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RESEARCH PAPER

# Bioactivation of unreactive phosphate in Udaipur Phosphate Rock with organic manures

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***Abstract*** **:** An incubation study was conducted for sixty days to study the enrichment of fresh cow dung (FCD) and matured farm yard manure (FYM) with Udaipur phosphate rock applied at three rates (1, 5 and 10% weight basis). Udaipur PR contained 19.4 per cent $P_2O_5$ (8.35% P) and 1.62 per cent was citrate soluble phosphate. Water soluble P content of UPR was 0.01 per cent and pH was of 8. 25 in 1:2.5 ratio. Fresh cow dung and FYM contained 0.37 per cent and 0.64 per cent total P and having pH of 7.91 and 8.24, respectively. Incubation of UPR with two organic amendments (FCD and FYM) brought about changes in different phosphorus fractions during initial 30 days of incubation. Variation of moisture from field capacity to saturation had no effect. Increase in time of incubation increased the total P and citrate soluble-P content of the two amendments significantly irrespective of the level of enrichment with UPR. The increase in total-P was more duration first 30 days as compared to subsequent days of incubation. The magnitude of increase was greater in FCD (205%) than that inFYM (112%). Water soluble P increased during initial 30 days of incubation in both the amendments and then it declined. Citrate soluble P decreased with rate of UPR application at 0 days in both FCD and FYM.

***Key Words*** **:** Fresh cow dung (FCD), Farm Yard Manure (FYM), Udaipur Phosphate Rock (UPR), Total-P, Citrate soplluble-P, water soluble-P

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## INTRODUCTION

Soils have significant amount of phosphorus which is not immediately available to crops and only a small fraction becomes available during crop season. When rock phosphate is applied to soils a significant P accumulation occurs. Although direct use of phosphate rock (PR), which is the basic raw material used in the production of water soluble P fertilizers, is economical, lower reactivity of PR, hinders its direct application. Several scientists showed the possibility of increasing the reactivity of PR by composting (Bangar *et al.*, 1985; Singh *et al.*, 1992). Singh (2003) practiced incubation of PR with poultry manure for soybean. Organic materials produce organic acids such as formic acid, lactic acid, tartaric acid oxalic acid etc. during decomposition and organic acids act on PR releasing phosphorus (Kpomblekou-a and Tabatabi, 1994). Therefore, it was hypothesized that incubation of PR with organic manures under moist conditions may increase the reactivity of PR. The main objective of this investigation was to evaluate the effect of the moist incubation of Udaipur phosphate rock (UPR) with matured farmyard manure (FYM) and fresh cow dung (FCD).

## MATERIALS AND METHODS

Udaipur PR was incubated with the above two sources of organic manures for a period of two months and moisture was maintained at field capacity and saturation moisture which was maintained every alternate day. Three levels (1%, 5% and 10% by weight) of UPR were incubated with two types of organic manures. Experiment was arranged in a completely randomized design with three replicates and temperature

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maintained 25±1$^0$C. Samples were drawn on 0, 30 and 60 days of incubation. Air dried samples were ground and passed through a 2 mm sieve before analysis. Total, water soluble and citrate soluble P (AOAC, 2000) contents of the samples were determined. The reaction (pH) of the organic materials and UPR were determined at 1:10 and 1:2.5 ratios in distilled water.

Udaipur PR contained 19.4 per cent $P_2O_5$ (8.35% P) and 1.62 per cent was citrate soluble phosphate. Water soluble P content of UPR was 0.01 per cent and pH was of 8. 25 in 1:2.5 ratio. Fresh cow dung and FYM contained 0.37 per cent and 0.64 per cent total P and having pH of 7.91 and 8.24, respectively.

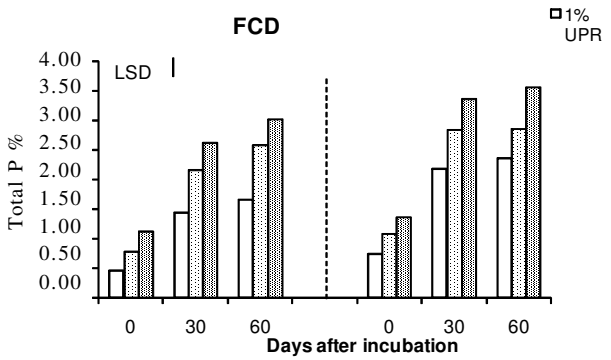


**Fig. 1: Changes in total P content during incubation of fresh cow dung (FCD) and Farm Yard Manure (FYM) enriched with different levels of UPR**

## RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

**Total P content:**

Total P content of both FCD and FYM increased over initial content with increasing rate of UPR addition. The magnitude of increase was, however, greater in FCD (205%) than that in FYM (112%). Increase in time of incubation increased the total P content of the two amendments significantly irrespective of the level of enrichment with UPR. The magnitude of increase, as shown in Fig. 1, was higher during the first 30 days as compared to the following 30 days in both the organic amendment *i.e.*132 per cent and 15 per cent for FCD and 148 per cent and 6 per cent for FYM at 10 per cent UPR blend. This increase could be attributed to the loss in weight associated with the decomposition of the two organic amendments. Increase in total P content has also been reported by many workers (Bangar *et al.,* 1985; Singh *et al.,* 1992) while composting PR with organic amendments. Increase in total P content indicated that a considerable loss in weight occurred during incubation. Relatively higher mean loss in weight observed in UPR enriched FCD (68% in FCD and 64% in FYM) divulged that FCD contained more decomposable material compared to FYM which was partially decomposed hence weight loss was comparatively less.

