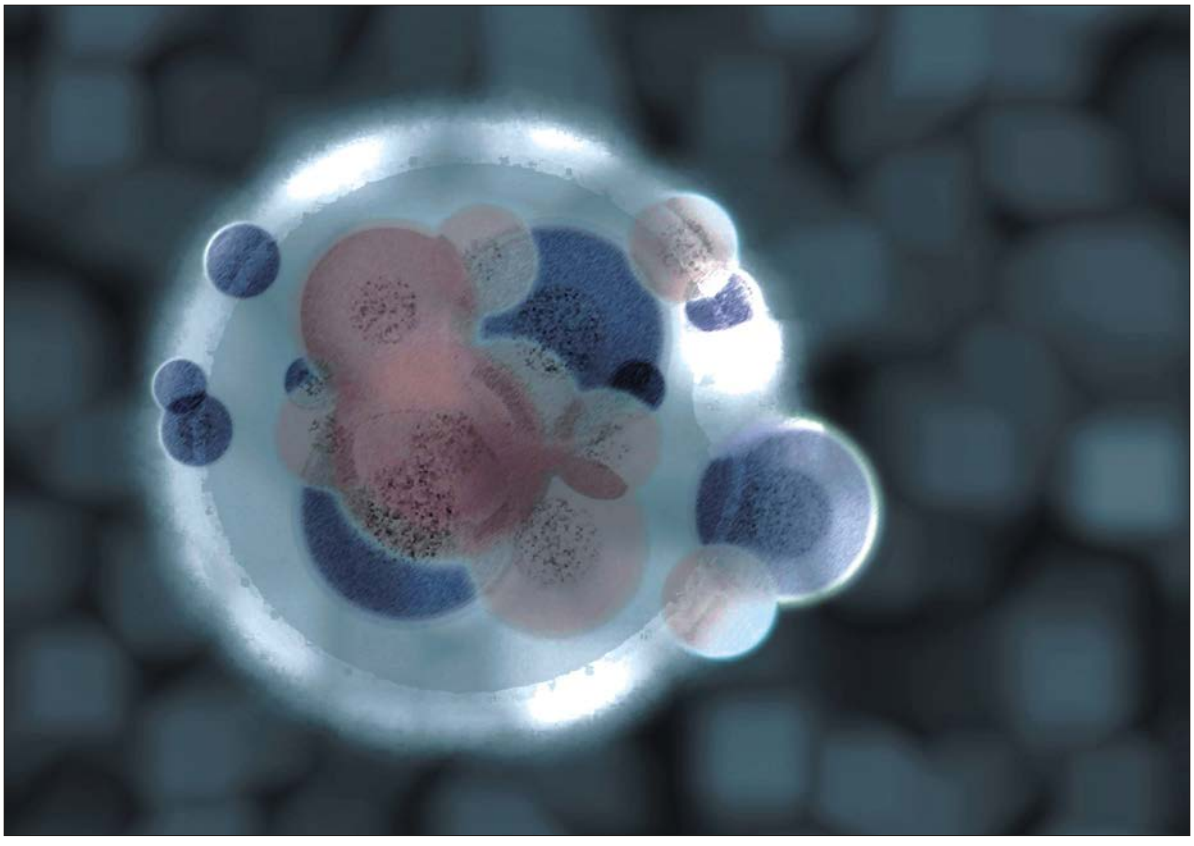

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Effect of Incubation Period on Phosphate Sorption from Two P Sources

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Abstract: The results showed that by increasing the time of incubation, P availability in soil gradually decreased for both organic (DCP) and inorganic (SSP) sources. Phosphorus sorption irrespective of source, however, increased with incubation time. SSP compared to DCP yielded more AB-DTPA extractable P up to day 7, P content of SSP after day 14 became equal to that of DCP, and there after declined. After day 56, as much as half of P from SSP was sorbed out compared to 1/4th of P from DCP. Thus a readily soluble P source (SSP) was more affected to sorption under an alkaline calcareous soil environment compared to slowly soluble P source (DCP) which maintained P availability in soil for a longer period of time.

