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# EFFECT OF RICE STRAW COMPOST, BIO AND N- MINERAL FERTILIZERS ON SOME SOIL CHEMICAL PROPERTIES, MAIZE YIELD AND ITS COMPONENTS

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## ABSTRACT

A filed experiment was conducted at Ismailia Agric. Res. Station to evaluate the effect of the application of rice straw compost, bio- fertilizers (EM and $N_2$ – fixers) and N – mineral fertilizers (ammonium sulphate or urea), which added alone or in combination to sandy soil - on some soil chemical properties, growth and yield of Zea maize cv. single cross 10 Hybrid. The obtained data revealed that application of compost plus effective microorganisms (EM) to sandy soil has a considerable effect on decreasing soil pH.

Data also explained that salinity expressed as EC dS/m and soluble ions increased due to $N_2$ – fixers application. Organic matter percent, cation exchange capacity and exchangeable cations also increased after the use of compost combined with EM and/ or $N_2$ -fixer addition. It is of worth to mention that application of compost alone or in combination with bio-fertilizers to sandy soil resulted in improving the native supplying power of the necessary nutrients in soil solution. We can also concluded that application of compost in combination with EM and recommended dose of ammonium sulphate was superior treatment in increasing grain and stover yields, plant height and weight of 100 - kernels, contents and uptake of nutrients of Zea maize cultivated in sandy soil.

**Keywords***:* Sandy soil, compost, N- mineral fertilizers, effective microorganisms EM, $N_2$ – fixers and maize production.

## INTRODUCTION

Sandy soil occupies the majority of desert areas in Egypt. Also, the main mechanical constituent of this sand soil is the sandy fraction, which is not partially capable to retain neither water nor nutrients for growing plants. Accordingly, these soils are poor not only in the nutrient- bearing minerals, but also in organic matter, which are a nutrients storehouse for the essential plants (Metwally and Khamis, 1988). Taalab (1999) stated that the addition of organic wastes and compost to sandy soil increased its organic matter content. Kedar *et al*. (2005) showed that the uptake of N, P and K by corn seed and stover were significantly highest with farmyard manure application at the rate of 5 ton/ha. Shaban and Omar (2006) reported that the content of N, P and K in maize grain was increased due to application of bio- fertilizers and N- mineral fertilizers to soil. Bruns and Ebelhar (2006) reported that nitrogen fertilizers applied at different rates to soil increased micronutrient uptake by maize grains as compared to untreated plants. Ramu and Reddy (2007) noticed that the application of nitrogen fertilizers up to 240 kg / ha to soil increased N, P and K uptake by maize grains. Mohamed *et al.* (2008) showed that the content of N, P and K in maize grains was significantly increased upon application of organic manure, micronutrients and bio-fertilizers to loamy sandy soil. Ewees *et al*. (2008) demonstrated that weight

of 100-grains of maize increased significantly as a result to application of organic manure plus bio- fertilizers to sandy soil. Ashmawe *et al*. (2008) observed that applying organic manure, bio- fertilizers and N- mineral fertilizers to soil increased of Fe, Mn, Zn and Cu contents of maize grain and straw. Shaban and Attia (2009) explained that application of bio- fertilizers in combination with chemical fertilizers to soil gave the highest values of Fe, Mn, Zn and Cu uptake by maize grains and straw.

The current study deals with the efficient use of rice straw compost, bio-fertilizers (effective microorganisms and $N_2$-fixers) and N-mineral fertilizers (ammonium sulphate and Urea) added alone or in combination to sandy soil on some soil chemical properties, growth and yield of Zea maize.

## MATERIALS AND METHODS

A field experiment was carried out in sandy soil located at El –Esmailia Agric. Res. Station to evaluate the effect of mineral fertilizers and rice straw compost added alone or in combination with some certain micro- organisms (EM) and $N_2$- fixers (NF), on some soil chemical properties, growth and yield of maize plants.

Upper 30 cm layer soil samples were collected before planting. Soil samples were air dried ground, sieved through a 2 mm sieve and kept in dry containers for analysis according to the methods described by Black (1965). Grains of maize (Zea maize cv. single cross 10 Hybrid) were used as indicator plants. Some physical and chemical properties of the studied soil samples are presented in Table (1).

The experimental design was split split-plot with three replicates. The applied rice straw compost and bio- fertilizers, i.e., (EM or $N_2$ - fixers) treatments are located in the main plots, mineral fertilizers (ammonium sulphate 20.6 % N or urea 46.5 % are located in the sub- plots and N-mineral fertilizer rates ,i.e., Half dose and full dose (1/2R, R) distributed in the sub-sub plots.

**The treatments located at:-**

1- Rice straw compost added alone at rate of 13 tons / fed.
2- Rice straw compost at rate of 13 tons / fed plus EM solution (at rate of 2 L / ton for one time before plantation
3- Rice straw compost at rate of 13 tons / fed plus $N_2$- fixers solution (at rate of 2 L / ton for one time before plantation
4- Effective microorganisms (EM) at rate of 10 L / fed, every two weeks (6 time in three months).
5- $N_2$-fixers solution at rate of 10 L / fed every two weeks (6 time in three months).
6- N- mineral fertilizers, ammonium sulphate, (20.6 % N) or urea (46.5 % N) at rates of :

a- Half recommended dose (1/2R) equal 291 and 130 kg / fed from $(NH_4)SO_4$ and urea respectively.
b- Full recommended dose (R) equal 582 and 260 kg / fed from $(NH_4)SO_4$ and urea.

7- Control without organic, Bio-and mineral fertilization

**Table (1a): Main characteristics of the experimental soil**

| **Soil properties** | **Values** |
|---|---|
| *Particle size distribution*: | - |
| Coarse sand | 72.21 |
| Fine sand | 21.16 |
| Silt | 4.89 |
| Clay | 1.74 |
| Texture class | Sandy |
| *Exchangeable cations (c molc $kg^{-1}$ soil):* | - |
| Ca | 1.78 |
| Mg | 1.10 |
| Na | 0.37 |
| K | 0.18 |
| ESP | 10.72 |
| pH (1:2.5 soil extract) | 7.73 |
| ECe (dS/m, soil paste extract) | 0.15 |
| ***Soluble ions (m molc $L^{-}$):*** | - |
| $Ca^{++}$ | 0.48 |
| $Mg^{++}$ | 0.22 |
| $Na^{+}$ | 0.71 |
| $K^{+}$ | 0.08 |
| $CO_3^{--}$ | 0.00 |
| $HCO_3^{-}$ | 0.60 |
| $Cl^{-}$ | 0.55 |
| $SO_4^{--}$ | 0.34 |
| Total $CaCO_3$ % | 0.93 |
| Organic matte % | 0.09 |
| CEC (c molc $kg^{-1}$ soil) | 3.45 |
| ***Some available macro and micronutrients (mg/kg soil):*** | - |
| N | 15.85 |
| P | 2.42 |
| K | 39.70 |
| Fe | 3.46 |
| Mn | 0.89 |
| Zn | 0.52 |

**Table (1 b): Main characteristics of rice straw compost**

| | |
|---|---|
| pH (1:10 water extract ). | 6.53 |
| EC (dS $m^{-1}$, 1:10 water extract) | 3.62 |
| Organic matter % | 43.28 |
| Organic carbon % | 25.1 |
| C/N ratio | 16.77 |
| Total N % | 1.50 |
| Total P % | 0.31 |
| Total K % | 1.99 |
| Available Fe (mg/kg) | 142.55 |
| Available Mn (mg/kg) | 10.84 |
| Available Zn (mg/kg) | 5.76 |

**Table (1 C): Identification of Effective microorganisms (EM) and $N_2$ fixers**

| *Lactic acid bacteria* | *Photosynthetic bacteria* | *Yeasts* | *Ray fungi and fungi* | |
|---|---|---|---|---|
| *-Lactobacillus plantaru (ATCC 8014)* | *Rhadopseudo-monas plustris (ATCC17001)* | *-Saccharomyces cerevisiae (IFO 0203)* | *-Streptomyces albus* | |
| *-Lactobacillus casei (ATCC 7469)* | *-Radobacter sphaerodes (ATCC17023)* | *Candida utlitis* | *-Streptomyces albus* | |
| *Streptococcus lactis (IFO 12007* | - | - | **Fungi** *-Aspergillus oryzae* | |
| $N_2$- fixers | | | | |
| *Azospirillum lipoferum* | | *-Azotobacter chroococcum* | | |

Organic compost and ordinary superphosphate (15.5 % $P_2O_5$) at rate 200 kg/fed were thoroughly mixed with the soil surface during soil preparation. Nitrogen fertilizers and potassium sulphate fertilizer (50 kg / fed) were applied into two equal split doses, i.e., after 21 and 45 days from sowing. Where, EM and $N_2$ - fixers were sprayed around the plant stems after dilution with water at ratio of 1:500 v / v every two weeks. Maize seeds were planted on hills 20 cm, apart and rows at 70 cm, under sprinkler irrigation system with an interval of four days. Plants were thinned to one plant after ten days from planting.

