STUDIES ON SOME FACTORS AFFECTING THE SOLUBILIZATION OF P IN THE RHIZOSPHERE

By

ROOKAYA SALAH MAHMOUD HOSSIEN
B.Sc. Agric. Sc. (Plant production), Ain Shams University, 2012

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ABSTRACT

Rookaya Salah Mahmoud Hossien. Studies on some Factors Affecting the Solubilization of P in The Rhizosphere. Unpublished M.Sc. Thesis, Department of Soil Science, Faculty of Agriculture, Ain Shams University, 2019.

This study was carried out to explore the effect of some factors i.e. $CaCO_3$, pH, organic matter (humic acids, H.A) and clay mineral (bentonite) on the availability and behavior of phosphorus in rhizosphere and non rhizosphere zone as well as dry weight and P content of phaseolus plant grown on calcareous and noncalcareous sandy soils. Three experiments were conducted as follows: an incubation experiment using plastic bottles containing acid washed sand mixed with the used treatments i.e. $CaCO_3$, bentonite, humic acid (H.A) at different rates to investigate their effect on availability of P. Results showed that, in general, both of $CaCO_3$ and incubation time significantly decreased the $NaHCO_3$– extractable P, the increase of pH reduced the extracted phosphorus. The increase of available phosphorus went hand by hand with increasing both of H.A application to soil and incubation time, while the available phosphorus decreased significantly with increasing rate of the added bentonite as well as incubation time.

A second experiment using a split medium technique was conducted to study the effect of $CaCO_3$, pH, humic acid, bentonite and root exudates on the pH, P solubility in the root growth medium and P concentration in bean plants (*Viciafaba* var. balady). Results showed that The lowest significant soluble P values were found in the treatments of control (without P), but the concentrations of P in roots and shoots of bean plant received (super phosphate, (S.P) + bentonite + humic acid (H.A), rock phosphate (R.P) + bentonite + humic acid (H.A), super phosphate, (S.P) + humic acid (H.A) and rock phosphate (R.P) + humic acid (H.A)) treatments were 1.83, 1.17, 1.14 and 1.0% for roots and 2.07, 2.03, 1.72 and 1.25% for shoots, respectively.

A third experiment was carried out under greenhouse conditions to study the effect of the different treatments on the availability of P in calcareous and noncalcareous sandy soils. The treatments of this experiment depended on the results of previous experiments. Phaseolus (***Phaseolus vulgaris*** - Common Bean) was chosen to evaluate the effect of the best treatments on plant growth as well as P fractions in the soil. The dry weights of shoot and root of phaseolus plants grown on noncalcareous sandy soil were higher than those grown on the calcareous one. The highest values of P concentration in shoot and root were found for (S.P+H.A) treatment in both soils and effects of other treatments were significantly greater than (S.P) treatment for shoot and root of phaseolus plant.

P sequential extraction showed that the highest significant Ca-P and OXD-P fractions were found for S.P treatments to the studied soils. The highest significant Org-P values were 24.8% and 26.2% for rhizosphere and non-rhizosphere zone, respectively S.P + H.A, while the highest significant Org-P fraction in non-cultivated calcareous soil was 24.4% for H.A treatment and $CaCO_3$ has a series of fixation reactions occur that gradually decrease P solubility and eventually availability to plants. Addition of organic matter (used as H.A) showed significant positive effect, while $CaCO_3$ and / or high pH showed significant negative effects when applied in combinations with P fertilizers to sandy soils. However, bentonite addition resulted slight effect.

Key words: Humic Acid, Bentonite, $CaCO_3$, pH, Rock phosphate, Rhizosphere, Split medium technique, Bean plants and fractionation of P.

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INTRODUCTION

The mobility of phosphorus (P) in the shallow subsurface is a matter of critical importance and considerable complexity. Its importance stems from the fact that P, an essential nutrient for all plant and animal life.

Agricultural fertilizers and other soil amendments, such as mineral P fertilizers and animal manure, provide P that is readily available to plants. The short-term availability of P to crops is strongly influenced by biochemical processes that affect organic matter, while its long-term status is generally determined by geochemical transformations.

Hopkins and Ellsworth (2005) reported that. Calcareous soil is defined as having the presence of significant quantities of free excess lime (calcium or magnesium carbonate). Lime dissolves in neutral to acid soil pH, but does not readily dissolve in alkaline soil and, instead, serves as a sink for surface adsorbed calcium phosphate precipitation.

The bioavailability of P is strongly tied to soil pH. The formation of iron and aluminum phosphate minerals results in the reduced solubility of P in strongly acidic soil, P solubility improving as pH approaches nearly neutral. This maximum solubility and plant availability of P at pH 6.5 declines again as the pH increases into the alkaline range.

Humic acid is a commercial product of organic fertilizers containing most elements that improve soil fertility and increase nutrients availability, thus enhances plant growth and yield as well as decreases the harmful effect of stresses **(Doran et al., 2003**). In addition, humic acid (HA) from wheat straw leachate can inhibit the formation of insoluble Ca phosphates and thus may enhance P bioavailability **(Grossl and Inskeep,**

1991). However, increasing phosphorus recovery is the effect of HA on the availability of P and micronutrients has been given particular attention because of observed increases in uptake rates of these nutrients following application of humic acid **(Satisha and Devarajan, 2005).**

Thus, the aim of this work is to evaluate the effect of some factors such as $CaCO_3$, pH, bintonite, organic mater (humic acid) on P solubility and availability in the rizosphere zone as well as increasing the efficiency of such nutrient in calcareous and noncalcareous soils which is reflected on the growth of plant.