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**MINERALIZATION OF INOSITOL PENTA-AND HEXAPHOSPHATES IN
SOME SOILS OF BANGLADESH.**

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Mineralization of Inositol Penta-and Hexaphosphates in Some Soils of Bangladesh.

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ABSTRACT

The nature of iP_5 and changes iP_6 in Bangladesh soils has been examined. Mineralization of iP_5 and iP_6 was found at all moisture levels either alone or with lime. A rapid mineralization occurred in the first 30 days followed by a moderate disappearance in the next 30 days in all treatments. Maximum mineralization of iP_5 and iP_6 occurred in submerged condition with lime. The hydrolysis was greater in soils containing more organic matter and iP_5 and iP_6 . Mineralization also increased with pH for inducing conditions to proliferate of the phytase for the breakdown of iP_5 and iP_6 .

INTRODUCTION

Literature review have shown that a large part of organically bound phosphate exists in the form of hex - and penta phosphates of inositol (1). Although inositol penta-and hexaphosphates (iP_5 and iP_6) comprises a major portion of soil organic phosphate, it contributes very little to the phosphate nutrition of plants unless it is mineralized. Moreover, the rate and extent of mineralization depends to a great extent

upon the chemical nature of the substrate involved and the conditions under which the transformation takes place. Furukawa and Kawaguchi (2) stated that increased availability of phosphate under submerged condition was associated with the hydrolysis of Fe- and/or Al-salts of soil iP_6 . Islam and Ahmed (3) pointed out that submergence and liming caused an appreciable amount of inositol phosphate mineralization. Thus, information is, therefore, necessary regarding the the effects of various static moisture levels and liming on the transformation of soil iP_5 and iP_6 into more mobile inorganic form.

With these views in mind, an attempt has, therefore, been made to follow the mineralization of iP_5 and iP_6 under different conditions in some soils of Bangladesh.

MATERIALS AND METHODS

Three surface soils (0-15 cm) representing three series and varying in physical and chemical properties (Table 1) were collected from different parts of Bangladesh. The soils were air dried, ground and screened through 100 mesh sieve.

TABLE—I General Characteristics of the Soils Examined

Soils Series	Texture	pH	Organic Matter %	Organic P ppm	Inositol penta-and hexaphosphates	
					ppm	* percent
Harta	Clay	5.8	22.31	560	340	61
Naldanga	Silt	5.9	20.76	530	280	53
Paysa	Loam	6.6	12.23	450	230	51
	Silt					
	Loam					

* Percentages were calculated on the basis of organic phosphate.

Chemical analyses

Analyses were made for organic carbon by the Tinsley's wet combustion method as described by Bremner and Jenkinson (4), and organic matter was calculated by multiplying organic carbon by 1.72, pH by glass electrode method (soil solution ratio being 1:2.5), organic phosphate by Mehta et al. (5) and inositol penta- and hexaphosphates by Mckercher and Anderson (1).

Incubation Experiment

Soil samples of 10 g were placed in test tubes (10 cm x 1 cm) and different amounts of calcium carbonate were added to bring the pH to 7.0 conducive for microbial growth and were incubated at 50 and 100 per cent water holding capacity and at submerged condition. Mineralization has also been studied at the same moisture levels without the addition of lime. Every effort was made to keep the moisture content constant during the experiment by the addition of distilled water whenever needed. Each treatment was replicated thrice and was arranged in a completely randomized design. The test tubes at all moisture levels, except submerged condition, were incubated at 27°C ($\pm 0.5^\circ\text{C}$) following the barium peroxide method of Cornfield (13).

RESULTS AND DISCUSSION

The concentration of iP_5 and iP_6 after 0, 7, 15, 30, 45 and 60 days of incubation are presented in Figure 1. The contents of the compound decreased with time with increasing moisture. The amount of the compound in soils incubated at 50 per cent of the water holding capacity (statistically insignificant) decreased with time, but the quantity decomposing was very little as compared to those of 100 per cent field moisture capacity and submerged condition which were statistically significant. Maximum mineralization occurred at submerged condition. When lime was added to the soils at different moisture levels, the efficiency of mineralization increased appreciably. Here also highest mineralization occurred at submerged condition. The disappearance of the compound as affected by the treatments caused a rapid hydrolysis in the first 30 days which was followed by a moderate disappearance in the next 30 days. Acquaye (6) showed that in soils at 50 per cent of their water holding capacity and at 27°C for periods up to 70 days, considerable mineralization of organic phosphate occurred. The incubation of submerged paddy soils at 40°C for 2 weeks caused a rapid hydrolysis of iP_6 due to enhanced solubilization of Fe/or Al-salts of P_6 (2). Islam and Ahmed (3) stated that liming and submergence of the soils at 27°C ($\pm 0.5^\circ\text{C}$) for 60 days caused an appreciable mineralization of inositol phosphate.

