all pots were saved for chemical analysis. Moreover, after harvest, a soil samples were collected from each pot, air-dried, crushed with a wooden roller, sieved to pass through a 2 mm sieve and kept for analysis.

Soil analysis.

The particle-size distribution was carried out by the pipette method (Richards, 1954; Jackson, 1969) and the corresponding textural class was determined from the USDA textural class triangle. The inorganic carbonate content (% $CaCO_3$) was estimated by a Collins calcimeter according to Jackson (1973) and USDA (1996). The soil organic carbon content was determined according to the modified (Walkely and Black method USDA, 1996). The soil pH in a 1: 2.5 ratio of the soil to water suspension was measured using a digital pH meter. The electrical conductivity (EC) of the 1:5 ratio of soil to water extract was estimated using an electrical conductivity meter (Jackson, 1973). However farmyard manure pH and EC were measured in 1:10 (w/v) of water suspensions and extracts respectively after 1 h shaking (Teutscherova et al. 2018). The available phosphorus was extracted by 0.5 M $NaHCO_3$ at pH 8.5 (Olsen et al. 1954) and spectrophotometrically determined according to Jackson (1973). The available potassium was extracted with 1 N ammonium acetate at pH 7.0 and determined using the flame photometer (Jackson, 1973). The total soil nitrogen was determined using the microkjeldahl method as described by Jackson (1973).

Plant and Organic Amendment

A sample of 0.5 g of the dried plant material or organic amendment (FYM or molasses) was digested using a 20 :5 mixture of sulfuric acid to hydrogen peroxide and then potassium, phosphorous and nitrogen were determined in digests using the methods as described for the soil analysis.

Calculation of NPK uptake and use efficiencies

Total NPK uptake by plant using the following:

$$\text{N, P or K uptake (mg pot}^{-1}) = \frac{\text{N, P or K concentration (mg kg}^{-1}\text{) in plant part (dry matter)} \times \text{dry biomass (g pot}^{-1})}{1000}$$

The calculate of NPK use efficiency according to (Dobermann 2005) was as follows:

$$\text{N, P or K use efficiency} = \frac{\text{harvest product at applied N, P or K mg pot}^{-1}}{\text{amount of phosphorus applied, mg N, P or K pot}^{-1}} = \text{mg biomass per mg N,P or K}$$

Statistical analyses

All data were analyzed using MSTAT-C (Russell, 1994) and the treatment means were compared by Least significant difference (LSD) test at 0.05 and 0.01% probability levels.

Results and Discussion

Effects of soil applications of farmyard manure (FYM) alone or combined with acid producing bacteria (APB) and yeast with the addition of molasse as a stimulant on improving the properties of the calcareous sandy soils, nutrient availability, plant growth, nutrient uptake and nutrient use efficiency by the wheat plant were discussed throw the next results .

Soil properties

The changes in the soil salinity (EC), pH, calcium carbonate ($CaCO_3$%) content and organic matter (OM%) content induced by the investigated treatments are shown in Figure 1.

Soil salinity

Electrical conductivity (EC) of the soil extract is a measure of the amount of salts in soil and it is an important indicator of soil health. Applying most treatments, the soil EC in increased comparison with the control treatment (Figure 1). Increasing the added amount of the farmyard manure resulted in increases in the soil EC because of its high content of soluble salts. Forster et al. (2006), Lakhdar (2009) and Barka et al (2018*)* found that, the compost application to the soil increased its, EC due to its high contents of soluble Mg, Ca and Cl. In addition, the decomposition of organic amendments with time affects on the increases the dissolution of the soil salts. All treatments in the second season decreased the soil EC. That could be due to leaching the soluble salts with irrigation water. Abo-baker (2017) showed that EC of the reduction of the soil amended with different organic amendments could be attributed to the emerged organic acids from OM decomposition that accelerate the loss of soluble salts with irrigation water. On the other hand, microbial (APB and Yeast) treatment did not show clear effect on the soil salinity.

Soil pH

After the first season, all treatments significantly decreased the soil pH compared to the control treatment. Lowest soil pH values of 7.35, 7.53, 7.56 and 7.65 were found with 30 g FYM /kg soil (T12), 30 g FYM /kg soil + APB + molasses (T14), FYM 10g/kg soil + APB + Yeast+ molasses (T15) and FYM 10g/kg soil + APB + molasses (T6) respectively (Fig.1). On the other hand, reductions were recorded in the soil pH after the second season compared to those of the first season. The pH values after the second season were 7.38, 7.44, 7.39 and 7.48 with T12, T14, T15 and T6 treatments, respectively. Moreover, increasing the level of FYM in all treatments resulted in decreases in the soil pH (Figure 1).

The reductions in the soil pH in the first and second seasons were more obvious under FYM applications combined with microorganisms' treatments. On the other hand, the control treatment exhibited the highest soil pH values. The reduction in the soil pH, depends upon of the progress of decomposition and oxidation of organic compounds in the soil Moreover, se reductions in the soil pH that occurred after the first and second seasons may be attributed to the activity of soil microorganisms producing CO_2 and root exudates during the decomposition of organic matter. These results are in an agreement with those of Kabirinejad et al. (2014), Abo-baker (2017) and Barka et al (2018).

