

MINERALIZATION OF INOSITOL PENTA- AND HEXAPHOSPHATE IN SOILS

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ABSTRACT

The nature of changes of inositol penta -- and hexaphosphate in some Bangladesh soils have been studied. Mineralization of both the compounds occurred at different moisture levels. Mineralization of inositol penta -- and hexaphosphate was continual, but the rate decreased with time. Mineralization was found to be a function of moisture, organic matter, pH and content of soil inositol penta -- and hexaphosphate with a positive correlation.

INTRODUCTION

Investigations into the nature of organic phosphorus compounds in soils have been focused mainly on the higher phosphorus esters of inositol penta -- and hexaphosphate (1,2,3) which sometimes constitute more than half of total organic phosphorus (1,3). These compounds contribute very little to the phosphorus assimilation by plants unless mineralized(4). Mineralization is the follow-up process of dissociation of the phosphorus containing complexes and is a time bound reaction. So factors responsible for dissociation of the complexes may presumably be also taken into account for the study of the process of mineralization. Mineralization depends to a greater extent upon the nature of phosphorus containing organic complexes and the environmental conditions under which the biochemical transformation takes place. Mineralization of phosphorus is also associated with the hydrolysis of the salts of inositol hexaphosphate with metal ions like Fe and Al(5). Experiment was, thus, conducted to study the soil inositol penta- and hexaphosphate mineralization under various conditions.

EXPERIMENTAL*Materials*

Three samples of surface soils (0-15 cm) representing three different series and varying in physical and chemical properties (Table 1) were collected from Bangladesh.

Chemical analyses.

Determinations were made of pH by Corning glass electrode method (the soil : water ratio being 1 : 2.5), organic matter by wet oxidation method (6), organic phosphorus by Mehta

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Bangladesh and an attempt was also made to evaluate the factors affecting the variation of phosphate content in profiles.

et al. (7), inositol pentaphosphate by McKercher and Anderson (8) and inositol hexaphosphate by Anderson and Malcolm (3).

TABLE I

GENERAL CHARACTERISTICS OF THE SOILS EXAMINED

<i>Soil series</i>	<i>Vegetation</i>	<i>Texture</i>	pH	<i>Organic matter (%)</i>	<i>Organic P (ppm)</i>	<i>IP₅* (ppm)</i>	<i>IP₆* (ppm)</i>
Harta	Cultivated	Clay	5.8	22.31	560	64.6	250
Naldanga	Cultivated	Silt loam	6.3	20.76	530	58.8	175
Paysa	Cultivated	Silt loam	6.6	12.23	450	52.2	95

* IP₅ = Inositol pentaphosphate; * IP₆ = Inositol hexaphosphate.

Experimental setup.

Air-dried soil samples (10g) with lime (to bring the pH to 7.0) and without lime placed in the test tubes (10 cm × 1 cm) were kept at 0 (air-dried), 50 and 100 per cent of the water holding capacity and under submerged condition (3 cm above the surface) althrough. The experiment was arranged in a completely randomized design with three replications. The test tubes at all moisture levels, except submerged condition, were incubated at 27°C (±0.5°C) following the barium peroxide method of Cornfield (9).

RESULTS AND DISCUSSION

Mineralization of inositol penta- and hexaphosphahate after 0,7,15,30,45,60 and 90 days of treatments are presented in Figs. 1-3. Mineralization of inositol penta- and hexaphosphate increased with time with increasing moisture levels upto submergence. Under submergence, probably metal complexes like Fe and Mn get reduced thereby increasing their degree of dissociation which helps in the mineralization of the compounds in the treated soils. Mineralization of inositol penta- and hexaphosphate in all the limed soils were higlier than those of unlimed soils. Neutral soil reaction probably is favourable for the activity of phytase synthesizing microorganisms which are generally held responsible for the breakdown of inositol phosphate and thereby increasing mineralization.