After 120 days from sowing plant heights were estimated. Then matured maize plants were harvested, air-dried, separated to ears, stover and grains. Maize grains, stover yield and weight of 100 - kernels for each plot were determined and recorded. Samples of plant stems and seed were collected, oven dried and ground using a mill and kept for plant analysis. Soil samples were collected from each plot after harvest, air dried, crushed and passed through a 2.0 mm sieve and kept for soil analysis.

The obtained results were subjected to statistical analysis of variance according to Snedecor and Cochran, (1980) using Costat software (1985) and the treatment averages were compared using L.S.D at 0.05 levels of probability.

The soil and plant samples analysis were determined according to Richards (1954), Jackson (1976) and Piper (1950).

Main characteristics of rice straw compost and identification of effective microorganisms (EM) and $N_2$ -fixers were presented in Table (1a, b and c).

## RESULTS AND DISCUSSION

**I. Effect of compost, bio-fertilizers and N – mineral fertilizers on soil chemical properties:**

**a) Soil pH:**

Data presented in Table (2) showed that the application of compost and bio- fertilizers to sandy soil alone or in combination with N- mineral fertilizers decreased significantly the soil pH values compared to control. Data also explained that application of compost plus effective microorganisms (EM) or $N_2$ - fixing bacteria (NF) with ammonium sulphate at the rate of Full recommended dose was more effective in decreasing soil pH than the other tested treatments under investigation. The reduction of soil pH could be attributed to the production of organic acids especially from compost and EM during its decomposition processes and soluble $SO_4^{2-}$ ions released from ammonium sulphate fertilizers. These findings are confirmed by Ashmawe *et al.* (2008) who found that soil pH values were decreased after treating sandy clay soil due to the application of organic manure, bio- fertilizers and N-mineral fertilizers.

***b)*** **Soil salinity expressed as EC dS / m**

Results in Table (2) revealed that the greatest value for EC was 0.211 dS/ m was recorded due to $N_2$ - fixers treatment, while the lowest one

(0.164 dS/m) was obtained from the combined treatments (compost plus effective microorganisms (EM) as compared to the untreated one. This could be attributed to the effect of compost on soil chemical properties especially soil salinity, therefore, increasing soluble ions content. Similar results were obtained by Abdel- Aal (2009) who noticed that the addition of rice straw compost to calcareous soil resulted in increasing its electrical conductivity.

**Table (2): Effect of compost, bio-fertilizers and N- mineral fertilizers on soil pH and electrical conductivity in sandy soil extracts**

| Treatments | N- mineral fertilizers | | pH(1:2.5 soil water extract) | EC (dS/m) |
|---|---|---|---|---|
| | Source | Rate | | |
| Control | | 0.0 | 7.76 | 0.140 |
| Rice straw compost | Ammonium sulfate | 0.0 | 7.63 | 0.183 |
| | | ½ R | 7.54 | 0.198 |
| | | R | 7.39 | 0.203 |
| | Urea | 0.0 | 7.63 | 0.183 |
| | | ½ R | 7.62 | ٠,١٧٠ |
| | | R | 7.67 | ٠,١٨٧ |
| | Mean | - | 7.55 | ٠,١٨٩ |
| Rice straw Compost + EM | Ammonium sulfate | 0.0 | 7.60 | 0.150 |
| | | ½ R | 7.45 | 0.156 |
| | | R | 7.36 | 0.169 |
| | Urea | 0.0 | 7.60 | 0.150 |
| | | ½ R | 7.57 | 0.159 |
| | | R | 7.65 | 0.172 |
| | Mean | - | 7.50 | ٠,١٦٤ |
| Rice straw Compost + NF | Ammonium sulfate | 0.0 | 7.60 | 0.159 |
| | | ½ R | 7.47 | 0.162 |
| | | R | 7.38 | 0.186 |
| | Urea | 0.0 | 7.60 | 0.159 |
| | | ½ R | 7.57 | ٠,١٧٦ |
| | | R | 7.66 | ٠,١٩٤ |
| | Mean | - | 7.52 | ٠,١٧٩ |
| EM solution alone | Ammonium sulfate | 0.0 | 7.69 | ٠,١٧٥ |
| | | ½ R | 7.49 | ٠,١٩١ |
| | | R | 7.40 | ٠,٢٠٦ |
| | Urea | 0.0 | 7.69 | ٠,١٧٥ |
| | | ½ R | 7.59 | ٠,٢٠٠ |
| | | R | 7.68 | ٠,٢١٢ |
| | Mean | - | 7.54 | ٠,٢٠٢ |
| NF solution alone | Ammonium sulfate | 0.0 | 7.71 | ٠,١٨٨ |
| | | ½ R | 7.52 | ٠,٢٠٢ |
| | | R | 7.43 | ٠,٢٠٨ |
| | Urea | 0.0 | 7.71 | ٠,١٨٨ |
| | | ½ R | 7.65 | ٠,٢١١ |
| | | R | 7.69 | ٠,٢٢٣ |
| | Mean | - | 7.57 | ٠,٢١١ |
| L.S.D. at 0.05 | | - | - | - |
| Treatments | | | 0.025 | 0.0014 |
| N Sources | | | 0.0156 | 0.00049 |
| Treatments X N Sources | | | NS | 0.00124 |
| Rates | | | 0.0169 | 0.0068 |
| Rates X Treatments | | | NS | 0.0018 |
| Rates X N Sources | | | 0.0240 | 0.00114 |
| Rates X Treatments X N Sources | | | NS | 0.0027 |

**c) Soluble ions:**

Data presented in Table (3) revealed that the application of compost, bio- fertilizers (EM or NF) and N- mineral fertilizers, either added individually

or together to sandy soil increased significantly the values of soluble ions concentrations as compared to control. Moreover, the use of $N_2$ - fixers was more effective in increasing the values of soluble ions than the other used materials. This could be attributed to the effect of compost on soil chemical properties enhancement. This conclusion is in on line with that obtained by Johnson *et al*. (2006) who showed that application of green manure, compost, peat and N-mineral fertilizer increased the amount of soluble ions.

**Table (3): Effect of compost, bio-fertilizers and N – mineral fertilizers on soluble ions of soil paste extracts of sandy soil**