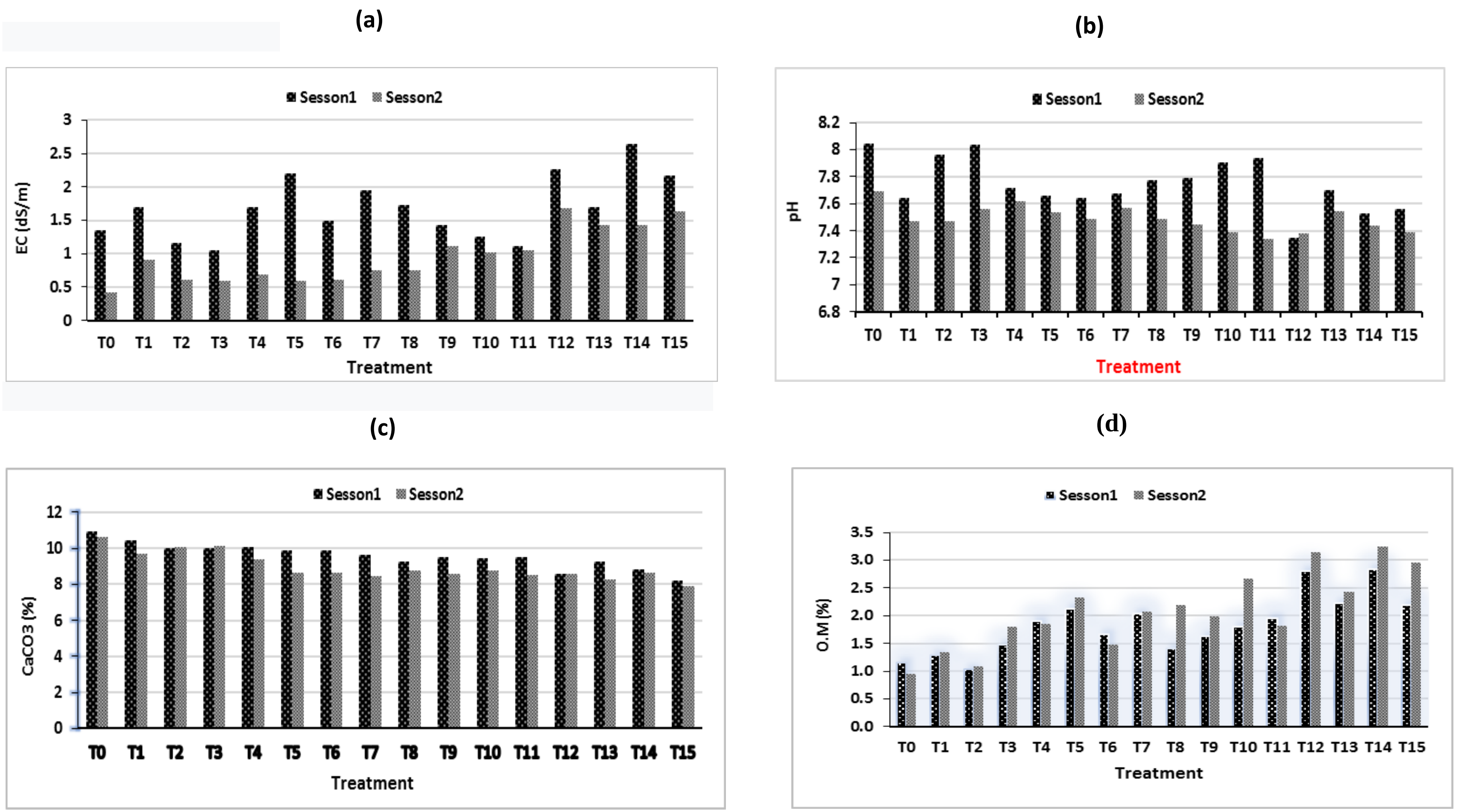


Figure 1: Effect of applying FYM alone or in combination with APB + molasses or yeast+ molasses and their mixture on EC (a), soil pH (b), Soil calcium carbonate (% $CaCO_3$) content (c) and Organic Matter (OM %) content (d)

Also acid-producing bacteria and yeasts contribute to reducing the soil pH through producing organic acids during the mineralization of organic material (Zhang et al., 2000; Han and Lee, 2005; Westerman and Bicudo 2005; Batha ,2011; Vieira et al., 2016 and Xi et al., 2019).

Soil calcium carbonate (CaCO3) content

All investigated treatments significantly decreased the soil calcium carbonate (CaCO3) content compared to the control treatment in both growth seasons (Fig. 1). After the first season, the $CaCO_3$ content decreased from 11.88 % in the soil before wheat planting to 9.82, 8.60, 9.29, 8.83 and 8.19 % with applying T8, T12, T13, T14 and T15 treatments, respectively. In addition, these decrease calcium carbonate decreases continued after the second season for those previous respected treatments. exhibiting more CaCO3 reduction of 8.76, 8.59, 8.29, 8.63 and 7.87% respectively. The decrease in the soil $CaCO_3$ content varied according to the amount of farmyard manure (FYM) and the applied type of microorganisms (APB and yeast) Indicated that, increasing the added FYM level increased the reduction in soil $CaCO_3$ content. Furthermore, 30g FYM /kg soil + APB + yeast+ molasses (T12) treatments gave a significant decrease in the soil $CaCO_3$ content compared to the other treatments. The negative effect of FYM on the soil $CaCO_3$ content is attributed mainly to the microbial activity in decomposing the organic matter, producing CO_2 and organic acids that react and dissolve the calcium carbonate of the soil. These results agree with those reported by Chun et al (2007), Abo-baker (2017) and Villarreal Sanchez et al. (2018).

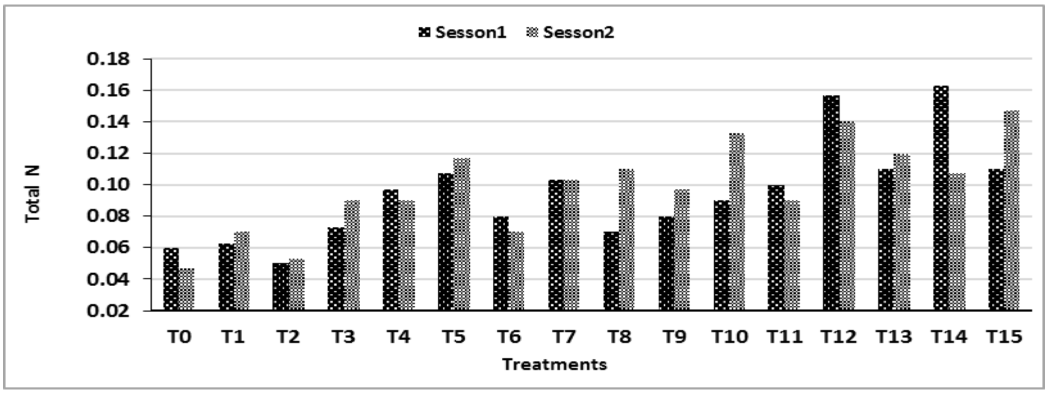
Soil organic matter (OM) content

The sole application of FYM alone or combined with yeast + molasses or APB+ molasses and their mixture significantly enriched the organic matter content of the soils compared to the control treatment (Figure 1). After the first season, the soil organic matter content reached 2.84, 2.80, 2.23 and 2.20% for T14, T12, T13 and T15 treatments, respectively higher than the control (T0). Similarly, after the second season, these treatments in the same sort showed highly significant soil OM increases of 3.24, 3.14, 2.43 and 2.95 % respectively, compared to (T0). Furthermore, increases in soil organic matter content occurred with increasing the FYM level in both seasons. These results in harmony with those of Rehan et al. (2004), Youssef, (2011), Hadad et al. (2015) and Abo-baker (2017)**.** In some treatments, the application of APB + molasses, yeast+ molasses or their mixture combined with the same added level of FYM (T6, T11, T13 and T15) decreased the soil organic matter content compared to the sole application of FYM. This may be argued to use of organic matter as a carbon sources by microorganism that to produce organic. Rashid et al. (2004) and Abo-baker (2017) reported that, all acid-producing microorganisms strains utilize organic matter in the soil as a carbon sources during the production of organic acids.