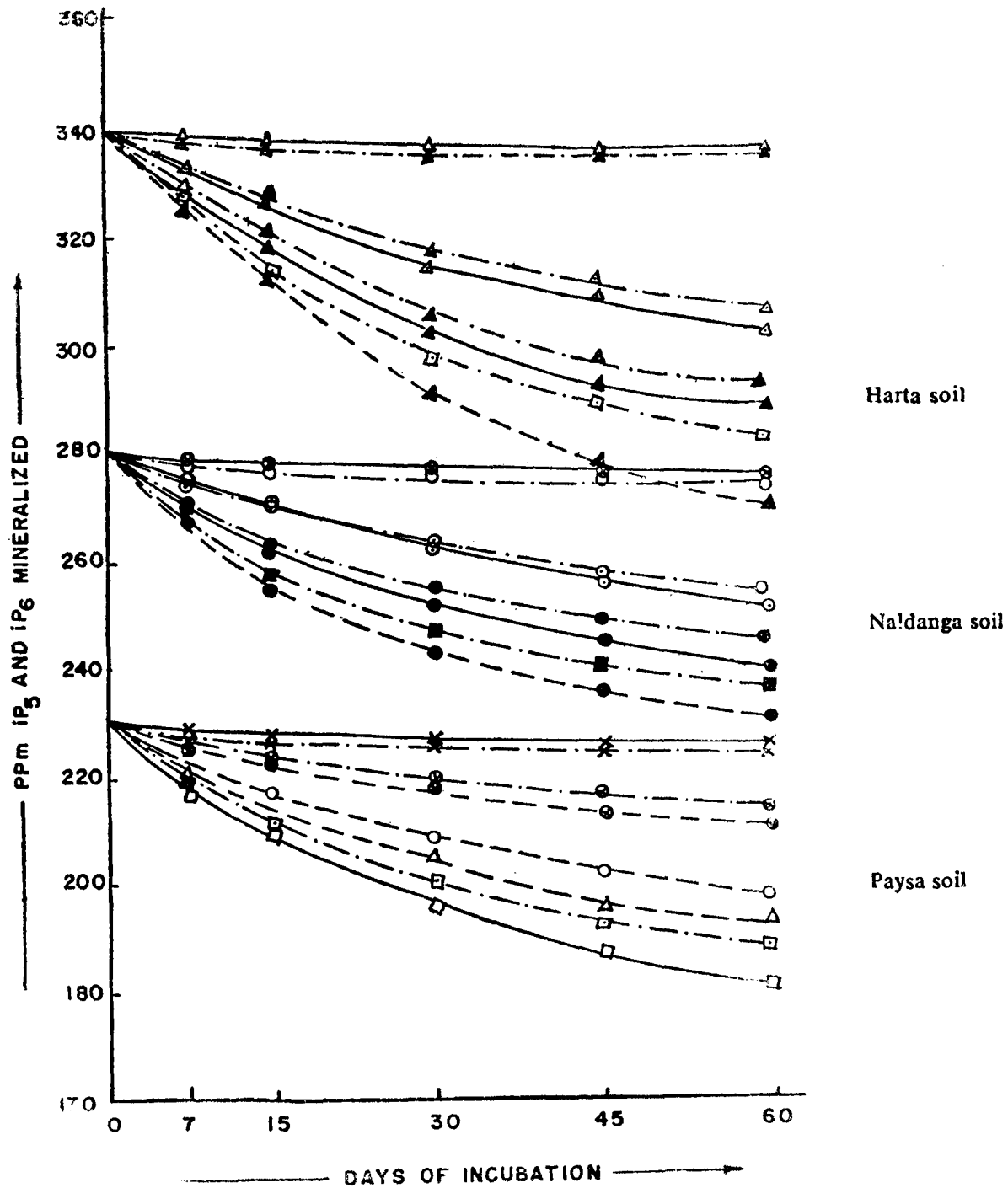


Fig. 1. Mineralization of iP_5 and iP_6 at different moisture levels alone and without lime (see legend).

