**Annals of Agric. Sci., Moshtohor** **ISSN 1110-0419**
**Vol. 55(1) (2017), 169 – 176** **http://annagricmoshj.com**

# Effect of bio fertilization with p-dissolving bacteria, rock phosphate, sulphur and organic manure in comparison with superphosphate on wheat (triticum aestivum) productivity and soil fertility.

**T. A. Mohamed**O. H. Mohamed*, M. M. El-Sayed*, S. A. Ismail**,**
***Dept. of soil and water, Fac of Agric., Banha Uinv.**
**** Soil, Water and Environment Res. Inst., A. R. C.**
**Corresponding author:** tahaahmed13rh@gmail.com

**Abstract**

Two field trials were conducted in two successive growing seasons (2012/2013 and 2013/2014) at the Experimental Farm of Mallawy Agricultural Research Station (ARC), Minia Governorate, Egypt to study the effect of biofertilization using P- dissolving Bacillus megaterium, P- applied at 43kgha$^{-1}$ as rock phosphate (RP), farmyard manure (FYM) at 24 Mgha$^{-1}$, S at 240kgha$^{-1}$ individually or in different combinations, as well as superphosphate at 16 or 32kgha$^{-1}$ on wheat. Yield of grains, straw, and grain+ straw increased by addition of such treatment. Uptake of N, P and K increased by different magnitudes. Highest positive effect was by biofertilization combined with RP, FYM and S giving effect rather similar to that of the high P rate as superphosphate.

**Key Words:** bacteria, rock phosphate, sulphur , organic manure

## Introduction

Under the Egyptian conditions, fixation and precipitation of applied soluble P in soil causes low efficiency of P fertilizer. Some soil microorganism can dissolve insoluble phosphate in soil, thus supplying the grown plants with available phosphate **(Saad and Hammad, 1998)**. Rock phosphate may be economically effective if applied in combination with application of phosphate- dissolving inoculation specialized organisms such as the Bacillus megaterium bacteria **(Haynes, 1992; and Abou El-Salehein and Ahmed, 1998; Montenegro and Zepata, 2002 and Ali et al 2012).**

Most Egyptian soil contains too little phosphorus to sustain high yields of crops and phosphates are the second fertilizers after nitrogen used for application to crops. Soluble phosphate is subjected to precipitation insoluble forms and crops may use only a little portion of applied soluble P. Response of wheat to soluble phosphorus fertilizer is mainly positive (**Mohamed and Saad 2004; Yadav et al 2007; Salton et al 2011; Khan et al 2012 and Gay et al 2013).**

Methods for increasing the efficiency of rock phosphate are include the use of biofertilization by inoculation of phosphate solubilizing bacteria, elemental sulphur and organic manure addation(**Vessey 2003 ; Habashy 2005 and Ismail et al 2014 B). Drever and Vance (1994)** reported that rock phosphate can be solubilized under the influence of acidity. Addation of sulphur leads to formation of acidic acid and thes makes soil condition more favorable for plant growth, including the availability of phosphorus **(Deluca et al, 1989; Jaggi et al, 2005 and Kacar and Katkat, 2007).**

The present study assesses the effectiveness of biofertilization with and without addition of rock phosphate under conditions of organic manure and / or sulphur addition on wheat crop.

## Materials and Methods

Two field experiments were conducted in two successive growing seasons (2012/2013and 2013/2014) at the Experimental Farm of Malawy Agricultural Research Station, Malawy Town, Minia Governorate, Egypt to study the effect of rock phosphate along with phosphorine inoculation with B. megaterium as a P- dissolving biofertilizer. In addition, farmyard manure and sulphur application were included two rates of superphosphate were added. The crop was wheat (Trilicum aestivum, cv). The soil was a clay (Table 1 shows soil properties). The design of the experiment was a randomized complete blocks, four replicates.

**The treatments were as follows:**
**Rock phosphate application** of 300kg Rock phosphate /fed.

**Bacterial inoculation:**
Seeds of wheat were inoculated with *Bacillus megaterium* bacteria supplied by the Department of Microbiology, Soil, Water and Environmental Institute.

**Organic manure application:**
Farmyard manure was used at 24 Mg (megagram) per hectare and Table 2 shows main properties of the manure used in the experiment (2012-2013 and 2013-2014 seasons).