Key words: Phosphorus sources, P-sorption, calcareous soil

Introduction

The consistency in P availability to plant has remained a matter of great interest especially for arid/ semi arid region with alkaline calcareous soils having abundant Ca rich clay mineral and free lime. The constituent of soil fixes much of the applied P into form that remains difficultly soluble in soil system, commonly known as "sorption" or "fixation". Sorption of P is a process in which readily soluble phosphate is changed to less soluble forms by reacting with inorganic or organic compound of the soil so that P becomes immobilized and there is decrease in the quantity of P to plants (Kardos, 1964).

Transformation of available P into unavailable compound is the major cause responsible for insufficient utilization of P fertilizer (Sharpley, 1983). Chaudhry and Qureshi (1980) reported that P fixation increased with the increase in clay content. Biswas and Ghoshi (1988) found a decrease in the recovery of added P in alkaline alluvial soil with the increase in time and temperature of incubation. Tisdale *et al*. (1985) reported that the amount of P sorbed by soil depend on the saturation of sorption complex or the number of sites available for reaction with added P. Agbenin and Tiessen (1995) investigated the time dependent P sorption of five soils and found a rapid initial sorption followed by a slower phase. At 50 days, sorption reached a steady state in all soil. Chand *et al.* (1995) found that the steady state equilibrium in low P fixing alluvial soil is attained within two days. This study was conducted to evaluate the extent of P sorption of two P sources, differing in water solubility, on an alkaline clay loam soil as affected by time of incubation.

Materials and Methods

Surface (0-15 cm) soil sample was collected, air dried, ground and sieved through 2 mm sieve. The soil sample was analyzed for physico-chemical properties (Table 1). Soil saturated paste was prepared to measure water holding capacity and also to determine EC and pH (Adams, 1984). Soil texture was determined by hydrometer method and $CaCO_3$ was analyzed as proposed by Richards (1954). Phosphorus was extracted by sodium bicarbonate (Olsen *et al*., 1954).

Two hundred gm soil was taken in plastic vessels and arranged in completely randomized design with three replicates and having treatments as Control (no P) or 75 mg P kg^{-1} soil each from an inorganic source (SSP) and an organic source (DCP), a low water soluble P source and a bye-product of industry. Composition of SSP and DCP are given in Table 2. The soil was incubated at 20°C and was maintained at 70% water holding capacity by replenishing deficient water after weighing the vessels twice a week. Phosphorus was extracted by AB-DTPA (Soltanpour and Schwab, 1997) in moist samples collected from each treatment at 0, 1, 3, 7, 14, 28, 56, 90 and 120 days after the incubation of the soil and P was determined by ascorbic acid blue colour method (Olsen *et al*., 1954). A separate sample was used to estimate moisture content and results were expressed on an oven dry basis. Sorbed P was determined by subtracting the net applied P available in the soil from the total applied P.

Table 1: Some physico-chemical properties of soil

Soil series	Bhalwal-5
Subgroup	Typic Ustochrept
Texture	Clay Loam
pH	8.20
ECe (dSm^{-1})	0.79
Organic matter (%)	0.43
Free $CaCO_3$(%)	2.10
Olsen's P (mg kg^{-1})	20.50

Table 2: Composition of dicalcium phosphate and single superphosphate

Source	pH	Water Soluble %1 sol.	Citrate soluble %P	Total
Dicalcium phosphate	5.49	1.33	17.46	19.01
Single super -phosphate	5.60	7.64	7.64	7.80

Results and Discussion

The amount of P available after the incubation period of 0, 1, 3, 7, 14, 28, 56, 90 and 120 days is presented in Fig. 1. Initially upto day 7, SSP yielded more AB-DPTA extractable P compared to that of DCP. It might be due to higher solubility index of SSP (Tisdale *et al.,* 1985) compared to slower solubility organic complex (DCP). Later, higher P concentration of soil solution enhanced the P fixation rate for SSP compared to that of DCP. Therefore, after fourteen days period, P content of SSP became equal to that of DCP but there after decreased. However, the amount of P available from DCP remained significantly higher than that of SSP for the 120 days period studied. This indicates that superiority once

achieved by a source continued for a longer period of time. The results are confirmatory to Biswas and Ghoshi (1988). They indicated a decrease in the recovery of added P in alkaline alluvial soil with the increase in time and temperature of incubation. The results of incubation experiment on 19 soils showed that in all soils and at all P rates, availability index decreased with time (Afif *et al.*, 1993).