| Treatment | N-mineral fertilize | | Soluble ions (m molc $L^{-1}$) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Source | Rate | Cations | | | | Anions | | | |
| | | | $Ca^{2+}$ | $Mg^{2+}$ | $Na^{+}$ | $K^{+}$ | $CO_3^{2-}$ | $HCO_3^{-}$ | $Cl^{-}$ | $SO_4^{2-}$ |
| Control | | 0.0 | 0.45 | 0.20 | 0.65 | 0.09 | 0.00 | 0.58 | 0.50 | 0.31 |
| Rice straw compost | Ammonium sulfate | 0.0 | 0.60 | ٠,٣٠ | ٠,٨٠ | 0.13 | 0.00 | 0.71 | ٠,٥٥ | ٠,٥٧ |
| | | ½ R | 0.66 | 0.35 | ٠,٨٢ | 0.15 | 0.00 | ٠,٧٤ | 0.64 | 0.60 |
| | | R | 0.70 | ٠,٣٩ | 0.82 | 0.12 | 0.00 | ٠,٧٦ | 0.66 | 0.61 |
| | Urea | 0.0 | 0.60 | ٠,٣٠ | ٠,٨٠ | 0.13 | 0.00 | 0.71 | ٠,٥٥ | ٠,٥٧ |
| | | ½ R | 0.51 | ٠,٢٥ | 0.79 | 0.15 | 0.00 | 0.78 | 0.57 | ٠,٣٥ |
| | | R | 0.61 | 0.32 | 0.81 | 0.13 | 0.00 | 0.80 | 0.59 | ٠,٤٨ |
| | Mean | - | ٠,٦٢ | ٠,٣٢ | ٠,٨١ | ٠,١٣ | - | ٠,٧٧ | ٠,٦٢ | ٠,٥١ |
| Rice straw Compost + EM | Ammonium sulfate | 0.0 | 0.50 | ٠,٢٣ | ٠,٦٦ | 0.11 | 0.00 | 0.59 | ٠,٥٢ | ٠,٣٩ |
| | | ½ R | ٠,٥٢ | ٠,٢٤ | 0.69 | 0.11 | 0.00 | ٠,٦٢ | ٠,٥٥ | ٠,٣٩ |
| | | R | 0.55 | 0.30 | ٠,٧٣ | 0.11 | 0.00 | ٠,٦٥ | ٠,٥٨ | ٠,٤٦ |
| | Urea | 0.0 | 0.50 | ٠,٢٣ | ٠,٦٦ | 0.11 | 0.00 | 0.59 | ٠,٥٢ | ٠,٣٩ |
| | | ½ R | ٠,٥١ | 0.25 | ٠,٧٠ | ٠,١٣ | 0.00 | ٠,٦٨ | 0.54 | ٠,٣٧ |
| | | R | 0.53 | 0.28 | ٠,٧٦ | 0.15 | 0.00 | 0.72 | 0.59 | ٠,٤١ |
| | Mean | - | ٠,٥٢ | ٠,٢٧ | ٠,٧٢ | 0.12 | - | ٠,٦٦ | ٠,٥٦ | ٠,٤٠ |
| Rice straw Compost + NF | Ammonium sulfate | 0.0 | 0.54 | ٠,٢٦ | ٠,٦٧ | ٠,١٢ | 0.00 | ٠,٦٢ | ٠,٥٣ | 0.44 |
| | | ½ R | ٠,٥٦ | 0.26 | 0.68 | 0.12 | 0.00 | ٠,٦٥ | 0.53 | ٠,٤٤ |
| | | R | 0.63 | 0.40 | 0.71 | 0.15 | 0.00 | 0.67 | 0.61 | 0.61 |
| | Urea | 0.0 | 0.54 | ٠,٢٦ | ٠,٦٧ | ٠,١٢ | 0.00 | ٠,٦٢ | ٠,٥٣ | 0.44 |
| | | ½ R | ٠,٥٧ | 0.29 | ٠,٧٩ | 0.11 | 0.00 | 0.68 | 0.63 | 0.45 |
| | | R | 0.65 | 0.32 | ٠,٨٣ | 0.14 | 0.00 | 0.74 | 0.67 | 0.53 |
| | Mean | - | ٠,٦٠ | ٠,٢٨ | ٠,٧٥ | ٠,١٣ | - | ٠,٦٩ | ٠,٦١ | ٠,٥٠ |
| EM solution alone | Ammonium sulfate | 0.0 | 0.67 | 0.27 | ٠,٧١ | 0.10 | 0.00 | ٠,٦٤ | ٠,٥٧ | 0.54 |
| | | ½ R | ٠,٧١ | 0.31 | 0.74 | 0.15 | 0.00 | 0.69 | ٠,٦٨ | 0.54 |
| | | R | 0.77 | 0.35 | 0.79 | 0.15 | 0.00 | 0.78 | 0.70 | 0.58 |
| | Urea | 0.0 | 0.67 | 0.27 | ٠,٧١ | 0.10 | 0.00 | ٠,٦٤ | ٠,٥٧ | 0.54 |
| | | ½ R | ٠,٦٦ | 0.33 | 0.84 | ٠,١٧ | 0.00 | ٠,٨٠ | 0.88 | 0.32 |
| | | R | 0.68 | 0.36 | 0.90 | ٠,١٨ | 0.00 | 0.87 | 0.90 | ٠,٣٥ |
| | Mean | - | ٠,٧٠ | ٠,٣٣ | ٠,٨٢ | ٠,١٦ | - | ٠,٧٩ | ٠,٧٩ | ٠,٤٤ |
| NF solution alone | Ammonium sulfate | 0.0 | 0.69 | 0.34 | ٠,٧٢ | 0.13 | 0.00 | ٠,٦٦ | ٠,٦٩ | ٠,٥٣ |
| | | ½ R | ٠,٧٥ | ٠,٣٧ | 0.75 | 0.15 | 0.00 | 0.74 | ٠,٧٣ | ٠,٥٥ |
| | | R | 0.78 | 0.37 | 0.78 | 0.15 | 0.00 | 0.78 | ٠,٧٥ | 0.55 |
| | Urea | 0.0 | 0.69 | 0.34 | ٠,٧٢ | 0.13 | 0.00 | ٠,٦٦ | ٠,٦٩ | ٠,٥٣ |
| | | ½ R | 0.70 | 0.36 | 0.90 | ٠,١٥ | 0.00 | 0.85 | ٠,٩٠ | ٠,٣٦ |
| | | R | 0.73 | ٠,٣٨ | ٠,٩٥ | 0.17 | 0.00 | ٠,٨٨ | 0.95 | 0.40 |
| | Mean | - | ٠,٧٤ | ٠,٣٦ | ٠,٨٣ | ٠,١٦ | - | ٠,٨٢ | ٠,٨٠ | 0.46 |
| **L.S.D. at 0.05** | | | - | - | - | - | - | - | - | - |
| **Treatments** | | | 0.017 | 0.021 | 0.034 | 0.013 | - | 0.028 | 0.031 | 0.026 |
| **N Sources** | | | 0.0071 | NS | 0.0079 | 0.0081 | - | 0.0074 | 0.0099 | 0.00818 |
| **Treatments X N Sources** | | | 0.0176 | 0.0146 | 0.0190 | NS | - | 0.0180 | 0.0245 | 0.0203 |
| **Rates** | | | 0.0089 | 0.0093 | 0.0112 | 0.0125 | - | 0.0103 | 0.0109 | 0.0112 |
| **Rates X Treatments** | | | 0.0217 | 0.023 | 0.0274 | 0.0309 | - | 0.0251 | 0.0267 | 0.0272 |
| **Rates X N Sources** | | | 0.0125 | 0.0132 | 0.0160 | NS | - | 0.0144 | 0.0155 | 0.0158 |
| **Rates X Treatments X N Sources** | | | 0.0309 | 0.0327 | 0.160 | NS | - | 0.0354 | 0.038 | 0.0384 |

***d)* Organic matter percentage:**

Concerning the effect of compost, bio- fertilizers and N-mineral fertilizers on organic matter content of sandy soil, data in Table (4) revealed that accentuating to the application rates of these ameliorating compounds led to a significantly increase in organic matter content as compared to untreated soil. In the current study, however, the addition of rice straw compost with bio- fertilizers, i.e., EM or NF to sandy soil gave higher organic matter content as compared to other treatments. This finding may be ascribed to the high organic matter content of compost and improving physico- chemical properties of the studied sandy soil. These results are in agreement with those obtained by El- Sanat (2008) who reported that the application of 20 $m^3$ / fed compost to soil obviously increased soil organic matter content.

e) Cation exchange capacity:

The soil cation exchange capacity (CEC) values as influenced by the ameliorating applied materials are presented in Table (4). Results revealed that the mean values of CEC of sandy soil treated with the amendments, i.e., (Compost, bio- fertilizers and N- mineral fertilizers) added alone or in all combination were significantly increased. The role of compost or bio-fertilizers in elevating the cation exchange capacity could be justified as it is rich in humus having numerous functional groups characterized by negative charges. These results are coincided well with that obtained by Abd El-Wahab (2008).

**f) Exchangeable cations.**

The associated changes in the exchangeable cations in sandy soil after applying the tested materials, i.e., compost, bio- fertilizers and N- mineral fertilizers are given in Table (4). Results revealed that exchangeable calcium and magnesium increased significantly, with superiority for soil treated with compost plus bio-fertilizers of EM or NF. However, the mean values of exchangeable $Ca^{++}$ were 3.15, 3.18, 3.15, 2.13 and 2.22 C. mole $kg^{-1}$ soil for compost, compost + EM, compost + NF, EM alone and NF alone, respectively. The corresponding $Mg^{++}$values reached 1.71, 1.75, 1.78, 1.45 and 1.07 C. mole $kg^{-1}$ soil, respectively. On the other hand, exchangeable $Na^{+}$ and $K^{+}$ were increased over the control but in low values. The increase in exchangeable cations may be due to high content of compost from these ions**.** These results are in harmony with those found by Mahmoud (2006) who noticed an increase in exchangeable cations upon treating clay soil with compost and Biofertan (nitrogen fixing bacteria, i.e., *Azospirillum*, *Azotobacter*, *Bacillus* and *Klebsiella* spp).

**Table (4): Effect of compost, bio-fertilizers and N – mineral fertilizers on organic matter percentage, Cation exchange capacity and exchangeable cations in sandy soil**

