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Studies on the manurial quality of organics enriched with Rock phosphate

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Abstract

Field study was conducted on the manurial value of organics vis-a-vis farmyard manure and combination of farmyard manure with waste plant biomass (*Lantana* and *Eupatorium*) by enriching these materials with indigenously available rock phosphate (Musoorie rock phosphate – 8.7% P) and allowing them to decompose for 90 days in clay lined pits. The chemical analysis of manurial products thus prepared was undertaken at 0, 45 and 90 days of decomposition. The results revealed a sharp decline in organic carbon content in the manurial products. In general, the rate of loss of carbon during first 45 days of decomposition was higher which may be attributed to the fast aerobic decomposition in the initial stage. Regarding the pH of these products, a decline of 0.2 – 0.4 units was observed. Both the water soluble and citric acid soluble phosphate indicated proportional increase in their contents with increasing enrichment levels and decomposition period. Organic-P and total P contents followed the similar trend. The total –N and inorganic N forms (NO_3 –N and NH_4^+ -N) also increased substantially with increased decomposition period. The NO^{-3} –N content was much higher than NH_4^+ -N. With time lapse, C:N ratio declined to 16:1. The important index of P availability (C : P ratio) to plants also decreased substantially to 15.7:1 in the manurial products.

Key words: Rock phosphate, enriched manure, biomass and manure quality.

Introduction

Role of organics is well established in the integrated system of agricultural production. In addition to animal based organics, the plant biomass of certain weeds vis-a-vis Lantana and Eupatorium available in abundance in some areas specified as waste lands and areas adjoining to fields may also be composted with farmyard manure and put to use. Organic manures often improve the overall physical environment of the soil but are low in nutrients especially phosphorus. .The potential of indigenously available rock phosphate can be harvested for the phosphorus enrichment of organics thus improving the manurial value of organics. Rock phosphate was obtained from Rajasthan state mines and minerals limited, Udayapur.

In acid soils, low P availability has been attributed to high P- fixing capacity of these soils and under such conditions the use of water soluble fertilizers is cost effective due to high P application rates. There has been a continuous research effort to use cheap and indigenously available P sources such as rock phosphate. But indigenous rock phosphates are of low P grade and their efficacy can be increased by using them as inorganic additives in suitable proportions along with the organics such as farmyard manure and compost. In addition to P supply, the quality of enriched farmyard manure and compost is also improved with respect to N, Ca, Mg and micronutrients concentrations (Mathur and Devanath, 1983 & Sharma and Bhardwaj, 2005). In view of these observations, the manurial quality during the decomposition of organics enriched with inorganic additives as rock phosphate was studied.

Material and Methods

The present investigation was undertaken in the experimental farm of Himachal Pradesh Krishi Vishvavidayalaya Palampur, falling under mid hill wet temperate zone in North -West Himalayas. The manurial products were prepared in clay lined pits of size 1 x 1 x 1 meter. Four products were prepared from the fresh cattle dung + urine + litter (Farmyard manure) and four were prepared by using farmyard manure + waste plant biomass in the ratio of 50:50. Biomass included the clippings of *Lantana camara* and *Eupatorium* spp. widely available in nearby area. Enrichment was done with Mussorie rock phosphate (8.7 % P) to the levels of 0.44, 0.88 and 1.32 percent P. Before filling the material in the clay lined pits, polythene sheet was spread at the bottom of each pit, to prevent leaching. All the material was filled in layers as per the treatments. Then the pits were covered with grasses so as to avoid excessive

wetting of the material by rain or loss of moisture. Decomposition was allowed for three months, between August and and November for two consecutive years. The material in the pits was thoroughly stirred with rakes at 15-20 days interval to provide adequate aeration. For the preparation of 100 Kg P enriched product on dry weight bases, the amount of Mussorie rock phosphate required for 0.44 percent P enriched level work out to be 5 kg. The manurial products ($P_1 - P_8$) are listed in table 1.

Manurial samples were collected after 45 and 90 days of decomposition for quality analysis, following standard procedures as described by Black (1965).

Table 1. List of manurial products

Product	Composition
P_1	Preparation of organic manure from fresh cattle dung (FYM as such)
P_2	Same as P_1 enriched to 0.44 % P level
P_3	Same as P_1 enriched to 0.88 % P level
P_4	Same as P_1 enriched to 1.32 % P level
P_5	Preparation of organic manure from fresh cattle dung (FYM) and biomass (Lantana and Eupatorium) in the ratio of 50:50
P_6	Same as P_5 enriched to 0.44 % P level
P_7	Same as P_5 enriched to 0.88 % P level
P_8	Same as P_5 enriched to 1.32 % P level

Results and Discussion

The data are averaged for two consecutive years of study on dry weight basis.

Organic carbon

The results of fig. 1 revealed that in general the rate of loss of organic carbon during first 45 days of decomposition of manurial products was higher than the next 45 days signifying the fast aerobic decomposition at the initial stages. The per cent decrease in organic carbon was 19, 22, 23 and 22 after 90 days of decomposition in manurial products prepared from fresh FYM. The respective percent decrease of 23, 29, 28 and 29 per cent was recorded in manurial products prepared from fresh FYM + biomass (1: 1 ratio). The results further infered that in rock phosphate enriched manurial products, the rate of loss of carbon was higher.

