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INFLUENCE OF ORGANIC AND MINERAL FERTILIZERS ON SOME SOIL PHYSICAL PROPERTIES AND ZEA MAYS PRODUCTIVITY

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ABSTRACT

A field experiment was conducted on a clay soil using Zea mays (single cross 10) during 2009 season at Agricultural Experimental Station Fac of. Agric, Mansoura Univ., to study the influence of combined use of mineral fertilizers (urea) and organic fertilizers in the form of farmyard manure (FYM) and composted rice straw (CRS) on soil bulk density ,porosity (E) ,Void ratio (e), soil organic matter(Soil-O.M) and Zea mays productivity at certain times 25, 45 and 110 days from Zea mays planting. The Randomize complete blocks design with three replications was used. The mineral fertilizer (urea) was applied at the rate of N_1=100 and N_2=200 kg N fed^{-1}.The amounts of various organic fertilizers used were (10 and 20 m^3 fed^{-1}), for both FYM and CRS. Organic fertilizers added either alone or in combinations with urea to the soil.

Results indicated that the maximum increase in 100 grain weight, grain yield and straw yield (42.81, 998.22 and 2395.73 $g.m^2$) were recorded with N_2CRS_2.

While, the minimum (35.23, 745.44 and 1789.07 $g.m^2$) were recorded with the control.

Multiple linear regressions illustrated that:

1- bulk density, porosity and O.M% had role in predicting the grain yield (g/m^2) (R^2 = 60.1%) and the expected equation to predict the grain yield as follow:

Grain Yield (g/m^2) = 989 - 70 bulk density - 586 porosity + 225 OM%

2- bulk density and O.M% had role in predicting the porosity (R^2 = 100.0%) and the expected equation to predict the porosity as follow:

PROSITIY = 1.00 - 0.377 bulk density + 0.000130 OM%

3- porosity and O.M% had role in predicting the bulk density (R^2 = 100.0%) and the expected equation to predict the bulk density as follow:

BULK DENSITY = 2.65 - 2.65 porosity + 0.000351 OM%

Therefore, it could be concluded that the integration of organic and inorganic fertilizers was better than inorganic fertilizer only. Where using the high amount of organic fertilizers with urea gave the highest Zea Mays yield and increased the soil storing of (Soil-O.M) and accordingly raising the soil fertility.

INTRODUCTION

Maize (zea mays L.) one of the most important cereal crops in the world. It used as a food source for human and animal. Maize is the most widely grown crop in many countries in the world. It is a major source of starch and in many industrialized food products.

Balanced application of inorganic fertilizer and organic amendments greatly influence the soil organic matter accumulation and the soil physical environment.

Organic matter plays an important role in nutrient recycling. It has been shown that addition of organic materials caused an increases in plant dry matter yield and its uptake of the macro and micro nutrient elements

(Abdas *et al*., 2009). The role of organic fertilizers (compost) is improving soil organic matter, nitrogen content and phosphorus concentration. Furthermore decreasing soil pH, which result in increasing solubility of nutrients and nutrient availability to the plants, hence enhancement plant growth and development as well as gradually increasing grain yields of maize. (Ali *et al*., 2003).

Also, addition of organic matter improved soil properties such as aggregation, water-holding capacity, hydraulic conductivity, bulk density, the degree of compaction, fertility and resistance to water and wind erosion (Franzluebbers, 2002). In addition the fertilization may also affect the volume of the soil exploited by the roots for water and nutrients. Application of inorganic fertilizers alone decreased the stability of macro-aggregates and moisture retention capacity but increased the bulk density (Sarkar *et al*., 2003).

Tolessa and friesen (2001) reported that the growth and yield of maize significantly increased with the application with FYM enriched with chemical fertilizers.

The grain yield of maize was significantly increased by increasing nitrogen levels. The highest grain yield was obtained by adding 240 kg N/fed in two season. (Abdel-hafez *et al*, 2008)

Many investigators stated that the combined application of FYM with inorganic nitrogen fertilizers exerted favorable effect on maize productivity and NPK uptake such as Gebraiel *et al*. (2005), karki *et al*. (2005). and Artar *et al*. (2006)

The importance of mineral nitrogen fertilizer in combination with organic manure which has essential elements required for physiological mechanisms of plant growth and producing the best yield quality. The positive effects of mineral nitrogen and organic manure at different rates either alone or in combination with each other on growth, yield and chemical constituents in different plants were recorded by (Mohamed-faten, 2004).