**Table 1.** Physical and chemical characteristics of soils of the experiment of 2012-2013 and 2013-2014 seasons.

| Soil characteristic | 2012/2013 | 2013/2014 |
|---|---|---|
| **Particle size distribution** | | |
| - Coarse sand % | 2.65 | 3.01 |
| - Fine sand % | 10.24 | 12.98 |
| - Silt % | 35.46 | 31.90 |
| - Clay % | 51.65 | 52.11 |
| **Soil texture** | Clay | Clay |
| pH (1:2.5) soil water suspension | 8.1 | 8.0 |
| EC $dSm^{-1}$ (soil paste extract) | 1.22 | 1.30 |
| Organic mater $gkg^{-1}$ | 14.1 | 13.9 |
| **Soluble cations and anions ($mmolel^{-1}$)** | | |
| - $K^{+}$ | 1.26 | 1.13 |
| - $Na^{+}$ | 0.38 | 0.42 |
| - $Ca^{++}$ | 5.35 | 6.11 |
| - $Mg^{++}$ | 4.64 | 4.57 |
| - $Co3^{--}$ | 0.00 | 0.00 |
| - $HCo3^{-}$ | 3.75 | 3.11 |
| - $Cl^{-}$ | 3.60 | 3.76 |
| - $SO4^{--}$ | 4.28 | 5.36 |
| Soil available N ($mgkg^{-1}$) | 30 | 25 |
| Soil available P ($mgkg^{-1}$) | 10 | 9 |
| Soil available K ($mgkg^{-1}$) | 170 | 183 |

**Table 2.**Chemical propertiesof the Farmyard Manure **.**

| Chemical property | 2012/2013 season | 2013/2014 season |
|---|---|---|
| EC (1:5) | 6.70 | 6.50 |
| Organic matter $gkg^{-1}$ | 147 | 178 |
| C/N ratio | 14/1 | 13/1 |
| Total N ($gkg^{-1}$) | 7.3 | 7.9 |
| Total P ($gkg^{-1}$) | 2.1 | 2.6 |
| Total K ($gkg^{-1}$) | 6.6 | 7.2 |

**The thirteen different treatments are as follows:**

1- Not treated

2- 43kg P as Rock phosphate $h^{-1}$.

3- Biofertilization as Inoculation with phosphate, dissolving bacteria (PDB).

4- Organic manure (24Mg $h^{-1}$) (Mg: megagram=$10^6$g).

5- Sulpher treatment (240kg S $h^{-1}$) (pulverized sulphur)

6- P as rock phosphate + Biofertilization

7- P as rock phosphate + farmyard manure "FYM" (24Mg $h^{-1}$).

8- P as rock phosphate + sulpher.

9- P as rock phosphate + Biofertilization + FYM.

10- P as rock phosphate + Biofertilization + sulpher.

11- P as rock phosphate + Biofertilization +FYM + sulpher.

12- P as calcium superphosphate (16$kgh^{-1}$) "$P_1$".

13- P as calcium superphosphate (32$kgh^{-1}$) "$P_2$".

The rock phosphate contained 60 g $Pkg^{-1}$

The wheat (Trilicum aestivum, V) Beni Suef 1 was sown during the third week of November 2012/2013and 2013/2014 at rate of 144 kg seeds $h^{-1}$. The previous crop was maize in both growing seasons. The field was surface irrigated with Nile water.

Inorganic nitrogen fertilizer was applied to at the recommended rate of 180 kg $Nh^{-1}$ as urea (460gN $kg^{-1}$) added in two equal doses. The first was before the first irrigation and the second was before the second irrigation. Inorganic Potassium was applied to at the recommended rate of 520 kg $h^{-1}$ as potassium sulphate (400 gK $kg^{-1}$) applied with the first dose of nitrogen fertilizer. Following 75 days of planting, samples of 10 wheat plants were randomly chosen from each plot, dried in the oven at 70ºC to determine dry weight/plant and content of N, P and K.

The crop was harvested during the first week of May in the two seasons. The wheat grain and straw yields were determined. Plants were cut at 2-3 cm above the soil surface, each plot separated into grains and straw. The wheat grains and straw and recorded. Sampled were ground and sieved to pass through 0.5 mm screen, and analysed for N, P and K. Soil samples of surface layer (0-30) were collected from each plot after the harvested and analyzed for N, P and K. Total N was determined in plant material

using the (**Chapman and Pratt 1978)** which P was determined in plant digests using the ascorbic acid method and K was determined by the flame photometer.

**Results and Discussion**

**- Growth parameters:**

Data in Table 3 reveal that there was significant increase due to application of rock phosphate, phosphorine, farmyard manure, sulphur and superphosphate on plant. Treatment of applying biofertilizer in combination with FYM, rock-P and S vaused an increase of 43.9% in the first season and 59.3% in the second season. These results indicates the high efficiency of phosphorus dissolving bacteria in mobilizing rock phosphate **(Kucey et al, 1989 and Kumar et al, 2009).** Farmyard manure must have produced organic acids during its decomposition which would dissolve rock phosphate **(Awaad et al, 2000 and Jat et al, 2000).** Sulphur application would lead to formation of sulphoric acodsa which help in dissolution of rock phosphate **(Deluca et al, 1989, Ceccotti, 1996 and Marziehi et al 2010)**.