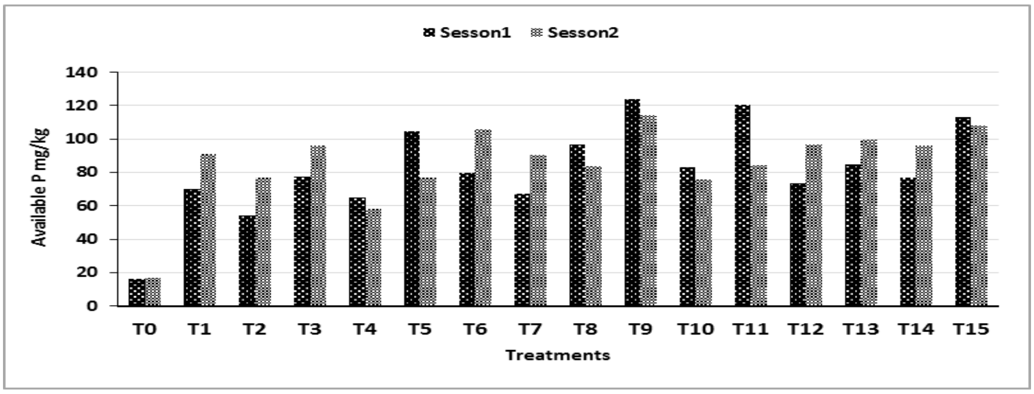
Total N, Available P and Available K contents in soil.

The effect of applied FYM alone or even incorporated with APB + molasses, yeast+ molasses and their mixture on the total soil nitrogen, available phosphorus and available potassium is illustrated in Figure 2.

(a)



(b)



(c)

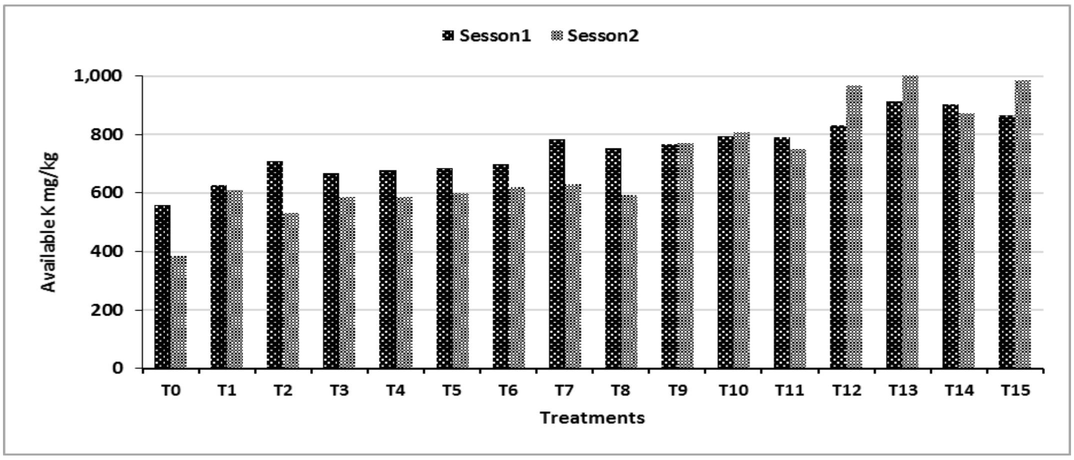


Figure 2: Effect of FYM alone or in combination with APB + molasses, yeast+ molasses or their mixture on the total N (a), available P (b) and available K (c) contents in soil.

Total N

The sole addition of FYM or blended with APB + molasses, yeast+ molasses or their mixture significantly had resulted in an increase of the total soil N content after each growth season (Figure 2.).

After the first season, the maximum total nitrogen content was recorded in the soil treated with 30 g FYM /kg soil (T12), 30 g FYM /kg soil + APB + molasses (T14). 30 g FYM /kg soil + yeast+ molasses (T13) and 30g FYM /kg soil + APB + Yeast+ molasses (T15) giving total N values of 0.16, 0.16, 0.11 and 0.11 % respectively. On the other hand, applying these treatments in the second season resulted in respective total N values of 0.14, 0.11, 0.12 and 0.15 % after wheat growth . In general, the increase in the total soil N content were associated with increasing the farmyard manure addition level. However, microorganisms (APB and Yeast) treatments without FYM application did not show a clear effect on the soil N content. Mineralization of organic materials in FYM fertilizer may be responsible for increasing the availability of plant nutrients in the soil, such as total N (Eghball, 2002, Gutser et al. 2005 , Herencia et al. 2007, Melero-Sanchez et al., 2008, Aboukila et al. 2018).

Available soil phosphorus

The available soil phosphorus significantly increased with applying FYM alone or in combination with APB + molasses, yeast+ molasses and their mixture (Figure 2). After the first season, the available phosphorus in the soil treated with 20 g FYM /kg soil + yeast+ molasses (T9), 20g FYM /kg soil + APB + yeast+ molasses (T11), 30g FYM /kg soil + APB + yeast+ molasses (T15), 10g FYM /kg soil + Yeast+ Molasses (T5) increased from 16.44 mg/kg for the control to 123.79, 120.54, 112.93 and 104.55 mg/kg, respectively. and from 16.44 to 96.57, 84.91, 83.03, 79.13 and 77.13 mg/kg for the soil amended with 20 g FYM /kg soil (T8), 30 g FYM /kg soil + yeast+ molasses (T13) , 20 g FYM /kg soil + APB + molasses (T10) 10g FYM /kg soil + APB + molasses (T6) and 30 g FYM /kg soil + APB + molasses (T14) respectively. After the second season, a similar trend por the available P was recorded as that of the first one, which the available soil phosphorus significantly increased as a result of applying these treatments compared to the control one (Figure 2). The phosphorus released for the organic matter decomposition as well as the soil P that became available due to decomposit products effects are responsible for increasing the soil p availability for plants. Inorganic and organic acids and CO2 produced from the decomposition of organic matter and APB resulting the organic matter as well as the reduction in pH as a in soil pH reduction have significant effects in increasing the phosphorus availability in the soil (Das et al.,2008; El-Meselawe, 2014; Abo-baker 2017; Abou hussien et al, 2019). In most cases, addition of APB + molasses or yeast+ molasses or their mixture with FYM increased the available P more than using addition of FYM alone. In addition, using yeast+ molasses or yeast +APB +molasses with FYM increased the available P more than addiner the APB + molasses with FYM. Therefore, APB play an important role in increasing the availability of P in soil through the production of organic and inorganic acids, as well as CO2. These products help to convert the insoluble forms of P into soluble ones. Similar results were obtained by Han and Lee, (2005) and Abo-baker (2017). Also, yeasts play a role to solubilize insoluble phosphates, because they use molasses and organic matter as a carbon source to produces organic acids, lower the soil pH and dissolve the calcium phosphate in calcareous soils. Yeast encourages on microbial growth resulting in improving the soil properties of the rhizosphere and so increasing of phosphorus availability in the soil. These results are in are agreement with those found by Batha (2011), Vieira, et al. (2016) and Xi et al (2019).

