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Study of using bio-phosphorus fertilizers on maize plant under alkaline soil conditions

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Abstract: **This study aims to use bio-phosphorus fertilizers (compost with co-inoculation PDB) on the growth of maize plants under alkaline soil condition.**

A field experiment was carried out at the Experiment Station, Faculty of Agriculture, Sirte University During the year (May- September). Tow factorsexperiment was conducted in a split plot design with three replications. Phosphorus fertilizer types were applied to the main plots. The area of the sub-plot was 10.50 m2 (3.5 m length *3 m width), with 5 ridges 60 cm apart and 25 cm between hills. The experiment included 35 treatments which were the combination of four types of phosphorus fertilizer types and seven rates of phosphorus application. Five phosphorus fertilizer types (Rouk phosphate (RP) plus 1% compost, RP plus 4% compost, RP plus 7% compost, RP plus 10% compost and). These mixtures were inoculated with phosphate dissolving bacteria. Seven phosphorus fertilizer rate (0, 3, 6, 9, 12, 15 and 18 Kg P/fed). Were applied in a single dose before sowing.The increases in yield of maize using RP+10%compost organic matter and inoculation with DPB in increasing the solubility of P from RP besides supplying the plants with some other macro and micronutrients.

Keywords: Rock phosphate, bacteriaCompost, Alkaline soil, maize plant.

1. INTRODUCTION

Phosphorus is one of the major essential macronutrients for biological growth and development, which largely Rock phosphate.Unfortunately Rock phosphate is not plant available in soils with a pH value higher than 5.5~6.0, and even when conditions are optimal, plant yields are lower than those obtained with soluble phosphate. Several methods are commonly used to increase rock phosphate availability. One traditional method is the acidulation of rock phosphate with small amounts of H_2SO_4 or to produce partially acidulated rock phosphate [1]. Other alternative methods include mixing of rock phosphate with various soil amendments or compaction of rock phosphate with water-soluble P fertilizers[2].

On the other hand, compositing of rock phosphates with agricultural wastes is known to increase solubility of rock phosphates [3]. The content of P solubility of a given rock phosphate varies with the kind of organic material and the rate of decomposition [4].

On the other siteMicrobial approaches have been proposed to improve the agronomic value of rock phosphate materials. Solubilization of rock phosphate by microorganisms excreting organic acids seems to be an attractive approach that has been actively studied for the last decade.An integrated application of rock P material with co-inoculation of bacteria that solubilize them might provide faster and continuous supply of P for optimal plant growth.However, little is known about the combined effects of rock material compost and co-inoculation of PSB on mineral availability in soils, mineral content and growth of maize.

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2. MATERIAL AND METHOD

2.1 Rock phosphate

A low grade rock phosphate (RP) sample was obtain from a sedimentary from phosphate rock deposit. The Chemical analysis of RP material was given in Table (1).

Table (1). The Chemical analysis of RP material was given

Rock Phosphate (RP)	
Constituents	**Concentration,%**
P	10.863
Ca^{++}	28.123
Na^{+}	0.6680
Fe^{++}	0.8710
K^{+}	0.1080
Mn^{++}	0.0360
Cl^{-}	0.5700
L.O.I	16.560

2.2 Compost

An organic compost sample was chosen in such a way that a representative of the compost organic produced in Egyptian farm. The chemical and physical properties were analyzed and presented in Table (2).

Table (2): The chemical and physical properties were analyzed and presented of compost.

Properties	**Values**
pH (1: 5)	8.14
E.C. (1: 5) dS/m	6.50
Soluble cations (meq / L)	
Ca^{++}	38.1
Mg^{++}	0.02
Na^{+}	0.54
K^{+}	0.23
Organic matter %	51.2
Available N %	0.77
Available P %	0.33

2.3 Phosphate dissolving bacteria

A commercial product of phosphate dissolving bacteria (PDB) was obtained from National Research, Sirte, Libya.

2.4 The used soil

The main physical and chemical soil properties of the experimental soil are presented in Table (3).

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Table (3):physical and chemical soil properties

Soil properties	Values
Mechanical analysis :	36.27
Sand %	18.91
Silt %	44.82
Soil texture	Clay
pH (1:1)	8.33
E.C. (1: 1) (ds/m)	3.80
Soluble cations (meq/L)	
Ca^{++}	4.80
Mg^{++}	2.80
Na^{+}	7.80
K^{+}	1.40
Soluble anions (meq/L)	
$CO_3^{=}$ + HCO_3^{-}	2.60
Cl^{-}	14.3
$SO_4^{=}$	0.45
Calcium Carbonate (%)	7.44
Organic - C (%)	0.79
Available Phosphorus (mg/kg soil)	5.20
Total P (mg/kg soil)	862.5

2.5 Statistical analysis

The collected data were statistically analyzed for ANOVA and means comparison to fulfill the significance according to [5]. Single linear regressions were applied to fit data using the method of [6].

2.6 Experimentation

Field experiment was carried out at the experiment station of the Agriculture Faculty (Sirte university). The main physical and chemical properties of the experimental soil are presented in next table.