**Table 3.** Effect of rock phosphate along with phosphorine, organic manure and sulfure as well as mineral phosphorus fertilization on growth characters**.**

| Treatments | Dry weight /plant(g) | |
|---|---|---|
| | Season (1) | Season (2) |
| Control | 1.73 | 1.18 |
| R.P. | 2.07 | 1.45 |
| B. | 1.96 | 1.25 |
| F.Y.M. | 2.19 | 1.66 |
| S. | 1.98 | 1.34 |
| R.P.+B. | 2.20 | 1.58 |
| R.P.+F.Y.M. | 2.21 | 1.70 |
| R.P.+S. | 2.12 | 1.64 |
| R.P.+B.+F.Y.M | 2.46 | 1.82 |
| R.P.+B.+S. | 2.26 | 1.76 |
| R.P.+B.+F.Y.M+S. | 2.49 | 1.88 |
| 50%R.R.P | 2.35 | 1.55 |
| 100%R.R.P. | 2.51 | 1.86 |
| L.S.D 0.05 | 0.075 | 0.083 |

RP: rock phosphate B: biofertilizer
FYM: farmyard manure S: sulfur
RRP: recommended rate of phosphorus

**-Yield:**

Biofertilization, FYM as well as S addition caused increases in grain yields. Increases due to these treatments in the first season were 11.20, 21.10 and 18.39% respectively (Table 5). Similar trends were obtained in the second season. These increases are manifestations of the positive effect of these treatments on growth parameters such as number of spikes $m^{-2}$ and number of grains $spike^{-1}$.

Application of rock phosphate increased grain, straw and biological yields by 17.04, 9.52and 11.34 % respectively (Table 5) in the first season and 25.97, 17.39 and 20.29% respectively in the second season. Positive effects on wheat growth and yield components before in Tables 3 and 4. These results are in agreement with these obtained by (**Haynes 1992 and Abou- Hassien et al 2002).**

Addition of biofertilizer + rock phosphate +FYM + sulphur increases grain, straw and grain +straw yields by 37.22, 14.29 and 21.65% respectively in the first season; and 17.24, 4.35 and 9.26% in the second season. These results indicate the combined effect which decrease soil pH that make partial acidulation and consequently dissolution of rock phosphate (**Singh and Reddy 2011 and Ismail et al 2014 A).** Biofertilization in combination with rock phosphate and FYM with S increased yield equal to yields of the high rate of superphosphate.

**- N, P and K uptake(Table 6-8)**

Rock phosphate application increased N, P and K uptake by grains and straw. Increases of total N, P and K due to rock phosphate were 15.0, 42.5 and 11.8% respectively in the first season, and 18.5, 54.6 and 18.2 in the second season. These results agree with those obtained by **Correa et al (2005) and Abd El- Hafeez et al (2013).**

Biofertilization increased N, P and K uptake by 13.6, 38.3 and 7.5% respectively in the first season and 21.5, 46.1 and 17.0% in the second one. These results are in harmony with those obtained by (**Attia and Badr El Din 1999 and Khalid 2004).** Biofrtilization combined with rock phosphate enhanced the effect of rock phosphate indicating increased solubility of P **(Singh et al 1994 and Zabihi et al 2011).**

**Table 4.** Effect of rock phosphate along with phosphorine, organic manure and sulfure as well as mineral phosphorus fertilization on grain, straw and biological yields**.**

| Treatments | grain yield (Mg ha$^{-1}$) | | straw yield (Mg ha$^{-1}$) | | Grain+ straw yield (Mg ha$^{-1}$) | |
|---|---|---|---|---|---|---|
| | Season (1) | Season (2) | Season (1) | Season (2) | Season (1) | Season (2) |
| Control | 7.96 | 5.49 | 15.12 | 11.04 | 23.28 | 16.56 |
| RP | 9.32 | 6.92 | 16.56 | 12.96 | 25.92 | 19.92 |
| B. | 8.85 | 6.71 | 15.84 | 12.96 | 24.24 | 19.44 |
| FYM | 9.64 | 6.81 | 16.56 | 13.44 | 26.40 | 19.94 |
| S. | 9.42 | 6.67 | 16.32 | 13.20 | 24.96 | 19.9*2 |
| RP+B | 9.32 | 7.10 | 16.56 | 12.96 | 25.92 | 20.16 |
| RP+FYM | 9.92 | 7.10 | 17.28 | 13.20 | 27.36 | 19.92 |
| RP+S | 9.57 | 6.99 | 17.76 | 12.96 | 26.40 | 19.92 |
| RP+B+FYM | 10.25 | 7.35 | 16.80 | 13.92 | 26.88 | 20.64 |
| RP+B+S | 9.14 | 7.81 | 17.28 | 13.44 | 26.64 | 19.20 |
| RP+B+FYM+S | 10.92 | 7.53 | 17.28 | 13.92 | 28.32 | 21.66 |
| SP | 9.17 | 6.99 | 15.84 | 12.24 | 24.96 | 19.44 |
| SP | 11.03 | 7.49 | 17.04 | 13.68 | 28.32 | 21.36 |
| L.S.D | 0.40 | 0.53 | 0.50 | 0.48 | 0.86 | 1.12 |