Available soil potassium

The available potassium in the soil significantly increased after both growth seasons with applying of FYM alone or integrated with APB + molasses, yeast+ molasses or their mixture (Figure 2). The highest available K levels in the soil after season were for 30 g FYM /kg soil + yeast+ molasses (T13), 30 g FYM /kg soil + APB + molasses (T14) which recorded 913.09 and 903.11 mg/kg respectively compared to the control treatment (558.05 mg/kg). Moreover, after the second season, the highest levels of the available K were obtained from 30 g FYM /kg soil + yeast+ molasses (T13), 30g FYM /kg soil + APB + yeast+ molasses (T15) and 30 g FYM /kg soil (T12) treatments which recorded 1028.61, 984.69 and 968.40 mg/kg, respectively. Generally, it could be concluded that, the available K of the soil increased with increasing the addition level of FYM. These increases in the available K could be due to the release of K during the mineralization of organic materials (Ahmed and Ali, 2005; Abo-baker, 2017). In addition, applying FYM combined with APB + molasses, yeast+ molasses or their mixture gave more available K increases than using FYM alone. Molasses contains pronounced amounts of K. Moreover, during organic matter decomposition, bacteria or yeast decrease the soil pH by producing inorganic and organic acids that enhances the release K of soil minerals (mica and feldspar). The agree with those obtained by Goldstein (1994) Uroz et al. (2009) Zarjani et al. (2013) Rashid et al (2016).

Dry matter yield of wheat plants

The dry matter of wheat plants which is the weight of plant material after the moisture within the plant material has been extracted. It is an indicator for the plant responses to the studied treatments. In the first and second season, the dry matter yield was significantly increased by the applications of FYM alone or incorporated with APB + molasses, yeast+ molasses or their mixture (Table 3). The highest amounts of the dry matter yield in the first season were obtained for T15, T14, T13 which were 14.84, 13.93 and 13.79 g/pot respectively. While the dry matter yield in the control treatment was 2.10 g/pot. The treatments with the same previous sort showed dry matter yield of 27.76, 27.44 and 24.62 g/pot in the second season. While the control treatment gave 5.79 g/pot. They may be attributed to the fact that the application of organic materials improves the physico-chemical and biological characteristics of the soil as well as its fertility status resulting in high wheat growth. This provides an active environment for plants and helps to improve the plant growth. In this regard, Abo-baker (2017) stated that applying filter mud cake or farmyard manure as organic amendments decreases the total dry matter yield of wheat plants. In most cases, the application of FYM combined with APB + molasses, yeast+ molasses or their mixture significantly increases the dry matter yield of wheat plants compared to that of FYM alone. Bacteria and yeast have beneficial return to increase the dry matter yield of wheat plant. They directly enhance the plant growth through various they produce that not only enhance the mobilizing of the nutrients but also help to solubilize insoluble unavailable forms of nutrients compounds resulting an increased nutrients availability in the soil.

Table.3: Application effects of FYM alone or combined with APB + molasses, yeast+molasses or their mixture on the dry matter yield (g/pot) and the uptake of N,P and K (mg/pot) by wheat plants during the 2018/2019 and 2019/2020 winter seasons.