This study aimed to:

1) Assess effects of integrated inorganic and organic fertilizers on Maize yield.
2) investigate the effect of integrated use of organic and inorganic fertilizers on soil bulk density, porosity and void ratio.
3) Monitor decomposition of soil organic matter (Soil-O.M %) at different stages of Maize growth.

MATERIALS AND METHODS

A field experiment was conducted using Zea mays plant (single cross 10) during 2009 season after wheat planting in the same soil at the Agricultural Experiment Station of Fac. Agric., Mansoura Univ., to study the effect of combined organic and inorganic (urea) fertilizers on soil bulk density, porosity, void ratio and productivity of Zea mays, monitoring the status of soil organic matter (Soil-O.M%) through the different stages of Zea mays growth (after 25, 45 and 110 days from planting). Randomize complete blocks design with three replications was used. The area of field plot was 1x1 m^2. The mineral fertilizer (urea) added to the soil at the rates of N_1=100 and N_2=200 kg N fed^{-1}. Organic fertilizers were applied to the soil in two forms, Farmyard manure (FYM) and composted rice straw (CRS) at the rates of (10, and 20 m^3 fed^{-1}). Organic fertilizers were added either alone or combined with urea fertilizers.

Recommended super phosphate was added to all plots at the rate of (200 kg super phosphate fed^{-1}).

Data in Table 1 show the physical and chemical properties of the experimental soil before planting. Soil samples were sieved and routine analysis in the beginning of the experiment was done according to Black *et al* (1965), Hesse (1971),page *et al* (1982) and Piper (1950). Samples of straw and grains were taken at harvest, then wet digestion was done according to Jackson, (1967).Organic materials were analyzed and added before planting by two weeks.(Table 2).

Porosity calculated from the following equation: [$E=(1-\rho b/\rho s)$].and void ratio calculated from the following equation:[$e=E/(1-E)$].

Data were also subjected to multiple linear regressions. Partial coefficient of determination (R^2) was estimated for each component to evaluate the relative contribution and to construct the prediction model for the grain yield, porosity and bulk density according to this formula : $Y=a+b_1x_1+b_2x_2+b_3x_3+b_4x_4+b_5x_5$ according to Snedecor and Cochran,(1982).

Table 1: Some physical and chemical properties of the experiment soil before planting.

pH (1:2.5)	E.c $ds.m^{-1}$ (soil paste)	Sp %	Ions meq/100 g soil							
			Ca^{+2}	Mg^{+2}	Na^{+}	K^{+}	CO_3^{-2}	HCO_3^{-}	Cl^{-}	SO_4^{-2}
7.92	2.10	65	0.62	0.32	0.78	0.06	0.00	0.50	0.66	0.62

Mechanical analysis %				O.M %	CaCO3 %	Available (ppm)		
sand	Silt	Clay	Texture			N	P	K
21.12	27.69	51.19	clayey	1.51	1.81	45	6.5	332

Table 2: Some chemical properties of farmyard manure (FYM) and composted rice straw (CRS).Before the addition to the soil.

Organic materials	Total N %	Total P, ppm	Total K, ppm	O.C %	C:N	O.M %	pH	EC, dSm^{-1}
Farmyard manure (FYM)	0.92	730.31	693.30	15.59	16.95	26.87	7.32	4.10
Rice Straw compost (CRS)	1.47	709.46	821.54	23.80	16.19	40.94	6.63	3.61

RESULTS AND DISCUSSION

- Soil Bulk density:

Fig 1,2 show that Bulk density increased by increasing the plant growth stages(25,45 and 110 days from planting) and there is no noticeable trend among the studied treatments. These results were confirmed with the work of Franzluebbers, 2002.