See Foot Notes of Table (3)

**Table 5.** Effect of rock phosphate along with phosphorine, organic manure and sulfure as well as mineral phosphorus fertilization on N, P and K uptake in grains**.**

| Treatments | N –uptake | | P – uptake | | K – uptake | |
|---|---|---|---|---|---|---|
| | Season (1) | Season (2) | Season (1) | Season (2) | Season (1) | Season (2) |
| Control | 89.08 | 62.08 | 25.68 | 17.73 | 46.56 | 35.47 |
| R.P. | 106.15 | 77.52 | 36.62 | 25.82 | 54.50 | 43.29 |
| B. | 100.87 | 75.79 | 35.71 | 25.03 | 52.65 | 44.06 |
| F.Y.M. | 114.69 | 85.94 | 40.82 | 28.17 | 64.20 | 44.76 |
| S. | 106.44 | 76.05 | 38.95 | 24.21 | 54.16 | 45.75 |
| R.P.+B. | 105.21 | 80.23 | 37.58 | 27.21 | 54.50 | 43.68 |
| R.P.+F.Y.M. | 118.08 | 90.26 | 44.88 | 31.51 | 65.32 | 47.37 |
| R.P.+S. | 107.08 | 79 | 42.50 | 29.76 | 52.08 | 43.03 |
| R.P.+B.+F.Y.M | 122.92 | 93.43 | 40.27 | 32.61 | 88.84 | 64.51 |
| R.P.+B.+S. | 103.20 | 88.29 | 41.47 | 32.18 | 48.84 | 50.44 |
| R.P.+B.+F.Y.M+S. | 129.98 | 94.94 | 47.35 | 34.92 | 73.92 | 51.64 |
| 50%R.R.P | 102.69 | 79 | 38.85 | 28.32 | 53.54 | 44.52 |
| 100%R.R.P. | 124.58 | 84.67 | 48.79 | 33.26 | 65.54 | 49.03 |
| L.S.D | 9.88 | 9.14 | 4.84 | 3.43 | 6.98 | 5.88 |

See Foot Notes of Table 3

**Table 6.** Effect of rock phosphate along with phosphorine, organic manure and sulfure as well as mineral phosphorus fertilization on N, P and K uptake in straw.

| Treatments | N –uptake | | P – uptake | | K – uptake | |
|---|---|---|---|---|---|---|
| | Season (1) | Season (2) | Season (1) | Season (2) | Season (1) | Season (2) |
| Control | 46.8 | 33.1 | 12.1 | 8.6 | 214.7 | 163.4 |
| R.P. | 53.0 | 38.9 | 18.2 | 15.5 | 236.8 | 190.6 |
| B. | 53.8 | 42.7 | 17.4 | 14.3 | 228.3 | 186.9 |
| F.Y.M. | 71.2 | 61.7 | 19.8 | 16.0 | 261.6 | 208.1 |
| S. | 53.9 | 43.6 | 15.3 | 15.9 | 221.1 | 188.7 |
| R.P.+B. | 56.4 | 42.7 | 23.2 | 19.5 | 236.8 | 186.7 |
| R.P.+F.Y.M. | 74.3 | 55.9 | 22.4 | 19.8 | 269.5 | 202.1 |
| R.P.+S. | 58.5 | 40.1 | 23.0 | 18.0 | 248.6 | 188.1 |
| R.P.+B.+F.Y.M | 74.3 | 56.5 | 25.2 | 20.9 | 258.7 | 215.8 |
| R.P.+B.+S. | 57.1 | 42.9 | 26.0 | 21.4 | 247.1 | 192 |
| R.P.+B.+F.Y.M+S. | 77.7 | 65.4 | 22.4 | 18.0 | 273.0 | 218.5 |
| 50%R.R.P | 52.3 | 39.3 | 19 | 13.4 | 228.0 | 176.2 |
| 100%R.R.P. | 77.7 | 43.8 | 23.8 | 19.0 | 246.9 | 203.6 |
| L.S.D | 7.1 | 5.7 | 3.45 | 2.4 | 18.5 | 20.7 |

See Foot Notes of Table (3)