A decrease in total organic phosphate upon liming acid soils, indicated that the rate of organic phosphate mineralization increased with pH (7, 8, 9, 10, 11, 12). Liming raised the p.H of the soils (Table 11) to a large extent. The change in pH

values from acidity to neutrality caused a favourable condition for proliferating phytase synthesizing micro-organisms responsible for the breakdown of iP_6 and thereby increasing the rate of mineralization,

LEGEND OF FIGURE 1

HARTA

—△—△—	CONTROL	
—△—△—	CONTROL + LIME	LSD AT 1% LEVEL
—△—△—	50% WHC	9.5 (100% WHC)
—△—△—	50% WHC + LIME	10.2 (100% WHC + LIME)
—▲—▲—	100% WHC	10.5 (SUBMERGENCE)
—▲—▲—	100% WHC + LIME	13.0 (SUBMERGENCE + LIME)
—□—□—	SUBMERGENCE	
—▲—▲—	SUBMERGENCE + LIME	

NALDANGA

—⊗—⊗—	CONTROL	
—○—○—	CONTROL + LIME	LSD AT 1% LEVEL
—○—○—	50% WHC	10.5 (100% WHC)
—○—○—	50% WHC + LIME	12.2 (100% WHC + LIME)
—●—●—	100% WHC	12.4 (SUBMERGENCE)
—●—●—	100% WHC + LIME	10.0 (SUBMERGENCE + LIME)
—■—■—	SUBMERGENCE	
—●—●—	SUBMERGENCE + LIME	

PAYSA

—X—X—	CONTROL	
—X—X—	CONTROL + LIME	LSD AT 1% LEVEL
—⊗—⊗—	50% WHC	8.2 (100% WHC)
—⊗—⊗—	50% WHC + LIME	9.8 (100% WHC) + LIME)
—○—○—	100% WHC	9.0 (SUBMERGENCE)
—△—△—	100% WHC + LIME	10.3 (SUBMERGENCE + LIME)
—□—□—	SUBMERGENCE	
—□—□—	SUBMERGENCE + LIME	

WHC = WATER HOLDING CAPACITY

TABLE—II pH changes of the soils during incubation

Soil Series	Treatments	Days of incubation					
		0	7	15	30	45	60
Harta	50% WHC	5.80	6.00	6.10	6.20	6.20	6.20
		5.90	6.10	6.20	6.30	6.32	6.32
		6.60	6.80	6.85	6.90	6.90	6.90
Naldanga	50% WHC + Lime	5.80	7.08	7.10	7.15	7.16	7.16
		5.90	7.10	7.20	7.25	7.25	7.25
		6.60	7.20	7.25	7.30	7.31	7.31
Paysa	100% WHC	5.80	6.15	6.20	6.25	6.25	6.25
		5.90	6.20	6.25	6.32	6.32	6.32
		6.60	6.85	6.88	6.90	6.92	6.92
	100% WHC + Lime	5.80	7.25	7.30	7.35	7.35	7.36
		5.90	7.30	7.35	7.28	7.40	7.41
		6.60	7.40	7.45	7.46	7.46	7.47
Su' mergence	5.80	6.20	6.23	6.24	6.25	6.25	
	5.90	6.31	6.33	6.34	6.35	6.35	
	6.60	6.90	6.95	6.95	6.98	6.99	
Submergence + Lime	5.80	7.35	7.38	7.40	7.45	7.45	
	5.90	7.40	7.45	7.46	7.48	7.49	
	6.60	7.50	7.60	7.61	7.65	7.65	

WHC=Water Holding Capacity.

The amount of iP_5 and iP_6 mineralized in all the treatments was more in Harta soil than in Naldanga soil and the least amount was observed in paysa soil. This corresponds to higher amounts of organic matter and iP_5 and iP_6 contents of the soils (Table I). The rate of mineralization is directly correlated with

the quantity of substrate (9, 3). Furukawa and Kawaguchi (2) observed that increased rate of mineralization was associated with higher amounts of organic matter, iP_5 and pH values of the soil. due to promoted dissolution and the weakend refixation of iP_5 and the strengthened enzymatic hydrolysis.

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