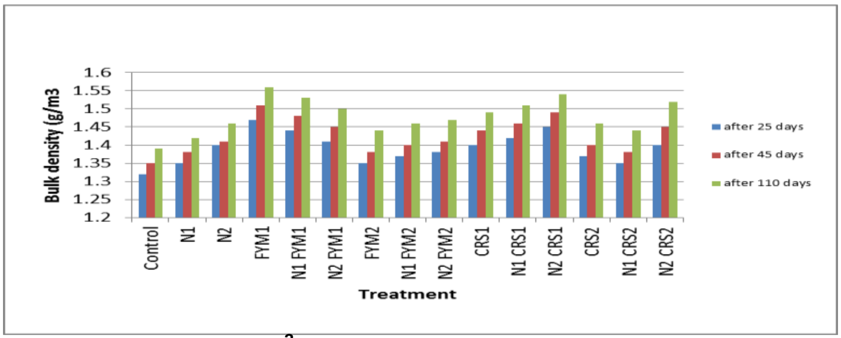

Fig 1: Bulk density (g/cm^3) in soil as affected by the studied treatments at certain times after planting during 2009 season.

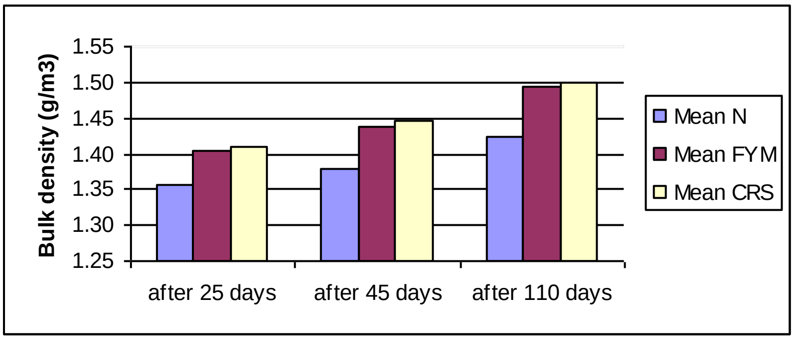

Fig 2: Means of bulk density (g/cm^3) in soil as affected by the studied treatments at certain times after planting during 2009 season.

Soil porosity:

Fig 3,4 show that porosity decreased by increasing plant growth stage, and it had not trend in the same stage. Flavio (2004) found that organic manure increased organic matter content, available phosphorous and exchangeable potassium of soil and improved the porosity and water retention capacity of the soil.

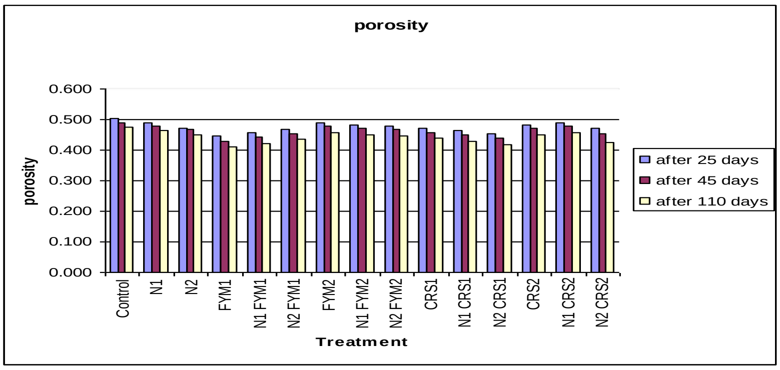

Fig 3: Soil porosity as affected by the studied treatments at different times of zea mays growth during 2009 season.

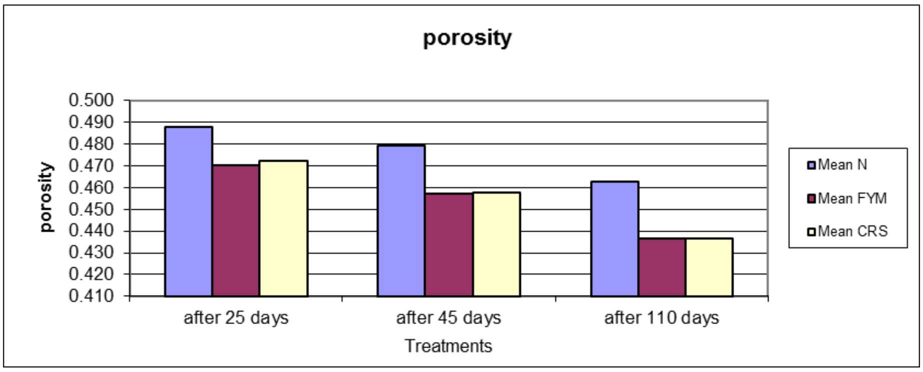

Fig 4: Means of soil porosity as affected by the studied treatments at different times of zea mays growth during 2009 season.