Under a set of conditions, mineralization increased with time with a decrease in rate in both the compounds, but the rate of mineralization of inositol pentaphosphate was more rapid than that of inositol hexaphosphate with the corresponding dates. More than 70% inositol pentaphosphate mineralized within 15 days of the experiment, however, that of inositol hexaphosphate was nearly

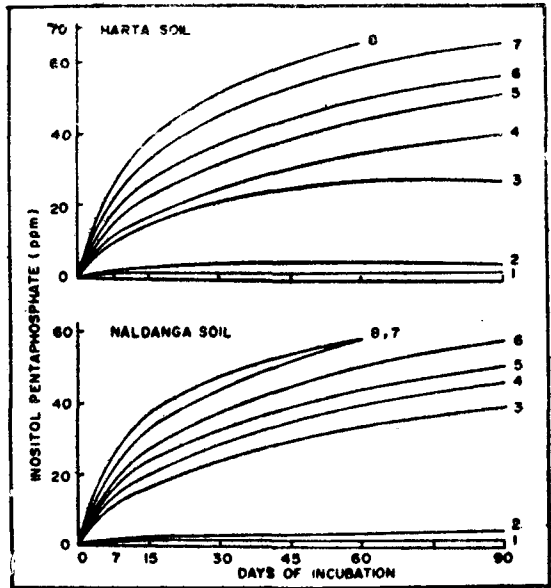


Fig.1. Mineralization of inositol pentaphosphate under various conditions. Legend: 1,3,5,7 represent 0, 50, 100% water holding capacity and submergence respectively. 2,4,6,8 represent 0, 50, 100% water holding capacity and submergence with lime respectively.

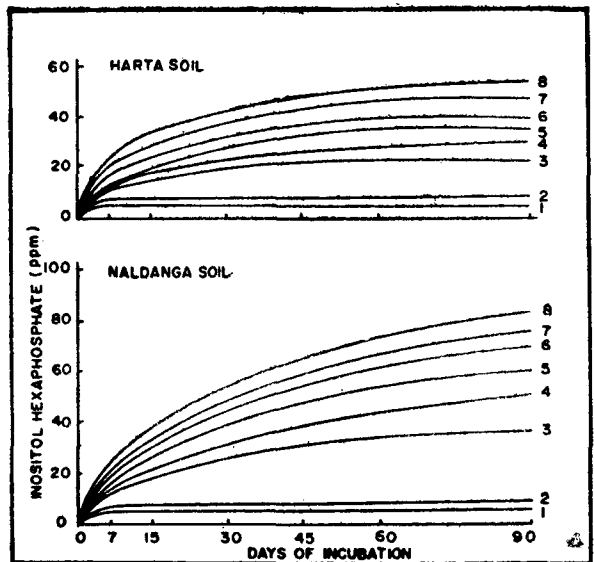


Fig.2. Mineralization of inositol hexaphosphate under various conditions. For legend see Fig. 1.

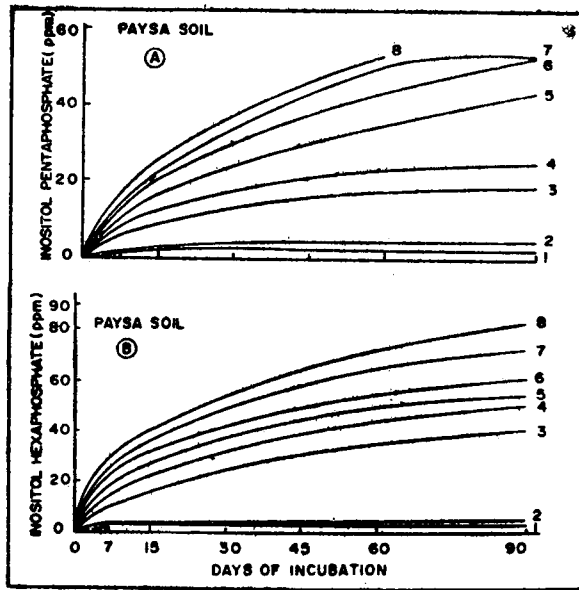


Fig.3. Mineralization of inositol pentaphosphate (A) and hexaphosphate (B) under various conditions. For legend see Fig.1.

50%. Inositol pentaphosphate mineralized completely within 60 days of experiment in all the soils treated with lime under submerged condition (Figs. 2 and 3B). It may be attributed to the degree of dissociation of the respective phosphate compound under the prevailing conditions.

The amount of inositol hexaphosphate mineralized in all the treatments were more in Harta than Naldanga samples and the least amount was observed in Paysa soil. This might probably be due to the variation in amounts of organic matter and inositol hexaphosphate content of the soils (Table I).

It seems probable that increased dissociation of the complexes and prevention of refixation (reformation) are conducive for increased mineralization. So, the conditions directly or indirectly responsible for the factors mentioned needs to be molded for increased mineralization of phosphorus from the soil stored organic phosphorus.

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