Singh *et al.*(1980) have attributed this to the better growth of fungi in the presence of rock phosphate which hastens the decomposition process.

Reaction (pH)

The results of fig. 2 revealed alkaline reaction of the manorial products. As regards the time variant factor, with advancement of decomposition there was decrease in pH which may be attributed to the release of organic acids in the decomposing materials. Organic acids released during decomposing materials are namely citric, tartaric and malic acid. The organic anions such as citrate, have been reported to form stable complexes with Fe and Al and thus preventing P fixation.

Water Soluble Phosphorus

The perusal of the data in fig. 3 indicated proportionate increase in water soluble - P with increasing P enrichment levels from 0.44 to 1.32 % in both the organics. Decomposing the manurial products upto 90 days exhibited substantial increase in the water soluble – P content. The increase in water soluble - P content by solubilization of phosphate from rock phosphate is expected due to the intense biological transformation taking place during decomposition. Further, the solubilization of rock phosphate has been attributed to the production of organic acids, especially the hydroxyl ones which release the phosphorus through chelation and removal of metal ions from insoluble metal phosphates (Chien, 1979).

Citric Acid Soluble Phosphorus

Citric acid soluble – P content, a prominent phosphorus availability index of growing plants, increased sustainability over a period of decomposition (Fig.4). Enrichment of fresh farmyard manure (Product P2, P3 and P4) recorded citrate soluble phosphate values in the range of 2837 – 3257 mg/kg of the material after 90 days of incubation. The corresponding values in products P6, P7 and P8 (FYM + biomass in the ratio of 50:50) ranged between 3464 – 3712 mg/kg. The results further inferred that by and large, the citric acid soluble P was higher in manurial products prepared from FYM + biomass. As regards the percent contribution of different forms of P, citric acid soluble P contributed to the extent of 29 percent towards total P of the compost product.

These results corroborate the findings of Mathur *et al.* (1980) and Kanwar (1997).

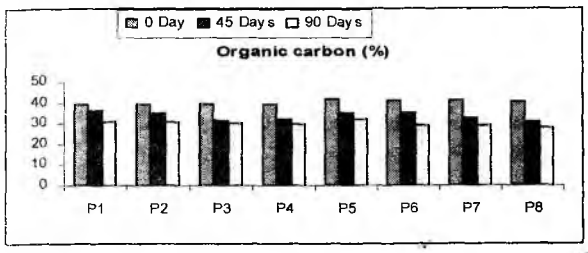


Fig 1. Organic carbon content (%) of manurial products at different stages of decomposition

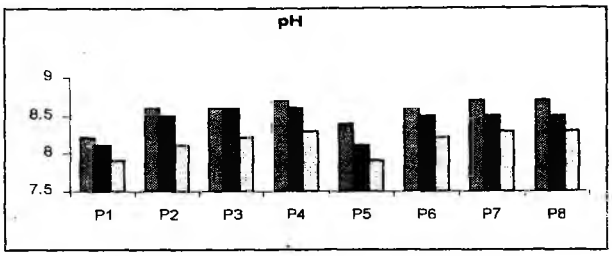


Fig 2. pH (1:5 manure: water ratio) of manurial products at different stages of decomposition

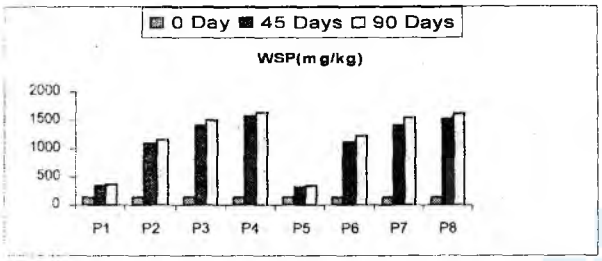


Fig 3. Water soluble P content (mg/kg) of P enriched manorial products at different stages of decomposition

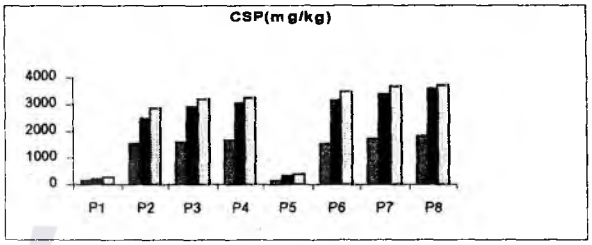


Fig 4. Citric acid soluble P content (mg/kg) of P-enriched manurial products at different stages of decomposition