Void ratio:-

Fig 5 .observed effect of different treatments on the void ratio with varying degrees and the highest value for the control so may be for the following reasons:

1- not completely decomposition of organic matter (FYM,CRS) in the various treatments which led to the increase primarily.[e=Vv/Vs].

2- Add the various treatments, whether mineral or organic led to greater plant growth and raise the value of the yield from improved various soil physical properties, which led to compacted of soil particles, changing the values of primarily and increase it.

3- Different service operations and improved irrigation of the soil and growth during crop growth affected by the compaction of the soil.

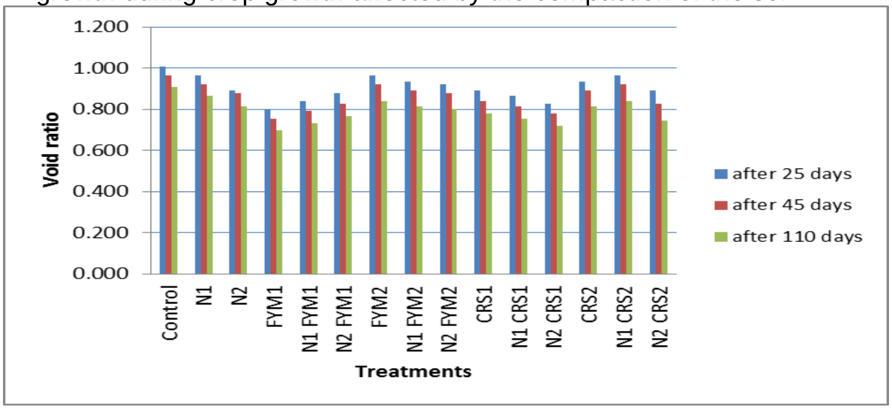

Fig 5: Void ratio as affected by the studied treatments at different times of zea mays growth during 2009 season.

Soil organic matter (Soil-O.M %):

Fig 6, 7 show that the percentages of soil organic matter increased with increasing amount of FYM or CRS applied either alone or in combination with different levels of urea as compared with the control. The highest values of

Soil-O.M % were found with i N_2CRS_2 at 25, 45 and 110 days from planting. Naeem (2006) confirmed These results.

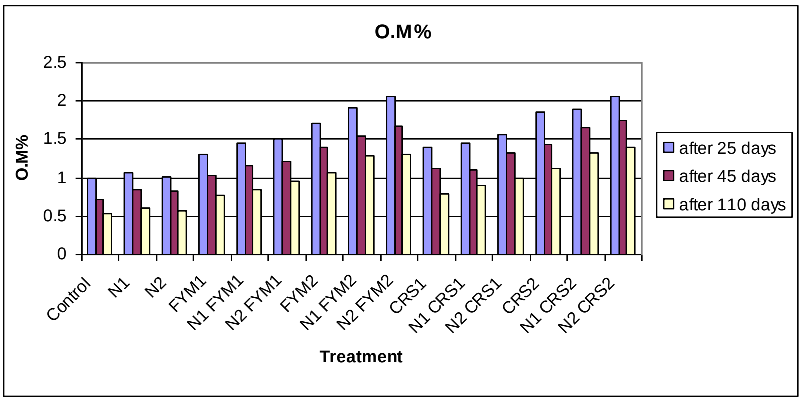

Fig 6: Soil organic matter (%) as affected by the studied treatments at different times of zea mays growth during 2009 season.