**Table 7.** Effect of rock phosphate along with phosphorine, organic manure and sulfure as well as mineral phosphorus fertilization on total N, P and K uptake**.**

| Treatments | N –uptake (kg ha$^{-1}$) | | P – uptake (kg ha$^{-1}$) | | K – uptake (kg ha$^{-1}$) | |
|---|---|---|---|---|---|---|
| | Season (1) | Season (2) | Season (1) | Season (2) | Season (1) | Season (2) |
| Control | 138.3 | 97.6 | 40.1 | 26.7 | 261.6 | 198.4 |
| R.P. | 159.1 | 115.7 | 57.2 | 41.3 | 292.5 | 234.6 |
| B. | 157.1 | 118.1 | 55.5 | 39.1 | 281.3 | 232.1 |
| F.Y.M. | 211.8 | 147.6 | 63.1 | 44.5 | 325.8 | 254.2 |
| S. | 160.2 | 119.5 | 56.7 | 40.3 | 275.0 | 232.2 |
| R.P.+B. | 161.4 | 123.1 | 36.6 | 46.5 | 291.7 | 229.8 |
| R.P.+F.Y.M. | 194.7 | 145.8 | 67.8 | 51.5 | 335.3 | 249.0 |
| R.P.+S. | 165.9 | 119.3 | 65.7 | 47.6 | 301.8 | 230.4 |
| R.P.+B.+F.Y.M | 199.7 | 150.1 | 65.4 | 53.5 | 348.1 | 280.1 |
| R.P.+B.+S. | 160.5 | 131.3 | 67.7 | 53.5 | 295.3 | 243.2 |
| R.P.+B.+F.Y.M+S | 210.1 | 162.7 | 72.2 | 53.1 | 346.1 | 269.8 |
| 50%R.R.P | 157.9 | 118.3 | 60.2 | 42.6 | 282.4 | 220.1 |
| 100%R.R.P. | 201.8 | 128.4 | 72.3 | 53.4 | 313.1 | 253.1 |
| L.S.D | 16.5 | 16.1 | 5.6 | 4.8 | 10.5 | 15.1 |

See Foot Notes of Table (3)

Application of FYM increased N, P and K increases were 30.1, 57.0 and 24.5% respectively in the first season. This indicates the positive effect of manure (**Hassanin 2009, Tahir et al 2011 and Ismail et al 2014 A).** Sulphur application increased uptake of N, P and K. Combined sulphur with rock phosphate did not affect N and K uptake composed with rock phosphate alone, while such combined treatment showed higher uptake than with rock phosphate alone-positive effect of S indicates its acidic effect ( **Muchovej et al 1989).**

Biofertilization, manure or sulphur increased the uptake of N, P and K due to the combined effect of biofertilization +manure + rock phosphate+ S caused increases of 32.1, 26.2 and 18.3% over rock phosphate alone in the first season. Same trends were obtained in the second season. Synergestic activity of biofertilization, FYM and S enhanced N, P and K uptake. These results are in harmony with those obtained by (**El- Koumy 2007 and Banerjee et al 2011).**

Application of superphosphates increases N, P and K uptake. These results are in agreement with those obtained by (**Abd El- Hafeez et al 2013 and Gay et al 2013).**

**- Soil fertility (Table 8)**

Availability of N, P and K in soil after harvesting showed increases due to application of amendement. Increased availability is mostly due to the nutrients release during the course of the experiment **(Ali et al 2012)**. These results agree with those obtained by **(Abd El- Lattif 2012).**

**Table 8.** Effect of rock phosphate along with phosphorine, organic manure and sulfure as well as mineral phosphorus fertilization on availability of N, P and K in soil**.**

| Treatments | Soil available N (mgkg$^{-1}$) | | Soil available P (mgkg$^{-1}$) | | Soil available K (mgkg$^{-1}$) | |
|---|---|---|---|---|---|---|
| | Season (1) | Season (2) | Season (1) | Season (2) | Season (1) | Season (2) |
| Control | 28.2 | 26 | 9.2 | 9.6 | 126 | 151 |
| R.P. | 28.2 | 26.2 | 12.4 | 12.7 | 128 | 153 |
| B. | 30.6 | 28 | 10.9 | 11 | 127 | 152 |
| F.Y.M. | 33.3 | 30.7 | 13.2 | 14 | 140 | 168 |
| S. | 29 | 26.8 | 11.8 | 12 | 129 | 153 |
| R.P.+B. | 30.8 | 28.1 | 14.1 | 13.9 | 129 | 152 |
| R.P.+F.Y.M. | 33.1 | 31 | 15.6 | 16 | 142 | 169 |
| R.P.+S. | 29.3 | 27 | 14.7 | 15 | 127 | 152 |
| R.P.+B.+F.Y.M | 33.4 | 33 | 17 | 17.6 | 141 | 170 |
| R.P.+B.+S. | 30.6 | 28.3 | 16.7 | 16.8 | 130 | 152 |
| R.P.+B.+F.Y.M+S. | 34 | 32.7 | 18 | 18 | 142 | 169 |
| 50%R.R.P | 29.1 | 26.6 | 10.6 | 10.8 | 129 | 153 |
| 100%R.R.P. | 30 | 27.2 | 11.2 | 11.7 | 130 | 155 |
| L.S.D | 3.9 | 4 | 0.58 | 0.67 | 7 | 8 |

