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EFFECT OF ORGANIC FERTILIZER AND MYCORRHIZA FUNGI ON SOME PHYSICAL AND CHEMICAL PROPERTIES OF SOILS

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Abstract

A field-based experiment was conducted during the 2017–2018 cropping season to evaluate the response of green house soil to a biofertilizer and Mycorrhiza relative to other sources of nutrients. The treatments were thus the control, cow manure, sheep manure, poultry residues, chemical fertilizer, cow with half chemical, sheep with half chemical, and poultry with half chemical. The treatments were assigned to experimental plots following a randomized complete block design (RCBD) and each treatment was treated in three replicates. The least significance difference (LSD) at 5% error rate was to compare significance means. Results showed that Poultry + ½ chemical treatment significantly reduced pH in soil (7.32), while significantly increased on EC, P in soil, N, P, K in plant reached (4.11 dS.m, 41.10, 2.821, 0.525 and 3.323 ppm) respectively. Significant increase in EC (3.221 $dS.m^{-1}$), K, N and P available in soil (359.8, 41.87 and 29.38 ppm) respectively, P and K content in plant (0.459 and 3.160 ppm) was realized inMycorrhiza, but it significantly reduced pH in soil (7.56). Results also indicated that the interaction of Poultry + ½ chemical with Mycorrhiza had a significant increase available of N, P, K in soil and K contents in plant (2.95, 46.13, 0.583 and 3.53 ppm) and TSS (8.70%) and Reduce pH (7.30).

Key words **:** Bio-fertilizers, organic fertilizer, physical and chemical properties of soils.

Introduction

The rates of addition of chemical fertilizers used in the cultivation of vegetable crops are large compared to other crops because of the possibility of growing in more than one season per year or shorten the season of growth, which has exacerbated and increase the adverse effects on health and the environment and the remaining impact of nitrates, which is one of the most dangerous to health Human (Osman, 2007). Forcing the use of bio-fertilizers to reduce the use of mineral fertilizers by 20-50%, lead to the production of growth inhibitors for pathogens, increase plant tolerance to environmental stress conditions and reduce environmental pollution (Thiab, 2012) ,environmentally safe and human health when compared to mineral fertilizers (Parial *et al.,* 2014) ,promotes plant growth by increasing nutrient uptake of the plant (Al-Taei, 2016), In addition, the products of organic agriculture have a high economic return, especially in developed countries compared to traditional agricultural products. (Al-Shahat, 2007 and Al-Abbadi, 2012). The aim of this research is study the effect of organic fertilizers and bio-fertilizers on some physical and chemical properties of soils.

Materials and Methods

This experiment was installed during the 2017–2018 cropping season at the University of Muthanna located in the Al Bandar research station. This study studied two factors: Factor 1 - fertilization treatments : Absolute control (T_1), Cow manure (T_2), Sheep manure (T_3), Poultry residues (T_4), Chemical (T_5), Cow + ½ chemical (T_6), Sheep + ½ chemical (T_7) and Poultry + ½ chemical (T_8). Factor 2 : With Mycorrhiza (M_1) and Without Mycorrhiza (M_0). The treatments were assigned to experimental plots following a randomized complete block design (RCBD) and each treatment was treated in three replicates. Significant differences were determined from among the mean values of treatments by employing the least significant differences (LSD) test, at 0.05 level.

Result

pH of Soil

Table (1) shows that there are significant differences between the fertilization parameters in the degree of soil reaction pH. The fertilization treatment with poultry wastes + half of the fertilizer recommendation T_8 has the lowest value of the soil reaction rate 7.320 and significantly lower than all the fertilization treatments including the T_1 Which recorded the highest soil interaction value of 7.950. Mycorrhiza treatment was superior than control treatment on pH of soil (7.660.7.568). The interaction treatments M_1T_8 and M_0T_8 were least significant on pH of soil (7.300 and 7.340) respectively than other interaction treatment except M_1T_7 (7.457) and T_4M_1 (7.417).

Table 1: Effect of Mycorrhiza fungi, organic fertilizer and their interaction on pH soil.

