SUMMERY

Biofertilization with phosphorus dissolving organisms (and others) affected status in P in soil-plant system ; biofertilization (for providing P for plant and soil) was studied using different micro-organisms, soils, and plants. Three greenhouse experiments were done in Egypt and Scotland , Britain , using Egyptian and Scottish soils .

In the 2 laboratory experiments : In experiment 1 , biofertilization increased P-retention by soils particularly when it was combined with organic matter addition . The portion of retained P ranged form 27 % up to total retention.In experiment 2 , P-sorption fitted the Langmuir adsorption isotherm as well as the Freundlich one. Log equilibrium solution P and log adsorbed P were correlated to test fittings to the linear form of each equation; and results showed very highly significant correlations with the Freundlich equation followed by the Langmuir one .

In greenhouse experiment 1 eight soils collected from eight different locations in Qaliobiya Governorate, Egypt were inoculated by phosphorus dissolving bacteria (PDB) , ***Bacillus megatherium*** in a form of commercial fertilizer named **PHOSPHORENE** with or without Ca-orthophosphate (OP) or rock phosphate (RP) using barley (***Hordom vulgare***) . Response to inoculation was positive in some cases and negative in others .Growth (55 days) increased by inoculation , though not consistently in all soils. Uptake of P and soluble available (Olsen-extractable)-P were greater by inoculation in many soils especially in presence of OP, and more so in sandy soils reaching up to more than 1.3 folds.

In greenhouse experiment 2 (conducted in the Scottish Agricultural Collage ,Edinburgh , Scotland ,Britain) inoculation with ***B. megatherium*** as the main microorganism (along with ***Asperagillus niger*** fungi and ***B. Thuringeinsis*** bacteria) in a commercial fertilizer named **BioPak** was done in 2 soils: an

Egyptian soil (S1) , an alkaline entisol ; and a Scottish one (S2) , an acidic inceptisol , using ryegrass (***Lolium perene***) with or without OP ,CP, or CP (chicken manure-P). Available P extracted by different extractants,(viz.aviz. Olsen's $NaHCO_3$, Mehlich1"HCl/H2SO_4" , Mehlich 3 "NH_4F/EDTA" , Morgan "Na-acetate", Bray "NH_4F /HCl" , and NH4 HCO_3-DTPA "AB-DTPA") as well as microbial (soil biomass)-P "SBP". Also done were the various fractions of soil P (Hedly et al.1982). Inoculation was positive in plant growth , P-uptake , mostly with no added amendments giving increases of 35 % in P-uptake , 20 % in Mehlech3 -P(the most effective extractant) , and 247 % in MBP. Positive response was mostly in S1 , particularly on MBP with more than five-folds and one-quarter increase S1.Olsen-P increased 15% in S2 and 6% in S1 despite lower total-P in S2 . High organic matter is a probable incentive for its greater microbial activity. The Ca-P fraction in S1 was twice as in S2 the reverse occurred with Al-Fe-P. Inoculation increased Ca-P by one half in S1 and one third in S2. Al-Fe-P increased only in S2m . More embodiment of dissolved P in the organic pool seemed likely in S1 .

With non-inoculated non-amended soils MBP was 29 % lower in S2 than S1 , with inoculated non-amended the reverse occurred,S2 had 3-folds more than S1due to growth of fungus enhanced by inoculation. Response in P-uptake was similar in both soils; plants seemed to have competed more effectively with microorganisms for P in S1.Inoculation in presence of CP had no effect; in some cases , it caused a negative effect in S2. Indications show competition between micro-organisms of the organic manure and those of the biofertilizer. Inoculation in presence of OP or RP, was positive on MBP in S2, and only with OP in S1.in terms of "plant uptake" or on the basis of "plant uptake+ available in soil" , and computing the recovery as the difference between "the non-fertilized, non-inoculated" and "the

fertilized inoculated" soils no positive recovery of OP-P was obtained .Recovery in terms of "plant uptake + available in soil + microbial biomass P", was very high , in some cases more than 100% due to definite considerable proliferation of micro-organisms accumulating very high amounts of P in their bodies, enhanced by inoculation

In greenhouse experiment 3 (conducted in Edinburgh , Britain , as the case with greenhouse experiment 2), two organisms P-dissolving ***A. niger*** fungi and P-accumulating ***B. thuringiensis*** bacteria (provided as cultures by the Microbiology Department of the University of Edinburgh) inoculated in cabbage shreds given 4 mg insoluble P (as RP) per fresh material equivalent to 1 g dry matter .Then cabbage was composted anaerobically for 5 weeks. The composted material was added as inoculant to a soil (an ***Inceptisol*** from Scotland) under different pH levels of 4.5 , 5.5 , 6.5 and ,and 7.5 (adjusted using **$Ca\ CO_3$** . Effect on growth of ryegrass was assessed (2 cuts , 25 weeks growth). ***A. niger*** was more effective than ***B. thuringiensis*** , particularly with pH 5.5 , more than with pH 4.5. Plant growth at pH 5.5 was two-thirds greater than at pH 4.5 with ***A. niger*** ; and one sixth with ***B. thuringiensis*** .Lowest growth was at pH 4.5 due to severe negative effect of acidity .Growth at pH 7.5 was the second highest.

In the incubation experiment which was done under laboratory conditions and $20^{o}C$, organic vegetative materials were inoculated with ***B. thuringiensis*** and ***A. niger*** (provided as cultures by the Microbiology Department of the University of Edinburgh). The materials were cabbage or potato materials (shredded)supplied with RP (4 mg P/equivalent of 1 dry matter cabbage or potato material).Composting was done by incubation for 7 weeks under aerobic or anaerobic conditions. Measurements of available-P (Olsen-P) and microbial biomass-P (MBP) were done weekly . Both P-forms increased by one and half times in the first 3 weeks ; then gradually decreased till week 5 , after which a

maximum all-time peak occurred on week 6 followed by a slight decrease on week 7. MBP was much higher in cabbage than potato compost. Cabbage was higher in its indigenous P. Anaerobic composting was superior to aerobic composting. Fungus growth seemingly surpassed bacterial growth during the first 3 weeks, then the reverse occurred during the last phase of experiment in week 6 and 7. The progressive increase of both kinds of measured P indicates quick mineralization of microbial P .Highly significant correlation occurred between available and microbial P.The method could prove practical for preparation of organic-biofertilized amendment for practical use.

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