| Treatments | N- mineral fertilizers | | Organic matter % | CEC (Cmolc/ kg soil) | Exchangeable cations(Cmolc/kg soil) | | | |
|---|---|---|---|---|---|---|---|---|
| | Source | Rate | | | Ca++ | Mg++ | Na+ | K+ |
| Control | | 0.0 | 0.095 | 3.49 | 1.82 | 1.10 | 0.37 | 0.18 |
| Rice straw compost | Ammonium sulfate | 0.0 | 0.181 | 5.02 | 2.82 | 1.60 | 0.35 | 0.22 |
| | | ½ R | 0.203 | 5.49 | 3.15 | 1.72 | 0.38 | 0.23 |
| | | R | 0.206 | 5.58 | 3.17 | 1.74 | 0.39 | 0.25 |
| | Urea | 0.0 | 0.181 | 5.02 | 2.82 | 1.60 | 0.35 | 0.22 |
| | | ½ R | 0.201 | 5.36 | 3.15 | 1.65 | 0.35 | 0.20 |
| | | R | 0.205 | 5.40 | 3.12 | 1.71 | 0.36 | 0.19 |
| | Mean | - | 0.203 | 5.46 | 3.15 | 1.71 | 0.37 | 0.22 |
| Rice straw Compost + EM | Ammonium sulfate | 0.0 | 0.201 | 5.30 | 3.09 | 1.67 | 0.33 | 0.21 |
| | | ½ R | 0.215 | 5.56 | 3.18 | 1.75 | 0.39 | 0.22 |
| | | R | 0.218 | 5.67 | 3..30 | 1.80 | 0.31 | 0.23 |
| | Urea | 0.0 | 0.201 | 5.30 | 3.09 | 1.67 | 0.33 | 0.21 |
| | | ½ R | 0.211 | 5.42 | 3.10 | 1.73 | 0.37 | 0.20 |
| | | R | 0.213 | 5.48 | 3.14 | 1.70 | 0.40 | 0.22 |
| | Mean | - | 0.214 | 5.53 | 3.18 | 1.75 | 0.37 | 0.22 |
| Rice straw Compost + NF | Ammonium sulfate | 0.0 | 0.189 | 5.15 | 2.80 | 1.80 | 0.35 | 0.17 |
| | | ½ R | 0.210 | 5.51 | 3.05 | 1.73 | 0.40 | 0.25 |
| | | R | 0.211 | 5.62 | 3.40 | 1.70 | 0.35 | 0.20 |
| | Urea | 0.0 | 0.189 | 5.15 | 2.80 | 1.80 | 0.35 | 0.17 |
| | | ½ R | 0.206 | 5.39 | 2.94 | 1.75 | 0.38 | 0.23 |
| | | R | 0.205 | 5.45 | 3.20 | 1.80 | 0.39 | 0.25 |
| | Mean | - | 0.208 | 5.49 | 3.15 | 1.78 | 0.38 | 0.23 |
| EM solution alone | Ammonium sulfate | 0.0 | 0.113 | 3.99 | 2.15 | 1.65 | 0.35 | 0.15 |
| | | ½ R | 0.119 | 4.13 | 2.07 | 1.75 | 0.40 | 0.18 |
| | | R | 0.122 | 4.17 | 2.10 | 1.58 | 0.39 | 0.20 |
| | Urea | 0.0 | 0.113 | 3.99 | 2.15 | 1.65 | 0.35 | 0.15 |
| | | ½ R | 0.117 | 3.96 | 2.30 | 1.69 | 0.41 | 0.15 |
| | | R | 0.120 | 4.14 | 2.05 | 1.32 | 0.35 | 0.22 |
| | Mean | - | 0.120 | 3.95 | 2.13 | 1.45 | 0.39 | 0.19 |
| NF solution alone | Ammonium sulfate | 0.0 | 0.112 | 3.95 | 2.25 | 1.55 | 0.38 | 0.20 |
| | | ½ R | 0.113 | 4.05 | 2.30 | 1.09 | 0.40 | 0.25 |
| | | R | 0.117 | 4.19 | 2.25 | 1.50 | 0.45 | 0.23 |
| | Urea | 0.0 | 0.112 | 3.95 | 2.25 | 1.55 | 0.38 | 0.20 |
| | | ½ R | 0.112 | 3.90 | 2.08 | 1.40 | 0.42 | 0.18 |
| | | R | 0.115 | 4.07 | 2.25 | 1.10 | 0.39 | 0.24 |
| | Mean | - | 0.114 | 4.05 | 2.22 | 1.07 | 0.42 | 0.23 |
| L.S.D. at 0.05 | | | - | - | - | - | - | - |
| Treatments | | | 0.0025 | 0.0187 | 0.0187 | 0.204 | 0.0195 | 0.035 |
| N Sources | | | 0.0022 | NS | NS | 0.0977 | 0.0039 | 0.0124 |
| Treatments X N Sources | | | NS | NS | NS | NS | 0.0096 | NS |
| Rates | | | 0.0137 | 0.0121 | 0.0121 | 0.110 | 0.0087 | 0.0169 |
| Rates X Treatments | | | 0.0032 | NS | NS | 0.270 | 0.0215 | 0.0416 |
| Rates X N Sources | | | NS | NS | NS | NS | 0.0123 | 0.0343 |
| Rates X Treatments X N Sources | | | NS | 0.0421 | 0.0421 | NS | 0.0304 | NS |

***g)* Available N, P and K.**

Data of N, P and K availability in the studied sandy soil amended with compost and bio- fertilizers, i.e., EM or NF added alone or all in combination with N – mineral fertilizers are shown in Table (°). Results showed significant

increases for the available N, P and K in the treated soil. Results also revealed that N, P and K concentrations increased with increasing nitrogen fertilizers rates. However, it could be concluded that addition of compost plus bio- fertilizers, i.e., EM or NF to sandy soil led to increase N- availability, which was found in different forms of N- mineral, N- organic and $N_2$- fixing bacteria. On the other hand the increase in P and K availability may be related to the combined effect of compost and bio- fertilizers, which was helped in solubilizing both P and K (Native or added), and in turn increasing the availability of P and K in treated sandy soil.

These results are in agreement with that obtained by Ibrahim *et al.* (2008) who found that the addition of organic manures individually or in combination with mineral fertilizers resulted in an increase in the availability of any of N, P and K in soil as compared to control.

h) Available Fe, Mn and Zn:

The appraisal of the available micronutrients, i.e., Fe, Mn and Zn in the studied sandy soil as affected by different treatments under investigation are displayed in Table (5). Results indicated progressively significant increases in the available Fe, Mn and Zn as a result of the applied tested materials, i.e., compost, bio- fertilizers and N- mineral fertilizers, compared to control. Such increases in the available micronutrients Fe, Mn and Zn may be due to the effect of these amendments especially compost and compost with bio- fertilizers on decreasing the soil pH. These Results almost similar with those obtained by Mohammed (2004) who found that application of N-organic sources led to increase availability of Zn, Cu, Mn and Fe.

**II) Effect of compost, bio-fertilizers and N – mineral fertilizers on maize yield and its components:**

**a) Grain yield**

Data in Table (٦) revealed that grain yield values of maize plants elevated significantly after using all the tested treatments compared with control. However, results illustrated that the values of grain yields increased progressively with increasing N- mineral fertilizers rates. The obtained results clarified that the highest effect on increasing grain yield, as a main value, (2860.70 kg/fed) was due to the use of compost plus effective microorganisms (EM). The current results may be interpreted as the addition of mentioned treatments improved physical and chemical properties of used sandy soil that consequently increased both available water and essential nutrients for plants, which reflected on increasing the grain yield of Zea maize. These results are in coinciding with those obtained by Ramu and Reddy (2007) showed that the application of nitrogen fertilizers up to 240 kg / ha to soil increased maize grain yield.

**b) Stover yield**

Data obtained from sandy soil treated with compost, different sources of bio-fertilizers and N- mineral fertilizers added alone or together (Table ٦) revealed that the stover yields of maize plants increased significantly for all the investigated treatments. It was found that the values of stover yield were higher with compost application. When added with effective microorganism's (EM) or $N_2$ fixer's (NF) than that with all other treatments. The increase in stover yield may be due to the beneficial effect of the previous materials on

soil physical properties such as soil structure, moisture availability, which affected stover yield. These findings are in accordance with those found by Sepat and Kumar. (2007) who reported that maize stover yield was increased after applied nitrogen fertilizers, farmyard manure and Azospirillum to the soil.

**Table (٥): Effect of compost, bio-fertilizers and N – mineral fertilizers on the availability of macronutrients and micronutrients in treated sandy soils**