	Dry matter (g/pot)		**N uptake (mg/pot)**		**P uptake (mg/pot)**		**K uptake (mg/pot)**	
Treatments	**Sesson1**	**Sesson2**	**Sesson1**	**Sesson2**	**Sesson1**	**Sesson2**	**Sesson1**	**Sesson2**
				Organic treatments				
F1=0 FAM	**4.22**	**7.11**	**13.38**	**19.69**	**1.59**	**2.27**	**3.05**	**5.50**
F2=FYM 10g/kg soil	**12.22**	**18.63**	**33.24**	**56.06**	**5.07**	**6.96**	**10.38**	**14.31**
F3=FYM 20 g/kg soil	**12.12**	**21.61**	**40.68**	**64.54**	**5.63**	**8.48**	**10.24**	**16.31**
F4= FYM 30 g/kg soil	**13.44**	**23.82**	**44.94**	**70.44**	**6.40**	**11.94**	**12.93**	**22.00**
LSD 0.05	**0.69**	**0.84**	**3.14**	**6.28**	**0.60**	**0.54**	**1.00**	**1.06**
LSD 0.01	**0.93**	**1.13**	**4.23**	**8.46**	**0.81**	**0.73**	**1.35**	**1.43**
				Biological treatments				
B1= Non	**8.95**	**12.84**	**28.57**	**39.53**	**3.88**	**5.19**	**7.48**	**9.92**
B2=Yeast+ Molasses	**10.99**	**18.22**	**34.67**	**57.74**	**4.79**	**7.77**	**9.62**	**15.58**
B3=APD + Molasses	**10.70**	**19.86**	**31.76**	**56.80**	**4.44**	**8.38**	**9.07**	**15.58**
B4=APD + Yeast+ Molasses	**11.38**	**20.23**	**37.24**	**56.66**	**5.58**	**8.32**	**10.43**	**17.05**
LSD 0.05	**0.69**	**0.84**	**3.14**	**6.28**	**0.60**	**0.54**	**1.00**	**1.06**
LSD 0.01	**0.93**	**1.13**	**4.23**	**8.46**	**0.81**	**0.73**	**1.35**	**1.43**
				Interaction between F x B				
F1B1 (T0)	**2.10**	**5.79**	**6.45**	**16.52**	**0.77**	**1.55**	**1.39**	**3.74**
F1B2 (T1)	**4.23**	**4.99**	**13.47**	**13.95**	**1.70**	**1.73**	**3.28**	**4.20**
F1B3 (T2)	**5.38**	**8.20**	**15.81**	**24.46**	**1.83**	**2.33**	**3.83**	**6.56**
F1B4 (T3)	**5.17**	**9.45**	**17.79**	**23.83**	**2.05**	**3.47**	**3.72**	**7.51**
F2B1 (T4)	**9.78**	**14.45**	**26.94**	**36.23**	**4.02**	**5.08**	**7.86**	**9.97**
F2B2 (T5)	**13.76**	**20.64**	**36.91**	**68.46**	**5.38**	**8.45**	**12.50**	**16.70**
F2B3 (T6)	**12.38**	**18.15**	**37.02**	**46.95**	**5.55**	**6.19**	**10.42**	**12.18**
F2B4 (T7)	**12.97**	**21.27**	**32.09**	**72.59**	**5.34**	**8.13**	**10.72**	**18.38**
F3B1 (T8)	**12.69**	**15.69**	**43.39**	**47.25**	**5.69**	**6.26**	**10.51**	**12.71**
F3B2 (T9)	**12.16**	**22.63**	**41.00**	**71.24**	**6.18**	**8.92**	**10.69**	**19.71**
F3B3 (T10)	**11.11**	**25.65**	**34.08**	**80.98**	**4.10**	**10.64**	**9.13**	**17.41**
F3B4 (T11)	**12.53**	**22.45**	**44.23**	**58.70**	**6.56**	**8.11**	**10.65**	**15.42**
F4B1 (T12)	**11.22**	**15.44**	**37.51**	**58.10**	**5.02**	**7.86**	**10.18**	**13.24**
F4B2 (T13)	**13.79**	**24.62**	**47.28**	**77.32**	**5.90**	**11.98**	**12.03**	**21.69**
F4B3 (T14)	**13.93**	**27.44**	**40.11**	**74.80**	**6.29**	**14.38**	**12.89**	**26.19**
F4B4 (T15)	**14.84**	**27.76**	**54.87**	**71.54**	**8.37**	**13.54**	**16.62**	**26.89**
LSD 0.05	**1.39**	**1.68**	**6.29**	**12.56**	**1.21**	**1.09**	**2.00**	**2.12**
LSD 0.01	**1.87**	**2.26**	**8.47**	**16.91**	**1.63**	**1.47**	**2.69**	**2.85**

They also improve the properties of the calcareous soil by dissolving the calcium carbonate. Yeasts play a role in soil aggregate formation and maintenance of soil structure, as well as they produce substances that stimulate plant development. Molasses contain different nutrients and some organic materials that are considered as an important source of nutrients for microorganisms and plants. The obtained results are compatible with those of Glick (1995), Singh et al. (2010), Shah (2010) and Abo-baker (2017). The dry matter yield of wheat plants after second season, was higher than that of the first season. It could be a result of the positive effects of the studied treatments. The potential positive effects could be improving the chemical and biological characteristics, and the nutrient status of the calcareous soil, as well as increasing the abundance, biodiversity and activity of microorganisms in the soil.

Uptake of N, P and K

Uptakes of N, P and K by wheat plants planted in the soil amended with the FYM with or without APB + molasses, yeast+ molasses and their mixture during both growth seasons are considered an indication of the treatment effects on the nutrients' availability of the soils. Significant increase in the amounts of N, P and K taken up by wheat plants grown in both seasons as a result of applying FYM alone or with APB + molasses, yeast+ molasses or their mixture. In the first season the highest uptake values of N, P and K by wheat plants were recorded for 30g FYM /kg soil + APB + yeast+ molasses treatment (T15) which displayed 54.87, 8.37 and 16.62 mg / N, P and K / pot, respectively and 30 g FYM /kg soil + APB + molasses treatment (T14) that exhibited 40.11, 6.29 and 12.89 mg N, P and K / pot, respectively. Moreover, in the second season, wheat plants showed a higher assimilation capacity for N, P and K uptake than of the first season. In the second season, gave higher uptake values of N, P and K by wheat plants were recorded which they were 71.54, 13.54 and 26.89 mg N, P and K / pot, respectively for T15 treatment and 74.80, 14.38 and 26.90 mg N, P and K / pot, respectively for T14 treatment. The response of NPK uptakes by the grown plants was more pronounced with the application of FYM combined with APB + molasses or yeast+ molasses and their mixture compared to applying FYM alone. The addition of organic amendments increases the metabolic activity in the plants and the migration of the metabolites through the root and stems toward the leaves, producing nutrients increases in leaves and stems. Also, yeast and APB produce of some substance and enzymes that can promote plant growth and increase the bioavailability of soil-borne nutrients whereby soil microbes metabolize recalcitrant forms of soil-borne nutrients to liberate these elements for plant nutrition. (Shteinberg and Datsyuk, 1985; Bonkowski, 2004; Kabesh et al., 2009; Richardson et al., 2009; Jacoby et al. 2010; Abo-baker, 2017).

Nitrogen, Phosphorus and Potassium Use Efficiency

The nutrient efficiency has been used as a measure of the capacity of a plant to uptake and utilize nutrient for biological and grain yield. So, it is taken as an indicator for the response of plants to the combined application of farmyard manure (FYM) with APB + molasses, yeast+ molasses or their mixture. In the first and second season, the N, P and K use efficiencies significantly increased with using FYM alone or with APB + molasses, yeast+ molasses or their mixture (Table 4). The highest N, P and K use efficiencies in the first season were obtained for T15 which were

Table 4: Effect of applying FYM alone or in combination with APB + molasses or yeast+ molasses and their mixture on nitrogen (N), Phosphorus (P) and Potassium (K) use efficiency (UE).