**Water soluble P:**

Average water soluble P content in UPR enriched FYM was higher by 630 mg P kg$^{-1}$ compared to the FCD, irrespective of the rate of UPR application at the initiation of incubation (Table 1). Water soluble P content declined with level of addition of UPR in both the amendments at the beginning of the incubation as a consequence of the lower content of water soluble P present in UPR (0.01% *i.e.* 119 mg kg$^{-1}$) compared to the FCD (0.09%) and FYM (0.16%).

The interaction between the UPR and the organic amendments could be due to the ability of the amendments to adsorb phosphates and also because of varying levels of P released mainly by the two organic amendments. It has been reported that UPR contains carbonates (calcite and dolomite) (Bhujbal and Mistry, 1984) which reduce P availability (Chand

**Table 1 : Changes in water soluble P content during incubation of fresh cow dung and farmyard manure with different UPR enrichments**

| Organic amendment | UPR rate (%) | Water soluble P (mg kg$^{-1}$) Days after incubation | | | |
|---|---|---|---|---|---|
| | | 0 | 30 | 60 | Mean |
| FCD | 1 | 1048 | 1171 | 759 | 993 |
| FCD | 5 | 1019 | 1101 | 626 | 915 |
| FCD | 10 | 995 | 1057 | 708 | 920 |
| Mean | | 1021 | 1110 | 698 | |
| FYM | 1 | 1737 | 1664 | 1541 | 1647 |
| FYM | 5 | 1586 | 1634 | 1355 | 1525 |
| FYM | 10 | 1631 | 1552 | 1588 | 1590 |
| Mean | | 1651 | 1617 | 1495 | |

LSD (0.05) Organic amendments = 37; Incubation time = 46; UPR = NS;
UPR rate x time = 73; Organic amendment x UPR rate = 64; Organic amendment x UPR rate x time = NS
FYM – Farm Yard Manure, FCD – Fresh cow dung

and Tomar, 1993). Influence of organic amendment and the interaction between the organic amendment and UPR enrichment on the water soluble P content continued throughout the incubation of 60 days (Table 1).

Water soluble P content remained relatively low throughout incubation and showed a decreasing trend with the increasing time of incubation up to 60 days (Table 1). Enrichments of FCD showed an appreciable decrease in water soluble P at 60 days of incubation as compared to the enrichments of FYM. On an average FCD and FYM showed 31.6 and 9.5 per cent decrease in water soluble P at the end of incubation. Decrease in water soluble P content may be due to the greater microbial immobilization of P and the behaviour of water soluble P in FCD based mixtures was in line as indicated by the greater loss in weight in the same UPR blends. Wu *et al.* (2007) reported significant decrease in Olsen P when the soils were treated with glucose and attributed the effect to the microbial immobilization as the microbial P content increased in simultaneously.

Increase in water soluble P fraction in FCD during the first 30 days could be due to the release of P from the organic materials and possibly from UPR. Bangar *et al.* (1985) reported an increase in water soluble P content during composting of PR with organic manures. The interaction effects observed between organic amendments and UPR enrichment suggest the possible influence of UPR and organic amendments on immobilization, release and sorption of P. It is difficult to quantify the release of P from UPR from these data, as release of P from organic material and microbial immobilization could have occurred simultaneously. Some P from UPR could have been released by the action of organic acids produced and/or due to the lowering of the solution P concentration due to adsorption.

**Citrate soluble P:**

Farmyard manure had higher content of citrate soluble P at the start of the incubation than that of the FCD. This could be due to the higher content of total P in FYM compared to FCD. The citric acid soluble P in the original organic amendments decreased with the increasing level of the UPR application which diminished the difference between the two organic amendments (Fig. 2). The decrease in citrate soluble P with the application of UPR could be attributed to the greater proportion of citrate in-soluble P (98% of total P) in UPR. Fig. 2 depicts that at the commencement of incubation (0 day) the highest level of citrate soluble P was observed in the lowest level of enrichment with UPR irrespective of the organic amendment. However, with the increase in time, the trend got reversed and the citrate soluble P increased with increasing rate of enrichment with UPR particularly in FCD. However, in FYM, the content of citrate soluble P showed little variation with increasing rate of enrichment with UPR at 30 and 60 days. This behavior indicates that fraction of the P which was