| Treatments | N- mineral fertilizers | | Available macronutrients mg / kg soil)( | | | Available micronutrients (mg / kg soil) | | |
|---|---|---|---|---|---|---|---|---|
| | Source | Rates | N | P | K | Fe | Mn | Zn |
| Control | | ٠,٠ | 17.35 | 2.47 | 40.82 | 3.55 | 0.91 | 0.55 |
| Rice straw Compost | Ammonium sulfate | ٠,٠ | 29.40 | 4.22 | 62.65 | 4.35 | 1.18 | 0.98 |
| | | ½ R | 31.55 | 4.91 | 66.75 | 4.70 | 1.28 | 1.06 |
| | | R | 33.46 | 5.01 | 68.84 | 4.81 | 1.35 | 1.09 |
| | Urea | 0.0 | 29.40 | 4.22 | 62.65 | 4.35 | 1.18 | 0.98 |
| | | ½ R | 28.12 | 4.85 | 64.89 | 4.56 | 1.24 | 1.02 |
| | | R | 32.75 | 4.90 | 67.42 | 4.75 | 1.29 | 1.03 |
| | Mean | - | 31.47 | 4.92 | 66.98 | 4.71 | 1.29 | 1.05 |
| Rice straw Compost + EM | Ammonium sulfate | ٠,٠ | 31.50 | 4.56 | 65.73 | 4.52 | 1.25 | 1.04 |
| | | ½ R | 36.86 | 5.05 | 69.84 | 4.85 | 1.39 | 1.10 |
| | | R | 38.90 | 5.18 | 72.25 | 4.97 | 1.48 | 1.16 |
| | Urea | 0.0 | 31.50 | 4.56 | 65.73 | 4.52 | 1.25 | 1.04 |
| | | ½ R | 34.09 | 4.89 | 68.06 | 4.62 | 1.35 | 1.06 |
| | | R | 36.74 | 5.02 | 70.85 | 4.87 | 1.42 | 1.11 |
| | Mean | - | 36.65 | 5.04 | 70.25 | 4.83 | 1.41 | 1.11 |
| Rice straw Compost + NF | Ammonium sulfate | ٠,٠ | 30.25 | 4.40 | 63.96 | 4.31 | 1.20 | 1.00 |
| | | ½ R | 33.65 | 4.97 | 68.45 | 4.79 | 1.33 | 1.07 |
| | | R | 35.42 | 5.08 | 70.59 | 4.90 | 1.42 | 1.12 |
| | Urea | 0.0 | 30.25 | 4.40 | 63.96 | 4.31 | 1.20 | 1.00 |
| | | ½ R | 31.53 | 4.87 | 67.85 | 4.63 | 1.30 | 1.02 |
| | | R | 33.90 | 4.95 | 69.17 | 4.81 | 1.37 | 1.05 |
| | Mean | - | 33.63 | 4.97 | 69.02 | 4.78 | 1.36 | 1.07 |
| EM solution alone | Ammonium sulfate | ٠,٠ | 23.82 | 3.00 | 60.02 | 3.75 | 1.00 | 0.65 |
| | | ½ R | 29.65 | 3.16 | 62.94 | 3.90 | 1.12 | 0.74 |
| | | R | 31.42 | 3.32 | 64.56 | 4.05 | 1.18 | 0.83 |
| | Urea | 0.0 | 23.82 | 3.00 | 60.02 | 3.75 | 1.00 | 0.65 |
| | | ½ R | 27.35 | 3.11 | 61.45 | 3.82 | 1.08 | 0.67 |
| | | R | 29.22 | 3.21 | 63.72 | 3.97 | 1.14 | 0.76 |
| | Mean | - | 29.41 | 3.2 | 63.17 | 3.94 | 1.13 | 0.75 |
| NF solution alone | Ammonium sulfate | ٠,٠ | 22.73 | 2.95 | 52.84 | 3.68 | 0.95 | 0.59 |
| | | ½ R | 28.78 | 3.09 | 55.89 | 3.82 | 1.02 | 0.69 |
| | | R | 30.57 | 3.24 | 56.47 | 3.91 | 1.09 | 0.72 |
| | Urea | 0.0 | 22.73 | 2.95 | 52.84 | 3.68 | 0.95 | 0.59 |
| | | ½ R | 26.80 | 3.01 | 53.79 | 3.78 | 0.99 | 0.62 |
| | | R | 28.91 | 3.15 | 58.05 | 3.91 | 1.05 | 0.68 |
| | Mean | - | 28.77 | 3.12 | 56.05 | 3.86 | 1.04 | 0.68 |
| L.S.D. at 0.05 | | | - | - | - | - | - | - |
| Treatments | | | 0.0216 | 0.072 | 1.958 | 0.193 | 0.0141 | 0.0207 |
| N Sources | | | 0.0059 | 0.034 | 0.413 | NS | 0.0101 | 0.0039 |
| Treatments X N Sources | | | 0.014 | NS | NS | NS | Ns | 0.0096 |
| Rates | | | 0.0103 | 0.038 | 0.808 | 0.111 | 0.0121 | 0.0125 |
| Rates X Treatments | | | 0.0254 | 0.093 | 1.980 | 0.272 | 0.0299 | NS |
| Rates X N Sources | | | 0.0146 | NS | NS | NS | 0.0171 | 0.0176 |
| Rates X Treatments X N Sources | | | 0.0359 | NS | NS | NS | NS | NS |

**Table (١): Effect of compost, bio-fertilizers and N – mineral fertilizers on grain, stover yields, plant height, weight of 100 - kernels for maize crop**

| Treatments | N- mineral fertilizers | | Grain yield (kg/fed | Stover yield (kg/fed) | Plant height (cm) | Weight of 100 kernel (g) |
|---|---|---|---|---|---|---|
| | Source | Rate | | | | |
| Control | | ٠,٠ | 973.92 | 2490.43 | 148.35 | 16.81 |
| Rice straw Compost | Ammonium sulfate | 0.0 | 2380.25 | 4409.54 | 179.13 | 18.97 |
| | | ½ R | 2675.08 | 4890.25 | 182.74 | 19.35 |
| | | R | 2711.94 | 4965.73 | 148.35 | 16.81 |
| | Urea | 0.0 | 2380.25 | 4409.54 | 175.82 | 18.12 |
| | | ½ R | 2509.78 | 4617.42 | 180.90 | 19.10 |
| | | R | 2617.05 | 4752.96 | 179.65 | 18.89 |
| | Mean | - | 2628.46 | 4806.59 | 179.13 | 18.97 |
| Rice straw Compost + EM | Ammonium sulfate | 0.0 | 2538.81 | 202.80 | 202.80 | 21.65 |
| | | ½ R | 2879.56 | 5130.81 | 207.57 | 23.75 |
| | | R | 2918.02 | 5280.75 | 210.38 | 25.90 |
| | Urea | 0.0 | 2538.81 | 4965.05 | 202.80 | 21.65 |
| | | ½ R | 2764.54 | 5089.32 | 204.95 | 22.64 |
| | | R | 2880.67 | 5167.48 | 208.61 | 24.80 |
| | Mean | - | 2860.70 | 5167.09 | 207.88 | 24.27 |
| Rice straw Compost + NF | Ammonium sulfate | 0.0 | 2479.45 | 4645.17 | 201.45 | 20.85 |
| | | ½ R | 2784.12 | 5082.91 | 204.17 | 22.97 |
| | | R | 2819.52 | 5115.87 | 206.24 | 23.79 |
| | Urea | 0.0 | 2479.45 | 4645.17 | 201.45 | 20.85 |
| | | ½ R | 2690.65 | 5496.02 | 203.18 | 21.15 |
| | | R | 2712.45 | 5017.49 | 205.63 | 23.46 |
| | Mean | - | 2751.69 | 5178.07 | 204.81 | 22.19 |
| EM solution alone | Ammonium sulfate | 0.0 | 2278.92 | 4206.67 | 188.56 | 19.35 |
| | | ½ R | 2482.35 | 4643.09 | 192.19 | 20.54 |
| | | R | 2517.87 | 4750.12 | 195.80 | 21.76 |
| | Urea | 0.0 | 2278.92 | 4206.67 | 188.56 | 19.35 |
| | | ½ R | 2390.65 | 4490.73 | 190.75 | 19.81 |
| | | R | 2410.09 | 4512.07 | 193.06 | 20.05 |
| | Mean | - | 2450.24 | 4599.00 | 192.95 | 20.54 |
| NF solution alone | Ammonium sulfate | 0.0 | 2109.71 | 4198.03 | 185.94 | 18.79 |
| | | ½ R | 2369.85 | 4421.67 | 187.08 | 19.64 |
| | | R | 2412.36 | 4502.54 | 189.27 | 20.73 |
| | Urea | 0.0 | 2109.71 | 4198.03 | 185.94 | 18.79 |
| | | ½ R | 2205.74 | 4270.92 | 186.54 | 19.02 |
| | | R | 2347.15 | 4339.48 | 188.42 | 20.17 |
| | Mean | - | 2333.78 | 4383.65 | 187.83 | 19.89 |
| L.S.D. at 0.05 | | | - | - | - | - |
| Treatments | | | 1.719 | 214.20 | 2.46 | 2.46 |
| N Sources | | | 0.794 | 120.12 | 0.862 | 0.862 |
| Treatments X N Sources | | | 1.946 | NS | NS | NS |
| Rates | | | 1.675 | 136.32 | 0.905 | 0.905 |
| Rates X Treatment | | | 4.129 | 335.12 | 2.215 | 2.215 |
| Rates X N Sources | | | 2.382 | 193.12 | NS | NS |
| Rates X Treatments X N Sources | | | 5.84 | NS | NS | NS |

**c) Plant height**

Plant heights of maize grown in sandy soil as affected by applied compost, bio and mineral fertilizers are given in Table (6). Regarding to the rate of addition, obviously results indicated that any increment levels

accentuated significantly the plant high of zea maize. The maximum plant height was obtained by applying compost mixed with effective microorganisms (EM). It is interesting to notice that using the highest dose of $(NH_4)_2 SO_4$ with compost and bio – fertilizers gave the highest increase in plant height. These findings may be attributed to the highly content of organic materials and microbial activity, which resulted in decreasing soil pH as well as increasing organic acids production. These positive effects may have an impact on moisture and nutrients availability for plant. These results are in agreement with that obtained by El-Yazied *et al*. (2007) They found that increasing nitrogen fertigation levels (or) chelated calcium concentration led to increase the plant height.