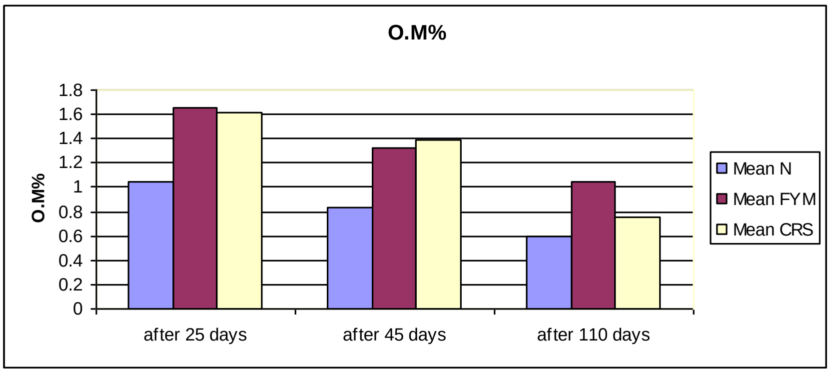

Fig 7: Means of soil organic matter (%) as affected by the studied treatments at different times of zea mays growth during 2009 season.

Regression between factors affecting yield and soil properties:

While multiple linear regressions from the following formula illustrated that bulk density, porosity and O.M% had role in predicting the grain yield (g/m^2) (R^2 = 60.1%) and the expected equation to predict the grain yield as follow:

Grain Yield (g/m^2) = 989 - 70 bulk density - 586 porosity + 225 OM%

- While multiple linear regressions from the following formula illustrated that bulk density and O.M% had role in predicting the porosity (R^2 = 100.0%) and the expected equation to predict the porosity as follow:

PROSITIY = 1.00 - 0.377 BULK DENSITY + 0.000130 OM%

There is a positive correlation between porosity and O.M%, where there is a negative correlation with bulk density.

- While multiple linear regressions from the following formula illustrated that porosity and O.M% had role in predicting the bulk density (R^2 = 100.0%) and the expected equation to predict the bulk density as follow:

BULK DENSITY = 2.65 - 2.65 PROSITIY + 0.000351 OM%

There is a positive correlation between bulk density and O.M%, where there is a negative correlation with porosity.

Yield:

Data in Table 3 show the100 grain weight, grain yield and straw yield of maize as affected by the application of different rates of organic (FYM or CRS) and inorganic fertilizers (N) and their integrations. The 100 grain weight, grain yield and straw yield increase with increasing levels of fertilizers when were added in the form of organic or inorganic fertilizers as compared to the untreated control. There is a significant increase in grain yield under integrated use of organic and inorganic fertilizers (FYM or CRS) at all levels over the control.

These mainly could be attributed to that combined use of FYM or CRS with urea where led to increases of nutrients availability for plant through their different growth stages which make balance in nutrients uptake. The maximum increase in 100-grain weight and grain yield (42.81 and 998.22 g.m^{-2}) was recorded by the application of integrated organic and inorganic fertilizers at N2CRS2 treatments respectively. Maximum values of straw yield (2395.73 g.m^{-2}) were found at the same treatments which gave higher grain yield.

Table: 3 Effect of organic, inorganic fertilizers and their combinations on Zea mays yield (g. m^{-2}) during 2009 season.

Treatments	100-grain weight(g)	grain Yield (g/m^2)	straw Yield (g/m^2)
Control	35.23j	745.44i	1789.07i
N1	35.32j	748.44i	1796.27i
N2	35.38j	750.33i	1800.80i
Mean	35.31	748.07	1795.38
FYM1	35.66ij	759.89i	1823.73i
N1 FYM1	36.06ij	773.22hi	1855.73hi
N2 FYM1	36.54hi	789.00gh	1893.60gh
FYM2	37.18gh	810.33g	1944.80g
N1 FYM2	38.01fg	838.00f	2011.20f
N2 FYM2	38.93ef	868.89e	2085.33e
Mean	37.06	806.56	1935.73
CRS1	39.29de	880.78e	2113.87e
N1 CRS1	39.70de	894.33de	2146.40de
N2 CRS1	40.24cd	912.33cd	2189.60cd
CRS2	40.96bc	936.33c	2247.20c
N1 CRS2	41.83b	965.44b	2317.07b
N2 CRS2	42.81a	998.22a	2395.73a
Mean	40.81	931.24	2234.98

N_1= 100 kg N fed-1. & N_2= 200 kg N fed-1.
FYM_1= 10 m3 fed-1. & FYM_2= 20 m3fed-1.
CRS_1= 10 m3 fed-1. & CRS_2= 20 m3 fed-1.