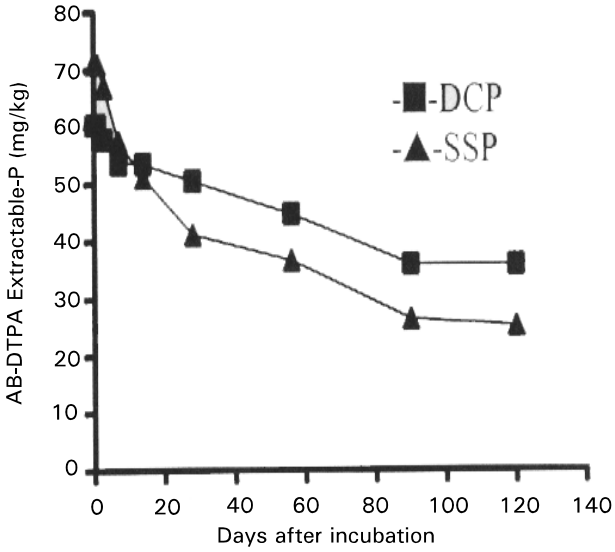

Fig. 1: Effect of time of incubation on AB-DTPA extractable P (mg kg^{-1}) from two sources

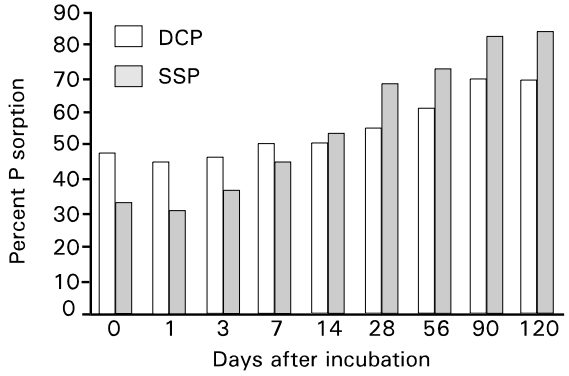

Fig. 2: Sorption of P (%) from DCP and SSP as influenced by time of incubation.

The percent P sorbed to clay loam soil with respect to time of incubation is presented in Fig. 2. The results showed that by increasing the time of incubation, percent P sorption increased for both P sources. Sorption of P was minimum at day 0 and steadily increased with incubation time. Yaseen *et al.* (1999) also reported increased P sorption with increase in incubation time. However, % P sorption from DCP was comparatively slow upto 28 days and thereafter increased, whereas in case of SSP, there was a steady and consistent increase in P sorption upto day 90. The results indicated that steady state condition (maximum sorption) was attained at day 90. The increase in incubation time did not further affect P fixation of both DCP and SSP. However, the steady state condition was attained after 69.76% P sorption from DCP compared to 82.63% P sorption from SSP. The low P sorption value for DCP to develop saturation (maximum sorption) under the same environment is really interesting. It might be due to satisfaction of some fixation sites by the ions produced after the decomposition of organic complex (DCP). Fox and Comerford (1992) reported that organic matter decomposition produced low molecular weight organic acids in the soil. It has been suggested that organic acids produced in the rhizosphere enhance the availability of P both by supplying proton and by complexing Cation (Moghimi *et al.*, 1978). Thus the results indicate that a readily soluble P source was more affected to sorption under an alkaline calcareous soil environment compared to slowly soluble organic P complex, that is less inclined to sorption and maintained P availability in soil for a longer period of time.

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