**d) Weight of 100 - kernels:**

Data in Table (6) indicated that the weights of 100 - kernels increased significantly after treating the studied sandy soil with the investigated treatments. However, the values of weight of 100 kernels were higher with compost plus effective microorganisms (EM) followed by compost plus $N_2$ fixers (NF) added to the experimental sandy soil. The increments of weight of 100 - kernels may be attributed to the influence of the applied materials on physical properties improved (soil water retention consequently that increased water stable aggregates, besides decreasing the bulk density of soil). All of these factors should be reflected on soil aeration, and due to its chemical properties effect (increase the availability of some macro and micro nutrients) needed for the plant growth and on the studied weights of 100 - kernels. These results are in coinciding with those obtained by Ewees *et al*. (2008**)** who demonstrated that weights of 100 - grains of maize were significantly increased as a result to the application of organic manure plus bio- fertilizers to sandy soil.

**III. Effect of compost, bio-fertilizers and N – mineral fertilizers on nutrient contents and uptake in maize plants:**

a) N, P and K contents % in maize grain and stover:

Data in Table (7) revealed that the application of compost, bio-fertilizers and N-mineral fertilizers, as individual or all together to sandy soil were associated by significant increases in the content of N, P and K in maize grain and stover as compared with untreated soil sample. Moreover, the highest values of N, P and K contents in maize grain and stover were due to the use of compost plus effective microorganisms (EM) followed by compost plus $N_2$-fixers (NF). The increase in N, P and K contents in maize plants may be due to improving of soil properties particularly soil pH, which increasing nutrients availability. The present results may be due to the effect of added of amendments on enhancing the availability and translocation mechanisms of nutrients particularly N, P and K. These results are in harmony with those obtained by Mohamed *et al*. (2008)

**Table (٧): Effect of compost, bio-fertilizers and N – mineral fertilizers on macronutrient contents in maize grain and stover**

| Treatment | N- mineral fertilizers | | Macronutrient contents % | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Source | Rate | Maize grain | | | Maize stover | | |
| | | | Nn N | P | P K | Nn N | P | P K |
| Control | | ٠,٠ | ٢,٣٩ | ٠,٢٦ | ٢,٤٧ | ٢,٨٧ | ٠,٣٢ | ٢,٩٥ |
| Rice straw Compost | Ammonium sulfate | 0.0 | 3.08 | 0.31 | 3.39 | 3.34 | 0.37 | 3.52 |
| | | ½ R | 3.32 | 0.34 | 3.57 | 3.35 | 0.40 | 3.75 |
| | | R | 3.37 | 0.35 | 3.60 | 3.57 | 0.42 | 3.79 |
| | Urea | 0.0 | 3.08 | 0.31 | 3.39 | 3.34 | 0.37 | 3.52 |
| | | ½ R | 3.29 | 0.33 | 3.55 | 3.30 | 0.38 | 3.68 |
| | | R | 3.34 | 0.34 | 3.59 | 3.53 | 0.41 | 3.76 |
| | Mean | - | 3.33 | 0.34 | 3.58 | 3.44 | 0.40 | 3.75 |
| Rice straw Compost + EM | Ammonium sulfate | 0.0 | 3.25 | 0.35 | 3.52 | 3.49 | ٠,٣٩ | ٣,٦٥ |
| | | ½ R | 3.40 | 0.37 | 3.63 | 3.71 | 0.42 | 3.81 |
| | | R | 3.45 | 0.39 | 3.67 | 3.88 | 0.45 | 3.90 |
| | Urea | 0.0 | 3.25 | 0.35 | 3.52 | 3.49 | 0.39 | 3.65 |
| | | ½ R | 3.37 | 0.36 | 3.61 | 3.68 | 0.40 | 3.79 |
| | | R | 3.42 | 0.38 | 3.65 | 3.83 | 0.43 | 3.83 |
| | Mean | - | 3.41 | 0.38 | 3.64 | 3.78 | 0.43 | 3.83 |
| Rice straw Compost + NF | Ammonium sulfate | 0.0 | 3.15 | 0.32 | 3.47 | 3.40 | 0.38 | 3.59 |
| | | ½ R | 3.36 | 0.37 | 3.60 | 3.48 | 0.41 | 3.79 |
| | | R | 3.41 | 0.37 | 3.64 | 3.65 | 0.43 | 3.83 |
| | Urea | 0.0 | 3.15 | 0.32 | 3.47 | 3.40 | 0.38 | 3.59 |
| | | ½ R | 3.34 | 0.34 | 3.58 | 3.43 | 0.39 | 3.72 |
| | | R | 3.39 | 0.35 | 3.62 | 3.59 | 0.42 | 3.78 |
| | Mean | - | 3.38 | 0.36 | 3.61 | 3.54 | 0.41 | 3.78 |
| EM solution alone | Ammonium sulfate | 0.0 | 3.07 | 0.29 | 3.31 | 3.22 | 0.36 | 3.48 |
| | | ½ R | 3.25 | 0.32 | 3.55 | 3.35 | 0.39 | 3.70 |
| | | R | 3.30 | 0.34 | 3.52 | 3.42 | 0.41 | 3.75 |
| | Urea | 0.0 | 3.07 | 0.29 | 3.31 | 3.22 | 0.36 | 3.48 |
| | | ½ R | 3.25 | 0.31 | 3.47 | 3.26 | 0.37 | 3.63 |
| | | R | 3.27 | 0.33 | 3.51 | 3.35 | 0.40 | 3.72 |
| | Mean | - | 3.27 | 0.33 | 3.51 | 3.35 | 0.39 | 3.70 |
| NF solution alone | Ammonium sulfate | 0.0 | 3.00 | 0.28 | 3.25 | 3.10 | 0.35 | 3.41 |
| | | ½ R | 3.17 | 0.31 | 3.45 | 3.29 | 0.38 | 3.64 |
| | | R | 3.20 | 0.33 | 3.48 | 3.37 | 0.40 | 3.70 |
| | Urea | 0.0 | 3.00 | 0.28 | 3.25 | 3.10 | 0.35 | 3.41 |
| | | ½ R | 3.11 | 0.30 | 3.41 | 3.19 | 0.36 | 3.61 |
| | | R | 3.15 | 0.32 | 3.44 | 3.31 | 0.39 | 3.65 |
| | Mean | - | 3.16 | 0.32 | 3.45 | 3.29 | 0.38 | 3.65 |
| L.S.D. at 0.05 | | | - | - | - | - | - | - |
| Treatments | | | 0.148 | 0.023 | 0.045 | 0.069 | 0.027 | 0.053 |
| N Source | | | NS | NS | NS | 0.023 | NS | 0.023 |
| Treatments X N Sources | | | NS | NS | NS | 0.563 | NS | NS |
| Rates | | | 0.081 | 0.010 | 0.032 | 0.042 | 0.013 | 0.026 |
| Rates X Treatments | | | NS | NS | 0.079 | 0.102 | NS | 0.065 |
| Rates X N Sources | | | NS | NS | NS | NS | NS | NS |
| Rates X Treatments X N Sources | | | NS | NS | NS | NS | NS | NS |

**c) N, P and K uptake (kg / fed) by maize grain and stover:**

Data located in Table (8) indicated that the values of N, P and K uptake in maize grain and stover increased significantly due to the application of compost, bio-fertilizers and N- mineral fertilizers to sandy soil compared to control.

The mean values of N, P and K uptake for maize grain were followed the increasing order: compost plus effective microorganisms (EM) > compost plus $N_2$ fixers (NF) > compost > effective microorganism's (EM) > $N_2$ fixers (NF) > control. The same trend was a proximally reached with stover uptake of these ions. The pronounced increases in N, P and K uptake by maize plants may be due to the effect of compost and bio-fertilizers on their improving action for physical, chemical and biological conditions of the cultivated soil, which influenced the nutritional uptake of the grown plants. Similar results are obtained by Ramu and Reddy (2007).

**Table (8): Effect of compost, bio-fertilizers and N – mineral fertilizers on macronutrients uptake in maize grain and stover**