Fertilizer Treatments	With Mycorrhiza (M_1)	Without Mycorrhiza (M_0)	Mean of Fertilizer Treatments
Absolute control (T_1)	7.943	7.957	7.950
Cow manure (T_2)	7.557	7.653	7.605
Sheep manure (T_3)	7.663	7.587	7.625
Poultry residues (T_4)	7.417	7.810	7.613
Chemical (T_5)	7.617	7.870	7.743
Cow+½chemical (T_6)	7.590	7.520	7.555
Sheep+½chemical (T_7)	7.457	7.543	7.500
Poultry+½chemical(T_8)	7.300	7.340	7.320
Mean Mycorrhiza	7.568	7.660	7.614
LSD 0.05	M= 0.0633	T= 0.1266	M T=0.1791

EC of Soil:

Table (2) shows that there are significant differences between the treatment fertilization on electrical conductivity (EC). The T_1 ratio was significantly lower compare with ether the fertilizing treatment by recording the lowest value of pH (2.467 $ds.m^{-1}$). From the table above, there is no significant difference between the treatment of Mycorrhiza fungi with comparison treatment in soil electrical conductivity (EC). The interaction treatments of the comparison treatment with or without the addition of the fungus (T_1M_1, T_1M_0) were considered to be the lowest value for the electrical conductivity of the soil (2.433, 2.500) sequentially.

Table 2: Effect of Mycorrhiza fungi, organic fertilizer and their interaction on EC soil.

Fertilizer Treatments	With Mycorrhiza (M_1)	Without Mycorrhiza (M_0)	Mean of Fertilizer Treatments
Absolute control (T_1)	2.433	2.500	2.467
Cow manure (T_2)	3.600	3.200	3.400
Sheep manure (T_3)	2.833	3.200	3.017
Poultry residues (T_4)	3.067	2.467	2.767
Chemical (T_5)	3.267	2.467	2.867
Cow+½chemical (T_6)	3.033	3.233	3.133
Sheep+½chemical (T_7)	3.567	3.033	3.300
Poultry+½chemical(T_8)	3.967	4.267	4.117
Mean Mycorrhiza	3.221	3.046	3.133
LSD 0.05	M= 0.1153	T= 0.2307	MT= 0.3262

The values EC and its pH can be explained by the role of organic matter in reducing the value of pH which was effect on the values of electrical conductivity. There is also an inverse relationship between the values of the two brands (EC, PH), due to the role of degradation products of organic matter (humic and fulvic acids) (Al-Obeidi, 2002).

Available of N in Soil

In table 3 showed the treatment of fertilization with sheep residues + half of the fertilizer recommendation T_7 was significantly higher than all fertilizer treatments as well as the T_1 on available of N in soil (48.70, 12.14 ppm) respectively. From the same table, the treatment of Mycorrhiza fungi was significantly higher than the control treatment on available N in soil (41.87, 40.79 ppm) respectively. The interaction M_1T_7 treatment (48.99 ppm) was significantly higher than most treatments including M_0T_1 treatment (12.03 ppm).

Table 3: Effect of Mycorrhiza fungi, organic fertilizer and their interaction on available N (ppm) in soil.

Fertilizer Treatments	With Mycorrhiza (M_1)	Without Mycorrhiza (M_0)	Mean of Fertilizer Treatments
Absolute control (T_1)	12.25	12.03	12.14
Cow manure (T_2)	42.37	41.22	41.80
Sheep manure (T_3)	45.81	44.14	44.97
Poultry residues (T_4)	44.83	43.53	44.18
Chemical (T_5)	46.04	45.66	45.85
Cow+½chemical (T_6)	47.64	46.57	47.10
Sheep+½chemical (T_7)	48.99	48.41	48.70
Poultry+½chemical(T_8)	47.00	44.76	45.88
Mean Mycorrhiza	41.87	40.79	41.33
LSD 0.05	M= 0.597	T= 1.194	MT= 1.689

Available of K (ppm) in soil.

In table 4 showed The treatment T_7 (Sheep + ½chemical) was significantly higher than the comparison treatment, the fertilizer recommendation and the treatment of fertilization of Poultry residues T_1, T_5, T_4 (190.4, 297.4 and 358.6ppm) respectively, while not significantly different from the rest of the treatments. the treatment of Mycorrhiza fungi was significantly higher than the control treatment on available K in soil (359.8, 346.0 ppm) respectively. The interaction M_1T_6 treatment (409.8ppm) was significantly higher than most treatments including treatment of comparison with or without adding Mycorrhiza fungi M_0T_1 (286.8ppm), M_1T_1 (308.0ppm).