Treatments	NEU (mg biomass/ mg N)		PEU (mg biomass/ mg P)		KEU (mg biomass/ mg k)	
	Sesson1	Sesson2	Sesson1	Sesson2	Sesson1	Sesson2
Organic treatments						
F1=0 FAM	2.87	4.83	25.86	43.61	15.28	25.76
F2=FYM 10g/kg soil	8.31	12.66	74.99	114.28	44.29	67.49
F3=FYM 20 g/kg soil	8.24	14.69	74.37	132.55	43.92	78.28
F4= FYM 30 g/kg soil	9.14	16.19	82.48	146.12	48.71	86.30
LSD 0.05	0.47	0.57	4.25	5.13	2.51	3.03
LSD 0.01	0.63	0.76	5.72	6.90	3.38	4.08
Biological treatments						
B1= Non	6.08	8.73	54.87	78.79	32.42	46.53
B2=Yeast+ Molasses	7.47	12.39	67.39	111.79	39.80	66.02
B3=APD + Molasses	7.27	13.50	65.63	121.85	38.76	71.96
B4=APD + Yeast+ Molasses	7.73	13.76	69.80	124.13	41.22	73.31
LSD 0.05	0.47	0.57	4.25	5.13	2.51	3.03
LSD 0.01	0.63	0.76	5.72	6.90	3.38	4.08
Interaction between F x B						
F1B1 (T0)	1.43	3.94	12.82	35.54	7.61	20.99
F1B2 (T1)	2.87	3.39	25.93	30.63	15.31	18.09
F1B3 (T2)	3.65	5.57	32.99	50.31	19.48	29.71
F1B4 (T3)	3.51	6.43	31.70	57.97	18.72	34.24
F2B1 (T4)	6.65	9.82	60.02	88.63	35.45	52.34
F2B2 (T5)	9.36	14.03	84.42	126.62	49.85	74.78
F2B3 (T6)	8.42	12.34	75.95	111.35	44.86	65.76
F2B4 (T7)	8.82	14.46	79.59	130.51	47.00	77.08
F3B1 (T8)	8.63	10.66	77.83	96.24	45.97	56.84
F3B2 (T9)	8.27	15.39	74.62	138.86	44.07	82.00
F3B3 (T10)	7.55	17.44	68.14	157.38	40.24	92.95
F3B4 (T11)	8.52	15.26	76.87	137.73	45.40	81.34
F4B1 (T12)	7.63	10.50	68.83	94.74	40.65	55.95
F4B2 (T13)	9.37	16.74	84.60	151.06	49.96	89.22
F4B3 (T14)	9.47	18.65	85.44	168.34	50.46	99.42
F4B4 (T15)	10.09	18.87	91.04	170.33	53.77	100.59
LSD 0.05	0.95	1.14	8.53	10.30	5.04	6.08
LSD 0.01	1.27	1.54	11.49	13.87	6.79	8.19

10.09, 91.04 and 53.77 mg biomass/ mg N , P and K respectively, 9.47, 85.44 and 50.46 mg biomass/ mg N , P and K respectively, for T14 and 9.37, 84.60 and 49.96 mg biomass/ mg N , P and K respectively, for T13 compared to the control treatment which were 1.43 , 12.82 and 7.61 mg biomass/ mg N , P and K respectively. Furthermore, in the second season, higher for N, P and K use efficiency values were recorded than for the first season. The highest values of the N, P and K use efficiency in the second season were obtained for T15 which were 18.87, 170.33 and 100.59 mg biomass/ mg N , P and K, respectively, T14 which were 18.65, 168.34 and 99.42 mg biomass/ mg N , P and K, respectively and T13 which 16.74, 151.06 and 89.22 mg biomass/ mg N , P and K, respectively, compared to the control treatment which recorded 3.39 , 35.54 and 20.99 mg biomass/ mg N , P and K, respectively. Generally, The N, P and K use efficiencies were higher with the application of FYM combined with APB + molasses, yeast+ molasses or their mixture compared to applying FYM alone. The role ABD and yeast in plant growth promotion and improving the soil properties is known through producing substances to stimulate plant development and releasing organic acids not only to lower the soil pH but also to dissolve the calcium carbonate of the calcareous soils, they also help to convert the unavailable P forms to available ones through producing organic acids. In addition, Yeast and APB release phytohormones which enhance root branching and elongation increasing the root ability to absorb nutrients from the soil.Yeast also play a role in soil aggregate formation and maintenance of soil structure as well the mineralization of organic materials. (Jacoby et al. 2010 ; Zhang et al. 2000; Batha, 2011; Botha, 2011; Vieira, et al. 2016; Xi et al , 2019; Abo-baker, 2017).

Conclusion

From the above-mentioned results, it could be concluded that, all amendments examined in this research especially farmyard manure (FYM) with or without APB + molasses or yeast+ molasses and their mixture were effective in improving the soil physical and chemical properties of the calcareous soil and enhancing plant growth. The application of APB + molasses, yeast+ molasses and their mixture to the calcareous soil was highly effective in reducing the soil pH and calcium carbonate as well as increasing the organic matter, total N, available P and K , germination parameters, N, P and K uptakes and N, P and K use efficiencies . The application of APB + molasses, yeast+ molasses or their mixture with farmyard manure (FYM) was more effective than using FYM alone in improving of calcareous soil properties and enhancing wheat growth. The best treatment in improving calcareous soil properties as well as increasing wheat growth and nutrient uptake and nutrient use efficiency was the farmyard manure combined with APB + yeast+ molasses especially when the farmyard manure is applied a level of 30 g/kg soil.

References

Abo-baker, A.A. (2017) "Successive Application Impact of Some Organic Amendments Combined with Acid Producing Bacteria on Soil Properties, NPK Availability and Uptake by Some Plants" *International Journal of Current Microbiology and Applied Sciences. 6(3): pp. 2394-2413*.

Abo–Baker, A.A. (2003) "Studies on mixed and single microbial inoculations of cultivated plants for improvement of growth and yield" *Ph.D. Thesis,* *faculty of agriculture, Assiut university Egypt.*

Abouhussien, E., Elbaalawy, A. M., and Hamad, M. (2019) "Chemical Properties of Compost in Relation to Calcareous Soil Properties and Its Productivity of Wheat" *Egyptian Journal of Soil Science 59(1): pp. 85-97.*

Aboukila, E. F., Nassar, I. N., Rashad, M., Hafez, M., & Norton, J. B. (2018) "Reclamation of calcareous soil and improvement of squash growth using brewers' spent grain and compost" *Journal of the Saudi Society of Agricultural Sciences 17: pp. 390–397.*

Abul-Soud, M., El-Ansary, D.O. and Hussein, A.M. (2010) "Effects of different cattle manure rates and mulching on weed control and growth and yield of squash" *Journal of Applied Sciences Research: 6 (9): pp. 1379–1386.*