| Treatment | N-mineral fertilizers | | Macronutrient uptake kg / fed | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Source | Rate | Maize grain | | | Maize stover | | |
| | | | N N | P | P K | N | P | K |
| Control | | ٠,٠ | ٢٣,٢٨ | ٢,٥٣ | ٢٦,٦٩ | ٧١,٤٨ | ٧,٩٧ | ٧٣,٤٧ |
| Rice straw Compost | Ammonium sulfate | 0.0 | 73.31 | 7.38 | 80.69 | 147.72 | 16.32 | 155.22 |
| | | ½ R | 88.81 | 9.10 | 95.50 | 163.33 | 19.56 | 183.38 |
| | | R | 91.39 | 9.49 | 97.63 | 177.28 | 20.86 | 188.20 |
| | Urea | 0.0 | 73.31 | 7.38 | 80.69 | 147.72 | 16.32 | 155.22 |
| | | ½ R | 82.57 | 8.28 | 89.10 | 152.37 | 17.55 | 169.92 |
| | | R | 87.41 | 8.90 | 93.95 | 167.78 | 19.49 | 178.71 |
| | Mean | - | 87.55 | 8.94 | 94.05 | 165.19 | 19.37 | 180.05 |
| Rice straw Compost + EM | Ammonium sulfate | 0.0 | 82.51 | ٨,٨٩ | ٨٩,٣٧ | ١٧٣,٢٨ | ١٩,٣٦ | ١٨١,٢٢ |
| | | ½ R | 97.91 | 10.65 | 104.53 | 190.35 | 21.55 | 195.48 |
| | | R | 100.67 | 11.38 | 107.09 | 204.89 | 23.76 | 205.95 |
| | Urea | 0.0 | 82.51 | 8.89 | 89.37 | 173.28 | 19.36 | 181.22 |
| | | ½ R | 93.16 | 9.95 | 99.80 | 187.29 | 20.36 | 192.89 |
| | | R | 98.52 | 10.95 | 105.14 | 197.91 | 22.22 | 197.91 |
| | Mean | - | 97.57 | 10.73 | 104.14 | 195.11 | 21.97 | 198.06 |
| Rice straw Compost + NF | Ammonium sulfate | 0.0 | 78.10 | 7.93 | 86.04 | 157.94 | 17.65 | 166.76 |
| | | ½ R | 93.55 | 10.30 | 100.23 | 176.89 | 20.84 | 192.64 |
| | | R | 96.15 | 10.43 | 102.63 | 186.73 | 22.00 | 195.94 |
| | Urea | 0.0 | 78.10 | 7.93 | 86.04 | 157.94 | 17.65 | 166.76 |
| | | ½ R | 89.87 | 9.15 | 96.33 | 188.51 | 21.43 | 204.45 |
| | | R | 91.95 | 9.49 | 98.19 | 180.13 | 21.07 | 189.66 |
| | Main | - | 92.88 | 9.84 | 99.35 | 183.07 | 21.34 | 195.97 |
| EM solution alone | Ammonium sulfate | 0.0 | 69.96 | 6.61 | 75.43 | 135.45 | 15.14 | 146.39 |
| | | ½ R | 80.68 | 7.94 | 88.12 | 155.54 | 18.11 | 171.79 |
| | | R | 83.09 | 8.56 | 88.63 | 162.45 | 19.48 | 178.13 |
| | Urea | 0.0 | 69.96 | 6.61 | 75.43 | 135.45 | 15.14 | 146.39 |
| | | ½ R | 77.70 | 7.41 | 82.96 | 146.40 | 16.62 | 163.01 |
| | | R | 78.81 | 7.95 | 84.59 | 151.15 | 18.05 | 167.85 |
| | Mean | - | 80.07 | 7.97 | 86.08 | 153.89 | 18.07 | 170.20 |
| NF solution alone | Ammonium sulfate | 0.0 | 63.29 | 5.91 | 68.57 | 130.14 | 14.69 | 143.15 |
| | | ½ R | 75.12 | 7.35 | 81.76 | 145.47 | 16.80 | 160.95 |
| | | R | 77.20 | 7.96 | 83.95 | 151.74 | 18.01 | 166.59 |
| | Urea | 0.0 | 63.29 | 5.91 | 68.57 | 130.14 | 14.69 | 143.15 |
| | | ½ R | 68.60 | 6.62 | 75.22 | 136.24 | 15.38 | 154.18 |
| | | R | 73.94 | 7.51 | 80.74 | 143.64 | 16.92 | 158.39 |
| | Mean | - | 73.72 | 7.36 | 80.42 | 144.27 | 16.78 | 160.03 |
| L.S.D. at 0.05 | | | - | - | - | - | - | - |
| Treatments | | | 1.662 | 1.099 | 0.198 | 1.1022 | 0.6531 | 0.5568 |
| N Sources | | | 0.5935 | NS | NS | 0.038 | NS | 0.055 |
| Treatments X N Sources | | | 1.564 | 1.098 | 0.505 | 0.653 | NS | NS |
| Rates | | | 0.768 | 0.401 | 0.187 | 1.483 | 0.038 | 1.483 |
| Rates X Treatments | | | 0.180 | NS | 0.088 | 0.0858 | 0.0633 | 0.0475 |
| Rates X N Sources | | | 1.361 | 0.743 | NS | 1.112 | NS | 2.574 |
| Rates X Treatments X N | | | NS | NS | NS | NS | NS | NS |

**d) Fe, Mn and Zn contents mg/ kg in maize grain and stover:**

The obtained data from sandy soil samples treated with compost, bio-fertilizers and N- mineral fertilizers added alone or all together are presented in Table (9).

**Table (٩): Effect of compost, bio-fertilizers and N – mineral fertilizers on micronutrient contents % in maize grain and stover**

| Treatment | N-mineral fertilizers | | Micronutrient contents (mg/kg) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Source | Rate | Maize grain | | | Maize stover | | |
| | | | | Mn | | | Mn | |
| Control | | ٠,٠ | ٢١٠ | ٥٢ | ٤٠ | ١٩٩ | ٤٩ | ٣٢ |
| Rice straw Compost | Ammonium sulfate | 0.0 | 280 | 62 | 47 | 252 | 60 | 42 |
| | | ½ R | 311 | 71 | 50 | 272 | 66 | 46 |
| | | R | 315 | 73 | 55 | 291 | 70 | 49 |
| | Urea | 0.0 | 280 | 62 | 47 | 252 | 60 | 42 |
| | | ½ R | 292 | 69 | 48 | 265 | 64 | 44 |
| | | R | 310 | 72 | 53 | 276 | 68 | 47 |
| | Mean | - | 307 | 71.3 | 51.5 | 276 | 67 | 47 |
| Rice straw Compost + EM | Ammonium sulfate | 0.0 | 305 | 67 | 49 | 270 | 65 | 45 |
| | | ½ R | 321 | 73 | 54 | 289 | 71 | 49 |
| | | R | 325 | 76 | 59 | 310 | 74 | 51 |
| | Urea | 0.0 | 305 | 67 | 49 | 270 | 65 | 45 |
| | | ½ R | 318 | 71 | 51 | 282 | 69 | 48 |
| | | R | 323 | 74 | 57 | 301 | 72 | 50 |
| | Mean | - | 321.8 | 73.5 | 55.3 | 296 | 72 | 50 |
| Rice straw Compost + NF | Ammonium sulfate | 0.0 | 295 | 66 | 48 | 260 | 61 | 42 |
| | | ½ R | 315 | 72 | 52 | 281 | 68 | 46 |
| | | R | 320 | 74 | 57 | 300 | 72 | 50 |
| | Urea | 0.0 | 295 | 66 | 48 | 260 | 61 | 42 |
| | | ½ R | 312 | 69 | 49 | 276 | 66 | 46 |
| | | R | 317 | 73 | 55 | 290 | 70 | 49 |
| | Mean | - | 316 | 72 | 53.3 | 287 | 69 | 48 |
| EM solution alone | Ammonium sulfate | 0.0 | 265 | 60 | 45 | 245 | 57 | 40 |
| | | ½ R | 295 | 69 | 48 | 263 | 65 | 45 |
| | | R | 305 | 72 | 54 | 271 | 68 | 48 |
| | Urea | 0.0 | 265 | 60 | 45 | 245 | 57 | 40 |
| | | ½ R | 281 | 66 | 47 | 254 | 63 | 43 |
| | | R | 299 | 70 | 52 | 265 | 66 | 46 |
| | Mean | - | 295.0 | 69.3 | 50.3 | 263 | 66 | 46 |
| NF solution alone | Ammonium sulfate | 0.0 | 251 | 57 | 44 | 230 | 55 | 37 |
| | | ½ R | 282 | 67 | 47 | 251 | 63 | 43 |
| | | R | 298 | 70 | 52 | 263 | 65 | 45 |
| | Urea | 0.0 | 251 | 57 | 44 | 230 | 55 | 37 |
| | | ½ R | 269 | 65 | 46 | 242 | 60 | 39 |
| | | R | 285 | 68 | 50 | 255 | 64 | 44 |
| | Mean | - | 283.5 | 67.5 | 48.8 | 253 | 63 | 43 |
| L.S.D. at 0.0 | | | - | - | - | - | - | - |
| Treatments | | | 0.756 | 0.74 | 0.220 | 2.299 | 0.689 | 1.433 |
| N Sources | | | 0.453 | 0.138 | 0.120 | 1.145 | 0.098 | 0.545 |
| Treatments X N Sources | | | 1.108 | 0.341 | 0.295 | NS | 0.240 | NS |
| Rates | | | 0.51 | 0.221 | 0.176 | 1.36 | 0.494 | 0.954 |
| Rates X Treatments | | | 1.249 | 0.546 | 0.431 | 2.78 | 1.21 | 2.033 |
| Rates X N Sources | | | 0.72 | 0.315 | 0.247 | 1.610 | 0.698 | NS |
| Rates X Treatments X N Sources | | | 1.76 | NS | 0.610 | NS | NS | NS |

Results revealed that micronutrient (Fe, Mn and Zn) contents mg/ kg in maize grain and stover exhibited significant increases due to applying all tested treatments as compared to the control. Treatment of compost plus EM and ammonium sulphate fertilizer at full recommended dose gave the highest values of (Fe, Mn and Zn) contents mg/ kg in maize plants. The previous trends may be due to the role of this treatment in improving soil properties

and increasing concentration of available micronutrients in the soil, which affects on Fe, Mn and Zn contents mg/ kg by maize grain and stover. These findings are agreed with those obtained by Ashmawe *et al* .(2008) who observed that applying organic manure, bio- fertilizers and N- mineral fertilizers to soil increased in the contents of Fe, Mn, Zn and Cu in maize grain and stover.