Table 4 : Effect of Mycorrhiza fungi, organic fertilizer and their interaction on available K (ppm) in soil.

Fertilizer Treatments	With Mycorrhiza (M_1)	Without Mycorrhiza (M_0)	Mean of Fertilizer Treatments
Absolute control (T_1)	201.3	179.5	190.4
Cow manure (T_2)	407.5	405.7	406.6
Sheep manure (T_3)	393.0	371.9	382.4
Poultry residues (T_4)	375.4	341.7	358.6
Chemical (T_5)	286.8	308.0	297.4
Cow+½chemical (T_6)	409.8	400.7	405.3
Sheep+½chemical (T_7)	398.6	385.4	392.0
Poultry+½chemical(T_8)	406.0	375.4	390.7
Mean Mycorrhiza	359.8	346.0	
LSD 0.05	M= 17.92	T= 35.83	MT= 50.68

Available of P in Soil

Table (9) shows that there are significant differences between the fertilization treatments in available of phosphorus in soil, The fertilization treatment of Poultry + ½chemical (T_8) was significantly higher on all fertilizer transactions, including T_1 (41.10, 5.73 ppm) respectively. The treatment of Mycorrhiza fungi (M_1) was significantly higher than the control treatment (M_0) on available of P in soil (29.38, 24.84 ppm) respectively. The interaction M_1T_8 tretment (46.13 ppm) was significantly higher than most treatments including M_0T_1 treatment (4.53 ppm).

Table 5 : Effect of Mycorrhiza fungi, organic fertilizer and their interaction on available P (ppm) in soil.

Fertilizer Treatments	With Mycorrhiza (M_1)	Without Mycorrhiza (M_0)	Mean of Fertilizer Treatments
Absolute control (T_1)	6.93	4.53	5.73
Cow manure (T_2)	29.63	25.50	27.57
Sheep manure (T_3)	31.23	27.80	29.52
Poultry residues (T_4)	36.53	29.63	33.08
Chemical (T_5)	16.97	16.73	16.85
Cow+½chemical (T_6)	31.27	28.27	29.77
Sheep+½chemical (T_7)	36.30	30.20	33.25
Poultry+½chemical(T_8)	46.13	36.07	41.10
Mean Mycorrhiza	29.38	24.84	
LSD 0.05	M= 0.690	T= 1.380	M T= 1.952

Available of N (ppm) in plant

The Mycorrhiza gave the highest N content of 2.95% which differed significantly from 2.69% in absolute control, indicating 4.9% of an increment. The application of poultry manure with half chemical gave the highest N content of 2.821% which differed significantly from ether treatments including absolute control T_1 (1.205%) and **Chemical (T_5)** (2.423%). Furthermore, significant differences were found in the interactions between fertilizer application and the Mycorrhiza treatments. The combination between poultry residues and Mycorrhiza gave the highest N content of 2.95% compared with absolute control with no Mycorrhiza application which gave the lowest N content of 1.166% (Table 6).

Table 6 : Effect of Mycorrhiza fungi, organic fertilizer and their interaction on available N (%) in plant.

Fertilizer Treatments	With Mycorrhiza (M_1)	Without Mycorrhiza (M_0)	Mean of Fertilizer Treatments
Absolute control (T_1)	1.2433	1.1667	1.2050
Cow manure (T_2)	2.2933	2.2000	2.2467
Sheep manure (T_3)	2.4033	2.3000	2.3517
Poultry residues (T_4)	2.5367	2.2733	2.4050
Chemical (T_5)	2.5500	2.2967	2.4233
Cow+½chemical (T_6)	2.7000	2.6100	2.6550
Sheep+½chemical (T_7)	2.9400	2.6033	2.7717
Poultry+½chemical(T_8)	2.9500	2.6933	2.8217
Mean Mycorrhiza	2.4521	2.2679	
LSD 0.05	M= 0.01198	T= 0.02396	MT= 0.03388