During the season, three plant samples , the first on Jul. 21 ; the second in Aug. 8 and the third in Aug. 29 to study the following characters.Also, at the time of harvest (Sept. 22), five plants were chosen at random from each plot sample to study the following characters Grain yield (ton/fed)-

2.7 Plant Analysis

Leaf samples were taken and washed with tap water distilled water, air dried and oven dried at 650 C for 48 hours ,then grounded in a mill and stored for P Analysis.Powder of plant material was wet–digested with H_2SA_4 -H_2O_2digest [7].and the following determinations were carried out in the digested solution.Total P was determined using Vanadomolybdo phosphoric method [8].

Table (4): The component and rates of the tested phosphorus Bio-fertilizers

Fertilizer Type	Fertilizer Rate Kg P/fed	Amount Kg/fed.		Notice
		RP	Compost	
RP+1% compost	0.00 3.00 6.00 9.00 12.0 15.0 18.0	0.00 0.40 0.81 1.21 1.62 2.02 2.43	0.00 40.43 80.86 121.29 161.73 202.16 242.59	Biofertilizer
RP+4% compost	0.00 3.00 6.00 9.00 12.0 15.0 18.0	0.0 1.62 3.32 4.85 6.46 8.09 9.70	0.00 40.43 80.86 121.29 161.73 202.16 242.59	Biofertilizer
RP+7% compost	0.00 3.00 6.00 9.00 12.0 15.0 18.0	0.0 2.83 5.66 8.49 11.32 14.15 16.98	0.00 40.43 80.86 121.29 161.73 202.16 242.59	Biofertilizer
RP+10% compost	0.00 3.00 6.00 9.00 12.0 15.0 18.0	0.0 4.04 8.09 12.13 16.17 20.22 24.26	0.00 40.43 80.86 121.29 161.73 202.16 242.59	Biofertilizer

3. RESULTS AND DISCUSSION

The present work was carried out for study of using bio- phosphorus fertilizers were on maize plants under alkaline soil conditions. The bio- phosphorus fertilizers were prepared by mixing the natural rock phosphate (RP) with compost in different combinations and treating the mixture with PDB.The results showed that grain was significantly influenced by fertilizer types and fertilizer rates of phosphorus (Table 5).

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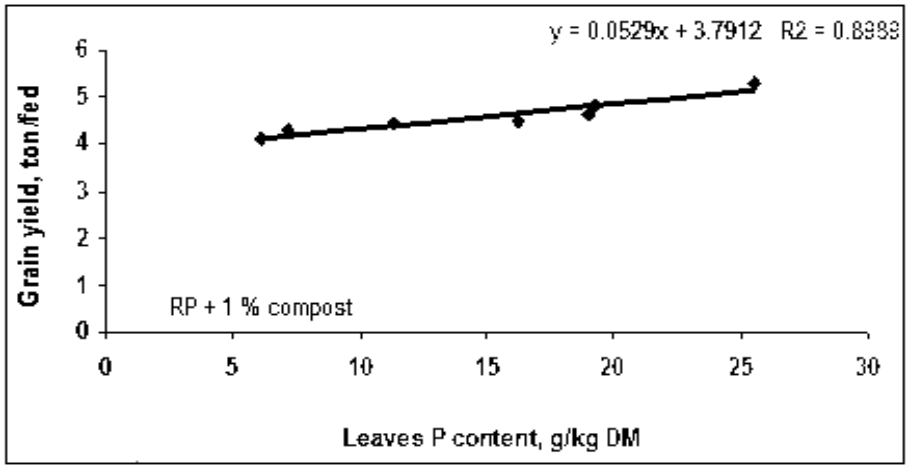
Table (5): Effect of fertilizer type and P rate ongrain yield of corn plants

Treatment		Grain Yield
Fertilizer type	Fertilizer P rate, Kg P/fed	(ton/fed)
RP+1% Comp	0	4.10
	3	4.28
	6	4.45
	9	4.48
	12	4.65
	15	4.80
	18	5.31
RP+4% Comp	0	4.10
	3	4.55
	6	5.80
	9	5.95
	12	6.18
	15	6.70
	18	8.33
RP+7% Comp	0	4.10
	3	5.31
	6	6.00
	9	6.17
	12	6.39
	15	7.25
	18	8.40
RP+10% Comp	0	4.10
	3	5.55
	6	6.57
	9	7.22
	12	7.61
	15	8.61
	18	9.41
Statistical Significant $_{ISD0.05}$		
Fertilizer P type (T)		0.47
Fertilizer R type (R)		0.44
T * R		0.99