See Foot Notes of Table (3)

Increased availability of P could be arranged by treatments as follows: RP+B+FYM+S> RP+B+FYM> RP+B+S> RP+FYM> RP+S> RP+B> FYM> RP> S> 100%RRP >B>50%RRP. FYM had the greatest effect. The positive effect of FYM reflect its acidifying effect in releasing available P **(Gowda et al, 2011)**. Sulphur must have caused by acidfy increasing available P **(Duponnois et al. 2005). Badr 2006 and Hellal et al (2009)** reported enhancing effects of organic manure in increasing P availability in soil.

**Conclusion**

The highest grain quality and yield of wheat was obtained by inoculation of seeds with P- dissolving bacteria in combination with 24 Mg FY|M, 43kg P as rock phosphate, 240kg S $h^{-1}$ .

**References**

**Abd El- Hafeez, A.M. and Ali, R.M. 2013:** Influence of inorganic nitrogen, phosphorus and bio-fertilizers on growth, yield and yield components and nutrient uptake of cucumber (*Cucumssativus L.*). J. Soil Sci. and Agric. Eng. Mansour Univ. 4 (11): 1329-1346.

**Abd El- Hafeez, A.M.; Awadalla, H.A. and Ismail, S.A. 2013:** Influence of different sources and levels of nitrogen and rock phosphate addation on maize productivity and soil fertility. J. Soil Sci. Agric. Eng., Mansoura Univ. 4 (11): 1313-1328.

**Abd El- Lattif, R.F.H. 2012:** Studies of balanced fertilization of corn plant under newly reclaimed land. M. Sci. Thesis, Fac.of Agric. Banha Univ., Egypt.

**Abou El-Salehein, E.H. and Ahmed, M.A. 199**8. Effect of some bio and chemical fertilizers on growth, chemical composition and yield of snap bean (Phaseolus vulgaris L.). Egypt. J. Appl Sci., 13(12): 228-246.

**Abou Hussien, E.A.; Abou El-Fadl, M.A.; Ramadan, S.A.; and Khalil, H. 2002:** Response of wheat and broad bean plants to phosphorus under different soil conditions. Egypt J.Agric.Res, 80(1): 41-55.

**Ali, H.; Sarwar, N.; Ahmed, S.; Tariq, A.W.; Shahzad, A.N. 2012:** Response of wheat crop to phosphorus fertilizers and application methods grown under agro-climatic conditions of southern Punjab. Pakistan Journal of Agricultural Science, 49 (4): 485-489.

**Ali, M.E.;Ismail,S.A,;Hameid,A.H.; El-Hussieny, O.H.M. and El-Sheref, G.F.H. 2012:** Effect of natural fertilizers under different levels of nitrogen and farmyard manure on the productivity of maize. Fayoum J. Agric. Res. & Dev. 26 (1):49-63.

**Attia, M. and Badr El Din, S.M. 1999.**The interaction between arbuscularmycorrhizal fungi as nutrient up-take of maize plants grown in a clay loamy soil. Egypt Microbiol, 34: 479–487.

**Awaad, Y.H.; Abdel- Ghani M.M.; Naim, M.H.S. and Skina, A.M. 2000:** A comparative study on the effect of some organic acid and inorganic amendments on sandy soil physical properties and yield of corn. J. Agric. Mansoura Univ. 25:1865-1871.

**Badr, M. A. 2006:** Efficiency of K- feldspar combined with organic materials and silicate dissolving bacteria on tomato yield. J. Appl. Sci. Res.2 (12): 1191-1198.

**Banerjee, M.; Rai, R.K. and Debtanu, M. 2011:** Effect of PSB and VAM with different sources of phosphatic fertilizer on growth attributes, Chlorophyll content and yield of wheat. International Journal of Bio- resource and stress management, 2(1): 72-77.

**Ceccotti, S.P. 1996:** Plant nutrition sulphur. A review of nutrient balance, environment impact and fertilizer.Fert. Res. 43: 117-125.

**Chapman, H.D. and Pratt, P.F. 1978:** Method of Analysis of Soils, Plants and Water, Univ. California Div. of Agric. Science, Priced Publ. 4034. USA.

**Correa, R.M.; Nascimento, C.W.A.; Souza, S.K.; Freie, F.J. and Silva, G.B. 2005:** Gufsa rock phosphate and triple superphosphate for dry matter production and P uptake by corn. Scienta Agricola 62 (2):159-164.