Ahmad, N., Quresh, R.H. i and Qadir, M. (1990) "Amelioration of a calcareous saline-sodic soil by gypsum and forage plants" *Land Degradation and Rehabilitation, 2: pp. 277-284.*

Botha, A. (2011) "The importance and ecology of yeasts in soil" *Soil Biology and Biochemistry 43(1): pp. 1-8*

Kabirinejad, S., Kalbasi, M., Khoshgoftarmanesh, A. H., Hoodaji, M., & Afyuni, M. (2014) "Effect of incorporation of crops residue into soil on some chemical properties of soil and bioavailability of copper in soil" *International Journal of Advanced Biological and Biomedical Research, 2014. 2(11): pp. 2819-2824.*

Barka, H. A.F., Benzaghta, M. A and Kasheem, A. M. (2018) "Effect of Different Organic Matters on Chemical Properties of Calcareous Soil". *Sirte University Scientific Journal. Vol.8(2): pp. 101-110.*

Abo–Baker, A.A. (2011) "Improving Filter Cake Mud with Rock Phosphate and Biofertilizers for Exporting Organic Onion Production in Newly Cultivated Land at South Valley Area" *Australian Journal of Basic and Applied Sciences, 5(8): pp. 1354-1361, ISSN 1991-8178.*

Bonkowski, M. (2004) "Protozoa and plant growth: the microbial loop in soil revisited" *New Phytol. 162: pp. 617–631.*

Candemir, F. and Gulser, C. (2007) "Changes in some chemical and physical properties of a sandy clay loam soil during the decomposition of hazelnut husk." *Asian Journal of Chemistry3: pp. 2452-2460.*

Chaturvedi, S., Upreti, D. K., Tandon, D. K., Sharma, A., & Dixit, A. (2008) "Biowaste from tobacco industry as tailored organic fertilizer for improving yields and nutritional values of tomato crop." *Journal of Environmental Biology 29: pp 759-763.*

Chun, S., H. Rai, M. Nishiyama, S. Matsumoto. (2007) "Using Organic Matter with Chemical Amendments to Improve Calcareous Sodic Soil." *Communications in Soil Science and Plant Analysis, 38: pp. 205–216*

Das, K.; Dang, R. and Shivananda, T. N. (2008) "Influence of bio-fertilizers on the availability of nutrients NPK in soil in relation to growth and yield of Stevia rebaudianagrown in south India." *International journal of applied research in natural products 1(1): 20-24.*

Dobermann A.R. (2005) "Nitrogen Use Efficiency – State of the Art

Agronomy & Horticulture -- Faculty Publications, University of Nebraska, Lincoln.

Eghball, B. (2002) “Soil properties as influenced by phosphorus and nitrogen-based manure and compost applications*”. Agronomy Journal. 94: pp. 128–135.*

Elgabaly, M.M. (1973) “Reclamation and management of the calcareous soils of Egypt”. *In: FAO Soils Bulletin 21, Calcareous soils: report of the FAO/UNDP Regional Seminar on Reclamation and Management of Calcareous Soils, Cairo, Egypt, 27 Nov - 2 Dec 1972. FAO Soils Bulletin No. 21, pp. 123–127.*

Elgezery, M. Kh. (2016) “Effect of Organic Additives on Efficiency of Sulphur Fertilization” *M. Sc. Thesis, Faculty of Agriculture Menoufia University, Egypt.*

El-Hady, O.A. and Abo-Sedera, S.A. (2006) “Conditioning effect of composts and acrylamide hydrogels on a sandy calcareous soil”*I-Physico-bio-chemical properties of the soil. International Journal of Agriculture and Biology. 8 (6):pp 876–884.*

El-Meselawe, A.E.S (2014) “Effect of Bio-organic Sdditives on Phosphate Solubilization in Soils” *M. Sc. Thesis, Evaluation of Natural Resources and Planning for Their Development Department, Environmental Studies and Research Institute, Sadat City University, Egypt.*

Villarreal Sanchez, J. A., Diaz Jimenez, L., Escobedo Bocardo, J. C., Cardenas Palomo, J. O., Guerra Escamilla, N. E., and Luna Alvarez, J. S. (2018) “Effect of marine microorganisms on limestone as an. Approach for Calcareous Soil” *Sustainability 10, 2078; doi:10.3390/su10062078*

FAO (2016) “FAO Soils Portal: Management of Calcareous Soils” *<http://www.fao.org/soils-portal/soil-management/managementof-some-problem-soils/calcareous-soils/ar/> (accessed 01.04.16).*

Forster, R., Adami, C. and Wilke. C.O. (2006) “Selection for mutational robustness in finite populations”. *Journal of theoretical biology. 243(2): pp. 181-190.*

Glick, B. R. (1995) “The enhancement of plant growth by free-living bacteria” *Canadian Journal of Microbiology 41: pp. 109–117.*

Goldstein, A.H. (1994) “Involvement of the quinoprotein glucose dehydrogenase inthe solubilization of exogenous phosphates by gram-negative bacteria” *In:Phosphate in Microorganisms: Cellular and Molecular Biology. ASM Press,Washington, DC, pp. 197–203.*

Gutser, R., Ebertseder, T., Weber, A., Schraml, M., & Schmidhalter, U. (2005) “Short-term and residual availability of nitrogen after long-term application of organic fertilizers on arable land” *Journal of Plant Nutrition and Soil Science. 168: pp. 439–446.*

Hadad, H. M. (2015) “Studies on organic decomposition and release of nutrients and heavy metals in soils amended with some organic wastes” *Ph.D. thesis, Faculty of Agriculture, Assiut University, Egypt.*

Han, H. S. and Lee, K.D. (2005) “Phosphate and potassium solubilizing bacteria effect on mineral uptake, soil availability and growth of eggplant” *Research Journal of*

Agriculture and Biological Sciences,1 (2): pp 176-180.