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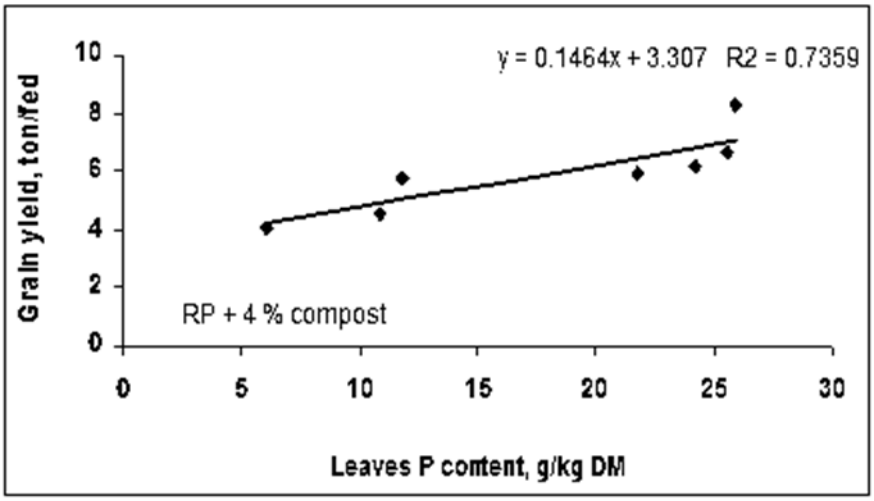

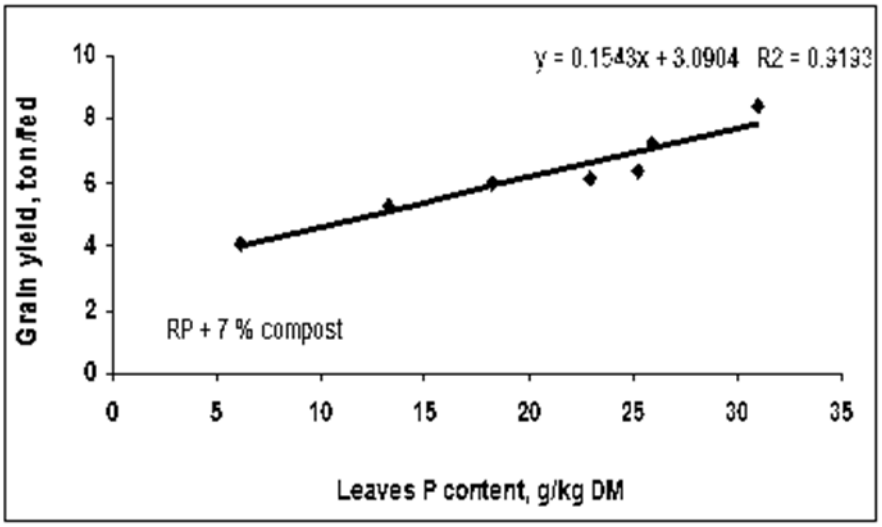

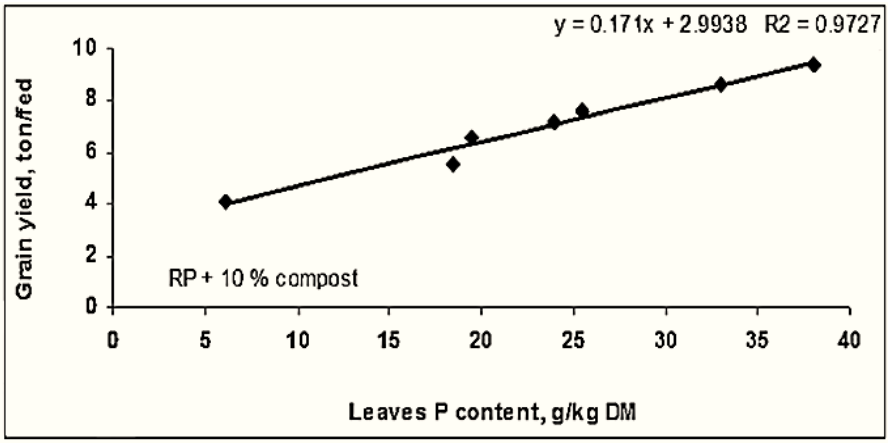

Fig(1):The relationship between grain yield and P rates of different phosphorous fertilizer type.

A significant positive relationship was found between grain yield (ton/fed)and P rate for the five type of phosphorus fertilizers .the values of r were higher indicating that corn plants were sensitive to the dynamics of P-availability with there P fertilizers types in soil .the comparison of the slopes of the regression equations gives a quantitative expression of the efficiency of P in the different phosphour fertilizers types.

It is clear from Table 5 that,at each type of P fertilizer, the yield increase significantly with P rate .The highest yield value was observed with RP+10 %compost at the rateof 18KgP\Fed.(9.41ton\fed).The increases in yield of maize using RP+10%compost organic matter and inoculationwith DPB in increasing the solubility of P from RP besides supplying the plants with some other macro and micronutrients.

4. CONCLUSIONS

It could be concluded that RP amended with compost at specific rates and inoculated with PDB was superior to sole application of superphosphate. This shows that the effectiveness of RP + compost + PDB on crop production was remarkably improved through the solubilizing effect of compost and PDB. Furthermore the complementary use of rock phosphate with 10 % compost of the amount of RP gave the optimum yield in maize.

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