Available of P (ppm) in Plant

Results indicated significant differences between the Mycorrhiza treatments in P in fruit of the eggplant. Mycorrhiza gave the highest P of 0.459 ppm which differed significantly from 0.354 ppm in absolute control indicating 29.6% increment. Application of organic substrates indicated that poultry manure with half chemical gave the highest P content (0.525 ppm) compare with the lowest (0.1950 ppm) in absolute control, which is an increment of 169.2%. Furthermore, significant differences were found for the interactions between fertilizer application and the use of Mycorrhiza. Results indicated that the use of a mixture of o0ultry manure with half chemical with Mycorrhiza gave the highest P (0.585 ppm) compared with the absolute control with no Mycorrhiza application which gave the lowest (0.173 ppm) of P content in fruit (Table 7).

Table 7 : Effect of Mycorrhiza fungi, organic fertilizer and their interaction on available P (ppm) in plant.

Fertilizer Treatments	With Mycorrhiza (M_1)	Without Mycorrhiza (M_0)	Mean of Fertilizer Treatments
Absolute control (T_1)	0.2167	0.1733	0.1950
Cow manure (T_2)	0.4433	0.3000	0.3717
Sheep manure (T_3)	0.4400	0.3167	0.3783
Poultry residues (T_4)	0.4733	0.3667	0.4200
Chemical (T_5)	0.4000	0.3667	0.3833
Cow+½chemical (T_6)	0.5700	0.4300	0.5000
Sheep+½chemical (T_7)	0.5500	0.4167	0.4833
Poultry+½chemical(T_8)	0.5833	0.4667	0.5250
Mean Mycorrhiza	0.4596	0.3546	
LSD 0.05	M= 0.01260	T=0.02521	MT= 0.03565

Available of K (ppm) in Plant

Results indicated significant differences between the Mycorrhiza treatments on K in fruit of the eggplant. Mycorrhiza gave the highest K of 3.160 ppm which differed significantly from 2.787 ppm in absolute control indicating 13.3% increment. Application of organic substrates indicated that poultry manure with half chemical (T_8) gave the highest K content (3.323 ppm) compare with the lowest (2.665 ppm) in absolute control, which is an increment of 24.69%. Furthermore, significant differences were found for the interactions between fertilizer application and the use of Mycorrhiza. Results indicated that the use of a mixture of poultry manure with half chemical with Mycorrhiza gave the highest K (3.530 ppm) compared with the absolute control with no Mycorrhiza application which gave the lowest (2.447 ppm) of P content in fruit (Table 8).

Table 8 : Effect of Mycorrhiza fungi, organic fertilizer and their interaction on available K (ppm) in plant.

Fertilizer Treatments	With Mycorrhiza (M_1)	Without Mycorrhiza (M_0)	Mean of Fertilizer Treatments
Absolute control (T_1)	2.883	2.447	2.665
Cow manure (T_2)	2.977	2.547	2.762
Sheep manure (T_3)	2.990	2.640	2.815
Poultry residues (T_4)	3.033	2.677	2.855
Chemical (T_5)	3.017	2.790	2.903
Cow+½chemical (T_6)	3.380	3.017	3.198
Sheep+½chemical (T_7)	3.473	3.060	3.267
Poultry+½chemical(T_8)	3.530	3.117	3.323
Mean Mycorrhiza	3.160	2.787	
LSD 0.05	M= 0.0649	T= 0.1298	MT= 0.1836

The effect of organic fertilizer may be attributed to its active role in increasing the biological processes of microorganisms in the soil. This increases the readiness of macronutrient elements (Table 3, 4, 5), as well as the addition to the organic fertilizers macro and micro elements added to the soil and thus helped the plant absorb it and increase its concentration within the fruit tissue (table 6, 7 and 8), this results agree with (Agaab, 2013 and EL-Kabey, 2014). Mycorriza increases availability of nutrient elements in soil and helps plant absorption, especially phosphorus by the fungus fungi will reach places far from the growth area of the system of roots and will increase their available in soil and increase absorption by the plant, and these results agree with (Al-Abdullah, 2008; Al-Khafaji, 2014 and Al-Taie, 2016).

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