The straw yield followed the same trend as that of maize grains. Data also show that utilization of CRS gave higher grains and straw yields whether, added separately or combined with urea to the soil than FYM utilization at the same level. This is might be attributed to the enrichment composted rice straw by nutrients and the high content of organic matter and the low both of C/N ratio and EC than farmyard manure (FYM) as shown in Table 2. The mean values of grains and straw yields descended as follow: CRS > FYM > urea. This result in the same trend with karki *et al*. (2005).

Conclusion:

It could be concluded that the integration of organic and inorganic fertilizers was better than inorganic fertilizer only. Where using the high amount of organic fertilizers with urea gave the highest Zea Mays yield and increased the soil storing of (Soil-O.M) and accordingly raising the soil fertility.

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تأثيرالأسمدة العضوية والمعدنية علي خواص التربة الطبيعية وإنتاجية الذرة

سامى عبد الحميد حماد ، حسن عبد الله مشرف ، طارق محمد الزهيرى و كريم فكرى فودة
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لقد اجريت تجربه حقليه علي ارض طينيه لزراعه الذره الشامية (صنف هجين فردي 10) وذلك خلال موسم 2009 بمحطة البحوث الزراعية بكلية الزراعة –جامعة المنصوره. وذلك لدراسة التاثير المشترك للاسمدة المعدنيه(يوريا) والاسمدة العضويه في صورتين (سماد بلدي – كمبوست قش ارز) علي الكثافة الظاهرية والمساميه ونسبه المسام للتربة ومحتوي التربه من المادة العضوية ذلك خلال موسم النمو بعد 25-45-110 يوم من الزراعة وانتاجيه نبات الذره . ولقد إستخدم تصميم القطاعات كاملة العشوائية مع 3 مكررات وكان معدل اضافه السماد المعدني (يوريا) هو بمعدل 100-200 كجم/فدان نيتروجين . ومعدلات السماد العضوي [(10-20م^3 /فدان)لكل من السماد بلدي و الكمبوست] . تضاف الأسمدة العضوية إما منفردة أو مع اليوريا في التربة . توضح النتائج أن أعلي زيادة في محصول 100 حبه ومحصول الحبوب ومحصول القش(42,81-998,22-2395,73 جم/م^2)بالترتيب. وسجلت مع المعدل الثاني من النيتروجين و المعدل الثاني من الكمبوست . وسجلت اقل نتائج مع الكنترول (35,23-745,44-1789,07 جم/م^2).

انحدار الخط المتعدد يوضح ان:- 1- الكثافة الضاهرية والمسامية والنسبة المئوية للمادة العضوية لها دور في التنبؤ بمحصول الحبوب (جم/م^2) وارتباطها المعنوي(60,1%) والمعادلة المتوقعة للتنبأ بمحصول الحبوب :

Grain Yield (g/m^2) = 989 - 70 bulk density - 586 porosity + 225 OM%

2-الكثافة الظاهرية والنسبة المئوية للمادة العضوية لها دور في التنبؤ بالمسامية وارتباطها المعنوي(100%) والمعادلة المتوقعة للتنبأ بالمسامية:

PROSITIY = 1.00 - 0.377 bulk density + 0.000130 OM%

3- المسامية والنسبة المئوية للمادة العضوية لها دور في التنبؤ بالكثافة الضاهرية وارتباطها المعنوي (100%) والمعادلة المتوقعة للتنبأ بالكثافة الظاهرية:

BULK DENSITY = 2.65 - 2.65 porosity + 0.000351 OM%

ولذلك فان استخدام الاسمدة العضويه مع السمدة المعدنية افضل من استخدام الاسمد المعدنيه بمفردها ولذا فان استخدام الكميات الكبيره من الاسمدة العضويه مع اليوريا يعطي اعلي محصول للذرة مع زيادة مخزون التربه من الماده العضوية وبالتالي رفع خصوبة التربة.

قام بتحكيم البحث

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