Herencia, J. F., Ruiz-Porras, J. C., Melero, S., Garcia-Galavis, P. A., Morillo, E., & Maqueda, C. (2007) "Comparison between organic and mineral fertilization for soil fertility levels, crop macronutrient concentrations, and yield" *Agronomy Journal. 99: pp. 973–983.*

Jackson, M.L. (1969) "Soil chemical analysis-advanced course" *Published by author, Soil Sci. Dept., Wisconsin Univ., Madison, USA.*

Jackson, M.L. (1973) "Soil chemical analysis". *Prentice-Hall, Inc., Englewood Cliffs. NJ, USA*

Jackson, M.L. (1967) "Soil Chemical Analysis" *Prentice-Hall of India Pvt. Ltd., New Delhi, 498p.*

Jacoby, R., Peukert, M., Succurro, A., Koprivova, A., & Kopriva, S. (2017) "The Role of Soil Microorganisms in Plant Mineral Nutrition—Current Knowledge and Future Directions" *Soil Microorganisms in Plant Nutrition. 8: pp. 1-19*

Kabesh, M. O., El-Kramany, M. F., Sary, G. A., El-Naggar, H. M., & Gehan, S. H. B. (2009) "Effect of sowing methods and some bio-organic fertilization treatments on yield and yield components of wheat" *Research Journal of Agriculture and Biological Sciences, 5(1):pp. 97-102.*

Lakhdar, A., Rabhi, M., Ghnaya, T., Montemurro, F., Jedidi, N., and Abdelly, C. (2009) " Effectiveness of compost use in salt-affected soil". *Journal of hazardous materials, 171(1-3): pp. 29-37*

Schütz, L., Gattinger, A., Meier, M., Müller, A., Boller, T., Mäder, P., and Mathimaran, N. (2018) "Improving crop yield and nutrient use efficiency via biofertilization—A global meta-analysis" *Frontiers in Plant Science journal, 8, 2204: pp. 1-16*

Melero-Sanchez, S., Madejon, E., Herencia, J.F., Ruiz-Porras, J.C. (2008) "Long-term study of properties of a Xerofluvent and Guadalquivir River Valley under organic fertilization" *Agronomy Journal. 100: PP. 611–618.*

Mussatto, S.I., Dragone, G., Roberto, I.C. (2006) "Brewers' spent grain: generation, characteristics and potential applications" *Journal of Cereal Science. 43: pp. 1–14.*

Olsen, S.R., Cole, C.V. Watanabe, F.S. and. Dean. L.A. (1954) "Estimation of available phosphorus in soils by extraction with sodium bicarbonate" *U.S. Department of Agriculture Circ. 939.*

Qadir, M., Ahmad, N., Qureshi, R. H., Qasim, S. M., and Javaid, M. (1992) "Biochemical reclamation of a calcareous saline-sodic soil". *Pakistan Journal of Agricultural Sciences, 29: pp. 406-411.*

Rashid, M., Khalil, S., Ayub, N., Alam, S., and Latif, F. (2004) "Organic acids production and phosphate solubilization by phosphate solubilizing microorganisms (PSM) under in vitro conditions" *Pakistan Journal of Biological Sciences, 7(2): pp. 187-196.*

Rashid, M. I., Mujawar, L. H., Shahzad, T., Almeelbi, T., Ismail, I. M., and Oves, M. (2016) "Bacteria and fungi can contribute to nutrients bioavailability and aggregate formation in degraded soils" *Microbiological Research, 183 : pp . 26-41.*

Rehan, M. G., El-Sayed, A. H., Hassan, M. M., and Negm, M. A. (2004) "Direct and residual effect of mixing the added compost to calcareous soil with sulphur and phosphorus on crop yields and some soil properties" *Journal of Agricultural Science, Mansoura University, 29(3): pp. 1603-1614.*

Richards, L.A. (1954) "Diagnosis and improvement of saline and alkali soils" *USDA.Handbook, Washington, USA.*

Richardson, A. E., and Simpson, R. J. (2011) "Soil microorganisms mediating phosphorus availability" *Journal of Plant Physiology. 156: pp. 989–996.*

Russell, O.F. (1994) "MSTAT-C v.2.1 (A computer based data analysis software). Department of Crop and Soil Science" *Michigan State University, U.S.A.*

Shteinberg, B. I., and Datsiuk, N. M. (1985) "The nature of factors stimulating cobolaminogenesis in Achromobacter cobalamini". *Mikrobiologiya, 54: pp. 108–113.*

Singh, G., Biswas, D. R. and Marwaha, T. S. (2010) "Mobilization of potassium from waste mica by plant growth promoting rhizobacteria and its assimilation by maize (Zea mays) and wheat (Triticum aestivum L.): a hydroponics study under phytotron growth chamber" *Journal of plant nutrition, 33(8): pp. 1236-1251.*

Teutscherova, N., Houška, J., Navas, M., Masaguer, A., Benito, M. and Vazquez, E. (2018) "Leaching of ammonium and nitrate from Acrisol and Calcisol amended with holm oak biochar A column study" Geoderma *, 323: pp. 136-145.*

Uroz, S., Calvaruso, C., Turpault, M. P. and Frey-Klett, P. (2009) "Mineral weathering by bacteria: ecology, actors and mechanisms" *Trends in microbiology, 17(8): pp. 378-387.*

USEPA. (1996) "Recent developments for in situ treatment of metals contamination soils" *U.S. Environmental Protection Agency Office of solid waste and emergency response.*

Vieira, E.F., Carvalho, J., Pinto, E., Cunha, S., Almeida, A. and Ferreira, I. (2016) "Nutritive value, antioxidant activity and phenolic compounds profile of brewer's spent yeast extract" *Journal of Food Composition and Analysis, l52: pp. 44–51.*

Wahba1, M. M., Labib, F. and Zaghloul. A. (2019) "Management of Calcareous Soils in Arid Region" *International Journal of Environmental Pollution and Environmental Modelling, Vol. 2(5): pp. 248-258.*

Westerman, P. W., and Bicudo, J. R. (2005) "Management considerations for organic waste use in agriculture". *Bioresource Technology, 96 (2): pp. 215-221.*

Xi, Q., Lai, W., Cui, Y., Wu, H., & Zhao, T. (2019) "Effect of Yeast Extract on Seedling Growth Promotion and Soil Improvement in Afforestation in a Semiarid Chestnut Soil Area" *Forests, 10(1), 76. doi:10.3390/f10010076*

Youssef, M.A. (2011) "Synergistic impact of effective microorganisms and organic manures on growth and yield of wheat and marjoram plants" *Ph. D. Thesis, Faculty of Agriculture/Assiut University, Egypt.*

Zarjani, J.K., Aliasgharzad, N., Oustan, S., Emadi, M. and Ahmadi, A. (2013) "Isolation and characterization of potassium solubilizing bacteria in some Iranian soils”. Archives of Agronomy and Soil Science. 59 (12): pp. 1713–1723.

Zhang, H.; Zhang, H. and Bi, H.J. (2000) “Research on yeast extract” *Chin. Condiment, 2: pp. 20–23.*