**Deluca, T.H.; Skogley, E.O. and Engle, R.E. 1989.**Band – applied in alkaline calcareous soil. Biol. Fertilizer Soils, (7): 346-350.

**Drever, J.L. and Vance, G.F., 1994.** Role of soil organic acids in mineral weathering processes. In: Lewan, M.D., Pittman, E.D. (Eds). The Role of Organic Acids in Geological Processes. Springer Verlag, New York, pp. 138– 161.

**Duponnois, R.; Aline, C.; Victor, H. and Jean, T. 2005:** The mycorrhizal fungs glomus intraradices and rock phosphate amendment influance plant growth and microbial activity in rhizosphere of Acocia holosericea. J. Soil. Biol. and Biochem., 37: 1460-1468.

**El-Koumy, H.M. 2007:** Effect of organic manure and bio fertilizers on wheat grown in lacustrine soil as compared with mineral fertilizers. Egypt, J. Soil Sci. 47 (3): 263-280.

**Gay, R.;Gorski, D. and Przybyl, J. 2013:** Effect of differentiated phosphorus and potassium fertilization on winter wheat yield and quality. J. of Elementology; 18 (1): 55-67.

**Gowda, A. M.; El-Taweel, A. A. and Eassa, K. B. 2011:** Studies on reducing the harmful effect of saline water irrigation on picual olive trees. Minufiya J. Agric. Res., 36 (3): 623-645.

**Habashy, N.R. 2005:** A comparative study for phosphorus forms or applied methods and their effects on tomato fruit yield and its quality in calcareous soil. Egypt. J. Appl. Sci. 20: 290-304.

**Hassanin, A.M.M. 2009:** Nitrogen fertilization of corn in newly reclaimed land. M. Sci. Thesis, Fac. of Agric. Minia Univ., Egypt.

**Haynes, R.J. 1992:** Relative ability of arrange of crop species to use rock phosphate and monocalcium phosphate as P sources when grown in Soils. J. Sci. Food Agric. 60: 205-211.

**Hellal, f. A.; Abd El-Hady, M. and Ragab, A. A. M.2009:** Ifluance of organig amendment on nutrient availability and uptake by faba been plants fertilized by rock phosphate and feldspar. American- Eurazian J. Agric. and Environ. Sci., 6 (3): 271-279.

**Ismail, S.A.; Abd El- Hafeez, A.M. and Galal, O.A.M. 2014A:** Response of soybean (*Glycine max L.*) to microbial inoculation under chemical fertilization: 1-Nodultion, yield its components. Egypt. J. of Appl. Sci. 29 (12B): 1237-1258.

**Ismail, S.A.; Abd El-Hafeez, A.M.; Galal, O.A.M. and Awadalla, H.A. 2014B:** Impact of some alternative fertilizers such as anhydrous ammonia, humic acid, rock phosphate and feldspar on growth, yield and its components and nutrient uptake of wheat as well as nutrient availability. Fayoum J. Agric. Res. & Dev. 28 (1): 89-107.

**Jaggi, R.C.; Aulakh, M.S. and Sharma, R. 2005:** Impacts of elemental sapplied under various temperature and moisture regimes on pH and available P in acidic, neutral and alkaline soils. Biol. Fertilizer Soils, 41: 58 – 52.

**Jat, R.S.; Khangarot, S.S. and Rathore, S.S. (2000):** Effect of different fertility levels on growth and yield of mustard (Brassica juncea L.). Annals of Sci., 21: 421-423.

**Kacar, B. and Katkat, A.V. (2007)** Plant Nutrition. 3th Edn. Nobel Press; Ankara, Turkey.

**Khalid, K.A. 2004.** Response of white mustard (Sinapisalba L.) plants to calcium superphosphate and phosphorine under calcareous soil conditions. Arab Universities, Journal of Agricultural Sciences, (12)2: 735-747.

**Khan, M.B.; Lone, M.I. and Rehmat U. 2012:** Effect of phosphatic fertilizers on chemical composition and total phosphorus uptake by wheat (Triticum aestivum L.) International J. of Agric. Sci. Res. and Tecnology (IJASRT) 2 (1): 37-42.

**Kucey, R.M.N.; Janzen H.H. and Legett M.E. 1989.** Microbial lymediated increases in plant available phosphorus. Advances in Agronomy 42: 199-228.

**Kumar, S. T.; Swaminathan, V. and Kumar, S. 2009.** Influence of nitrogen, phosphoras and biofertilizer on growth, yield and essential oil constituents in ratoon crop (*Artemisia pallens*). Electronic Journal of environmental. Agriculturral and food chemistry, (8)2: 86-95.