**e)Fe, Mn and Zn uptake g / fed in maize grain and stover.**

Data in Table (١٠) showed that increasing rates of N- mineral fertilizers application considerably raised Fe, Mn and Zn uptake by maize grains and stover.

**Table (1٠): Effect of compost, bio-fertilizers and N – mineral fertilizers on micronutrients uptake in maize grain and stover**

| Treatment | N-mineral fertilizers | | Micronutrient uptake (g / fed) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Maize grain | | | Maize stover | | |
| | Source | Rates | | | | | | |
| Control | | ٠,٠ | ٢٠٤,٥٢ | ٥٠,٦٤ | ٣٨,٩٦ | ٤٩٥,٦٠ | ١٢٢,٠٣ | ٧٩,٦٩ |
| Rice straw Compost | Ammonium sulfate | 0.0 | 666.47 | 147.58 | 111.87 | 1111.20 | 264.57 | 185.20 |
| | | ½ R | 831.95 | 189.93 | 133.75 | 1330.15 | 322.76 | 224.95 |
| | | R | 854.26 | 197.97 | 149.16 | 1445.03 | 347.60 | 243.32 |
| | Urea | 0.0 | 666.47 | 147.58 | 111.87 | 1111.20 | 264.57 | 185.20 |
| | | ½ R | 732.86 | 173.17 | 120.47 | 1223.62 | 295.51 | 203.17 |
| | | R | 811.29 | 188.43 | 138.70 | 1311.82 | 323.20 | 223.39 |
| | Mean | - | 808 | 187 | 136 | 1328 | 322 | 224 |
| Rice straw Compost + EM | Ammonium sulfate | 0.0 | 774.34 | 170.10 | 124.40 | 1340.56 | ٣٢٢,٧٣ | ٢٢٣,٤٣ |
| | | ½ R | 924.34 | 210.21 | 155.50 | 1482.80 | 364.29 | 251.41 |
| | | R | 948.36 | 221.77 | 172.16 | 1637.03 | 390.78 | 269.32 |
| | Urea | 0.0 | 774.34 | 170.10 | 124.40 | 1340.56 | 322.73 | 223.43 |
| | | ½ R | 879.12 | 196.28 | 140.99 | 1435.19 | 351.16 | 244.29 |
| | | R | 930.46 | 213.17 | 164.20 | 1555.41 | 372.06 | 258.37 |
| | Mean | - | 921 | 210 | 158 | 1528 | 370 | 256 |
| Rice straw Compost + NF | Ammonium sulfate | 0.0 | 731.44 | 163.64 | 119.01 | 1207.74 | 283.36 | 195.09 |
| | | ½ R | 877.00 | 200.46 | 144.77 | 1428.30 | 345.64 | 233.81 |
| | | R | 902.25 | 208.64 | 160.71 | 1534.76 | 368.34 | 255.79 |
| | Urea | 0.0 | 731.44 | 163.64 | 119.01 | 1207.74 | 283.36 | 195.09 |
| | | ½ R | 839.48 | 185.65 | 131.84 | 1516.90 | 362.74 | 252.82 |
| | | R | 859.85 | 198.01 | 149.18 | 1455.07 | 351.22 | 245.86 |
| | Mean | - | 870 | 198 | 147 | 1484 | 357 | 247 |
| EM solution alone | Ammonium sulfate | 0.0 | 603.91 | 136.74 | 102.55 | 1030.63 | 239.78 | 168.27 |
| | | ½ R | 732.29 | 171.28 | 119.15 | 1221.13 | 301.80 | 208.94 |
| | | R | 767.95 | 181.29 | 135.96 | 1287.28 | 323.01 | 228.01 |
| | Urea | 0.0 | 603.91 | 136.74 | 102.55 | 1030.63 | 239.78 | 168.27 |
| | | ½ R | 671.77 | 157.78 | 112.36 | 1140.65 | 282.92 | 193.10 |
| | | R | 720.62 | 168.71 | 125.32 | 1195.70 | 297.80 | 207.56 |
| | Mean | - | 723 | 170 | 123 | 1211 | 301 | 209 |
| NF solution alone | Ammonium sulfate | 0.0 | 529.54 | 120.25 | 92.83 | 965.55 | 230.89 | 155.33 |
| | | ½ R | 668.30 | 158.78 | 111.38 | 1109.84 | 278.57 | 190.13 |
| | | R | 718.88 | 168.87 | 125.44 | 1184.17 | 292.67 | 202.61 |
| | Urea | 0.0 | 529.54 | 120.25 | 92.83 | 965.55 | 230.89 | 155.33 |
| | | ½ R | 593.34 | 143.37 | 101.46 | 1033.56 | 256.26 | 166.57 |
| | | R | 668.94 | 159.61 | 117.36 | 1106.57 | 277.73 | 190.94 |
| | Mean | - | 662 | 158 | 114 | 1109 | 276 | 188 |
| L.S.D. at 0.0 | | | - | - | - | - | - | - |
| Treatments | | | 0.560 | 0.238 | 0.150 | 2.302 | 0.696 | 1.466 |
| N Sources | | | 1.238 | 0.360 | 0.298 | 1.163 | 0.128 | 0.589 |
| Treatments X N Sources | | | 0.60 | 0.321 | 0.185 | NS | 0.262 | NS |
| Rates | | | 1.381 | 0.566 | 0.455 | 1.80 | 0.508 | 0.987 |
| Rates X Treatments | | | 0.95 | 0.356 | 0.274 | 2.92 | 1.55 | 2.085 |
| Rates X N Sources | | | 1.92 | NS | 0.669 | 1.633 | 0.766 | NS |
| Rates X Treatments X N Sources | | | 0870 | 0.81 | 0.240 | NS | NS | NS |

The positive effect of the use of compost plus effective microorganisms (EM) surpassed the other applied treatments, and showed significant increases for Fe, Mn and Zn uptake by maize plants. The mean values of this treatment were 921, 210 and 158 g/ fed, for Fe, Mn and Zn in maize grain and 1528, 370 and 256 g/ fed. for maize stover. The increase in the uptake of Fe, Mn and Zn by maize plants can be attributed to the basis of the pronounced increase of organic matter content in soil, especially the active organic acids, which resulted in lowering soil pH and increasing the available micronutrients in the soil. These results are in agreement with those previously obtained by Bruns and Ebelhar (2006). These data also emphasized by those obtained by Shaban and Attia (2009).

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# تـأثير كمبوسـت قـش الأرز و الأسـمدة الحيويـة والنيتروجينيـة المعدنيـة علـي بعض الخواص الكيميائية للتربة ومحصول الذرة و مكوناته

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أجريت تجربة حقلية بمحطة البحوث الزراعية بالإسماعيلية لتقييم تأثير إضافة كمبوست قش الأرز والأسمدة الحيوية (الكائنات الحية الدقيقة الفعالة EM ومثبتات النيتروجين $N_2$-fixers) والأسمدة النتروجينية المعدنية (كبريتات الأمونيوم أو اليوريا) والتى أضيفت منفردة أو مخلوطة إلي الأرض الرملية- علي بعض خواص الأرض الكيميائية, وكذلك على نمو ومحصول الذرة الشامية صنف هجين فردي ١٠. وتوضح النتائج المتحصل عليها أن إضافة كمبوست قش الأرز مع الكائنات الحية الدقيقة الفعالة إلي الأرض الرملية كان له تأثير كبير علي انخفاض pH التربة. كما أوضحت النتائج أن ملوحة التربة معبرا عنها بال dS/m والأيونات الذائبة زادت نتيجة لإضافة مثبتات النيتروجين . كما زادت النسبة المئوية للمادة العضوية و السعة التبادلية الكاتيونية و الكاتيونات المتبادلة بعد استعمال الكمبوست مع اضافة الكائنات الحية الدقيقة الفعالة ومثبتات النيتروجين. وتجدر الإشارة إلي أن إضافة الكمبوست منفردا أو مخلوطا مع المخصبات الحيوية إلي الأرض الرملية حسن القدرة الأمدادية للمغذيات الضرورية في المحلول الأرضي. أيضا نستطيع أن نستنتج أن إضافة الكمبوست مع الكائنات الحية الدقيقة الفعالة مع الجرعة السمادية الكاملة من كبريتات الأمونيوم كانت أعلي معاملة في زيادة محصول الحبوب والقش و طول النبات ووزن المائة حبة وأيضا محتوي العناصر الغذائية و الكمية الممتصة في الذرة الشامية المنزرعة في الأرض الرملية.

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