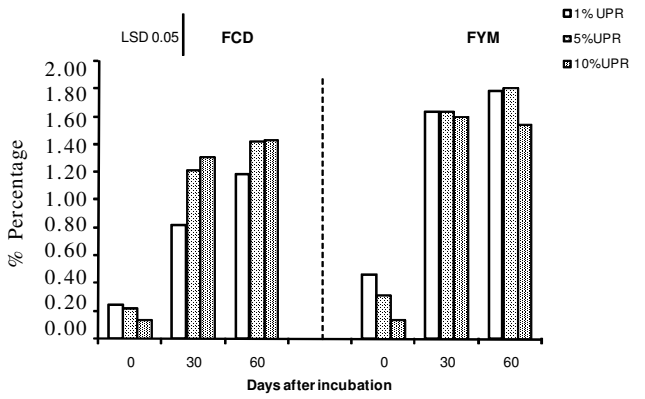


**Fig. 2 : Changes in citrate soluble P content during incubation of fresh cow dung and Farm Yard Manure with different UPR enrichments**

insoluble initially became soluble after incubation. Increasing the content of citrate soluble P content during composting has been documented (Bangar *et al.*, 1985; Singh *et al.*, 1992; Sharma and Sharma, 1997).

Conversion of citrate insoluble P to citric acid soluble P might have occurred due to the production of different organic acids during incubation. The variation in the pattern of citrate soluble P in FCD and FYM may be attributed to the quantity and the types of acids produced during incubation (Kpomblekou-a and Tabatabi, 1994). Gharu and Tarafdar (2004) also reported the influence of the type of organic acids on P mobilization in soils. The citrate soluble P content at the end of incubation increased with the increasing level of enrichment of organic manures with UPR (Table 2). Both the organic manures behaved similarly in respect of the content and net increase in citrate soluble P. It is interesting to note that at 10 per cent enrichment, the incubated blend contained more than 40 per cent of the total P as citrate soluble P compared to its original value of 10–12 per cent depending on the type of organic amendment.

**Table 2 : Content and the net increase in citrate soluble P (%) in organic manures enriched with different rates of UPR after 60 days of incubation**

| Organic amendment | UPR enrichment (%) | Total P basis | |
|---|---|---|---|
| | | Content | Net increase |
| FCD | 1 | 69.22 | 17.5 |
| FCD | 5 | 48.90 | 21.6 |
| FCD | 10 | 44.55 | 31.7 |
| FYM | 1 | 71.98 | 7.9 |
| FYM | 5 | 53.76 | 27.9 |
| FYM | 10 | 43.99 | 33.7 |

FYM – Farm Yard Manure, FCD – Fresh cow dung

**Conclusion:**

Results of the preliminary characteristics of the materials showed that UPR is low reactive. Incubation of UPR with two organic amendments (FCD and FYM) brought about changes in different phosphorus fractions during 30 days of incubation. The study revealed that the total P content and the citrate solubility of the UPR enrichments could be increased successfully by incubating them with organic manures. Variation of moisture from field capacity to saturation had no effect. Although a reduction in water soluble P content was observed with incubation yet the content of water soluble P was very small to cause any significant effect on P availability.

## REFERENCES

**AOAC (2000).** *Official methods of Analysis,* 17th edition, vol 1. W. Horwitz (Ed) AOAC International, USA.

**Bangar, K.C., Yadev, K.S. and Mishra, M.M. (1985).** Transformation of rock phosphate during composting and the effect of the humic acid. *Plant Soil,* **85** : 259 – 266.

**Bhujbal, B.M. and Mistry, K.B. (1984).** Characterization of major Indian phosphate rocks and their reactivity. *Fertilizer News*, **29** (10) : 26 – 32.

**Chand, T. and Tomar, N.K. (1993).** Effect of soil properties on the transformation of phosphorus in alkaline calcareous soils. *J. Indian Soc Soil Sci.,* **41**: 56 – 61.

**Gharu, A. and Tarafdar, J.C. (2004).** Influence of organic acids on mobilization of inorganic and organic phosphorus in soils. *J. Indian Soc. Soil Sci.,* **52**: 248 -253.

**Kpomblekou, A.K. and Tabatabi, M.A. (1994).** Effect of organic acids on release of phosphorus from phosphate rocks. *Soil Sci.,* **158**: 442 – 453.

**Sharma, J. and Sharma, C.R. (1997).** Direct and residual effect of compost enriched with mussorie rock phosphate in wheat (*Triticum aestivam*)-rice (*Oryza sataiva*) Sequence. *Indian J. Agric. Sci.,* **67**: 299 – 302.

**Singh, P. (2003).** Efficacy of rock phosphate conjointly used with poultry manure for P nutrition of soybean. M.Sc. Thesis, Punjab Agricultural University, LUDHIANA, PUNJAB (India). 115pp.

**Singh, S., Mishra, M.M., Goyaland, S. and Kapoor, K.K. (1992).** Preparation of nitrogen and phosphorus enriched compost and its effect on wheat (*Triticum aestivam*). *Indian J. Agric. Sci.,* **62**: 810 – 814.

**Wu, J., Huang, M., Xiao, H. A., Su, Y.R., Tong, C.L., Huang, D.Y. and Syers, J.K. (2007).** Dynamics in microbial immobilization and transformation of phosphorus in highly weathered sub-tropical soil following organic amendments. *Plant & Soil,* **290**: 333 – 342.

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