**Marziehi, M.A.; Amir, L.; Gholam, H.H. and Ali, R.B. 2010:** Effect of thiobacillus, sulphur and vermicompost on the water- soluble phosphorus of hard rock phosphate. Biotesource Tecnology, 101: 551-554.

**Mohamed, M.A.H. and Saad, O.A.O. 2004:** Effect of VA-mycorrhizae and Azotobacter on growth and oil production of Achillermile folium L. plant under different water regimes. J. Agric.Sci., Mansoura Univ., 29(10): 391-406.

**Montenegro, A. and Zapata, F. 2002:** Rape genotypic difference in P uptake and utilization from phosphate rocks in an Andsol of chile. Nutrient Cycling in Agroecosystem 63: 27-33.

**Muchovej, R.M.; Muchovej, J.J., and Alvarez, V.H. 1989:**Temporal relations of phosphorrus fractions in anoxisol amended with rock phosphate and Thiobacillus thiooxidans. Soil Science Society of America Journal, 53: 1096-1100.

**Saad, O.A.O. and Hammad. A.M.M. 1998:** Fertilizing wheat plants with rock phosphate combining with phosphate.

**Salton, N.A.; Delong, R.E.; Mossey, C.G.; Chark, S.; Shafer, J. and Branson, J. 2011:** wheat grain response to phosphorus, potassium and micronutrient fertilization, (Wayne E. SabbeArknsas Soil fertility Studies 2010). Research Series-Arkansas Agricultural experiment Station, (588): 42-45.

**Singh, H. and Reddy, M.S. 2011.** Effect of inoculation with phosphate solubilizing fungus on growth and nutrient uptake of wheat and maize plants fertilized with rock phosphate in alkaline soils. European Journal of Soil Biology, 47: 30-34.

**Singh, R.; Gupta, R. and Saxena, R.K. 1994:** Rock phosphate solubilization under alkaline condition by Aspergillus jabonicus and A. foetidus. Folia Microbiologica, 39: 33-36.

**Snedecor, G.W. and Cochran, W.G. 1982:** Statistical methods. The LOWA State Univ. Press Amer. U.S.A.

**Tahir, Sh.; Alam, S.M. and Zulfiqar Ahmad 2011:** Wheat yield and phosphorus fertilizer efficiency as influenced by pre-inoculated use of single superphosphate and poultry litter and its time of application. Journal of Plant Nutrition, 34(7): 1034-1040.

**Vessey, (2003).** Improvement of mung bean growth and productivity in salinity affected soil after seed inoculation with phosphate dissolving bacteria. African Crop sci. Comference Proeedings, (9): 385-389.

**Yadav, V.; Singh, L.R. and Rajendra Singh 2007:** Effect of phosphorus fertilization on wheat (Triticum aestivum L.) varieties under late sown condation in Mid-Western plain zone of Environment and Ecology: 255 (Special 4): 1201-1202.

**Zabihi, H.R.; Savaghabi, G. R.; Khavazi, K.; Ganjali, A. and miransari, M. 2011:**

Pseudomonas bacteria and phosphorus fertilization affecting wheat (*Triticum aestivium L.*) yield and P uptake under greenhouse and field conditions. Acta, Physiologiae Plantarum, 33 (1): 145-152.

## تأثير التسميد الحيوى مع البكتريا المذيبه للفوسفوروتداخلاته مع صخر الفوسفات والمنشطات العضوية والكيميائية مقارنة بسوبر فوسفات الكالسيوم علي إنتاجية القمح وخصوبة التربة

طه احمد محمد** ، عمر حسينى محمد*، مها محمد السيد على*، صفوت احمد اسماعيل**،
*قسم الاراضى والمياه –كلية الزراعه بمشتهر جامعه بنها.
**معهد بحوث الاراضى والمياه والبيئه.

- أجريت تجربتان حقليتان بالمزرعة البحثية بمحطة بحوث ملوي ، مركز البحوث الزراعية ، جمهورية مصر العربية خلال موسمي النمو 2013/2012 ، 2014/2013 وذلك من اجل دراسة تاثير التسميد الحيوى باستخدام البكتريا المذيبه للفوسفات مع استخدام صخر الفوسفات بمعدل 43 كجم /هكتار، والماده العضويه بمعدل 24ميجا جرام /هكتار، والكبريت بمعدل 240كجم/هكتار ،والسوبر فوسفات بمعدل 16، 32كجم/هكتار.

- وقد تبين ان محصول الحبوب والقش والقش +الحبوبادت زياده معنويه.
- امتصاص النيتروجين والفوسفور والبوتاسيوم زاد بزيادات مختلفه.
- وجد ان اعلى تاثير ايجابى كان بواسطة التسميد الحيوى مع الصخر والماده العضويه والكبريت اعطت تاثير مساوى مع اعلى معدل من السوبر فوسفات.