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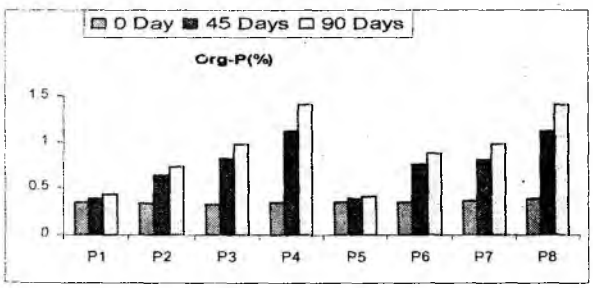


Fig 5. Organic P content (%) of P enriched manurial products at different stages of decomposition

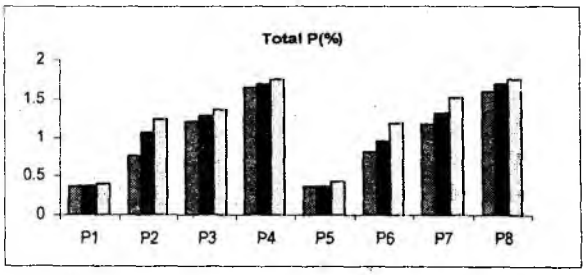


Fig 6. Total P content (%) of P- enriched manurial products at different stages of decomposition

Organic – Phosphorus

An insight of the results (Fig. 5) revealed a consistent increase in organic P content with the increase in decomposition time and enrichment levels. The variation in organic – P content ranged between 0.35 – 1.41 percent in the manurial products. During decomposition, large proportions of P released from rock phosphate is converted into organic form. It has been advocated that in the absence of competition by plants and fixation of P by sesquioxides as in soil system, microbial immobilization of P is likely to be more pronounced (Mathur and Devnath, 1983). However, Singh and Amberger (1990) have attributed the increase in organic - P content to the chelation of solubilized - P by humic substances in addition to immobilization by microflora.

Total - Phosphorus

Corollary to organic – P content, total – P increased substantially in both FYM and FYM + biomass manurial products enriched to different levels of P (Fig. 6). The variation in total – P content was between 0.30 – 1.75 per cent. The increase in total P content of manurial products may be attributed to the loss of organic carbon which is substantiated by the results shown in Fig.1, showing the loss of organic – C with time lapse and the amount of P contained by waste plant biomass.

Total N and its fractions

The data exhibited the changes in NO^{-3} –N, NH_4^+ -N content of fresh farm yard manure and P enriched farmyard manure (P1 –P4), which was recorded between 88-165 mg/kg and the corresponding value for farmyard manure and plant biomass composted products was 105 – 277 mg/kg. The increase in NO^{-3} – N content may be attributed to the reduction in mass of decomposing material and mineralization of organic N. Yadav *et al.* (1992) have attributed the progressive increase in NO^{-3} –N to the presence of rock phosphate, resulting in accelerated mineralization of N in addition to other factors.

Corollary to NO^{-3} – N, ammonical nitrogen followed the similar trend of increase with increase in decomposition period. However, this fraction contributed to low values varying between 24-61 mg/kg for manurial products (P1 –P4) and between 24-84 mg/kg for products P5-P8. Kanwar (1987) have attributed this mainly to the reduction in organic carbon of decomposing material and rate of mineralization.

As regards the total –N content, by and large it was higher in manurial products (P5-P8) where FYM + waste plant biomass was used in the ratio of 1:1 for decomposition and it may be ascribed to the higher N concentration (1.5%) in biomass (Lantana + Eupatorium). All estimation were done in the laboratory using standard methods.

Total –K

As the decomposition progressed, total K content of the manurial products also increased irrespective of the enrichment levels. The variation in total K content was between 0.47 – 0.66 percent in P1 –P4 manurial products where as the corresponding range for P5-P8 products were 0.50 – 0.77 per cent.

C: N - Ratio

The results emanating from the present study revealed substantial decrease in C:N ratio with time lapse. However, with increase in enrichment levels there was further decrease in C:N ratio which may be ascribed to the faster rate of microbial growth responsible for faster decomposition of the material. In the manurial products where FYM + plant biomass was used for decomposition, the C:N ratio came down as low as 16.3 after 90 days of decomposition. This has been ascribed to the enhanced rate of decomposition with time and higher N content (1.5%) of *Lantana* and *Eupatorium* biomass used in the composted material. Asiza *et al.* (1984) have also reported such decrease in C: N ratio with increase in decomposition time.

C: P – Ratio

As regards the C:P ratio of manurial products, there was decreasing trend with time lapse and with increased levels of P enrichment. Such decrease in C:P ratio may be attributed to the concentration effect as decomposition reduced the biomass and there was increase in total – P content. The organic amendments enriched with inorganic phosphate have significant bearing with phytoavailability of phosphorus. Further, mineralization to occur the organic amendments must contain at least 0.2 percent total – P (Tisdale *et al.* 1995) and in the present study the trend of total – P content in the P- enriched products corroborate such findings (Fig. 6).

Conclusion

The periodic chemical analysis of different phosphorus enriched manurial products prepared from farmyard manure and concentration of farmyard manure + waste plant biomass (*Lantana and Eupatorium*) in the clay lined pits was done for different parameters. The results have revealed substantial decrease in organic carbon content with

increase in decomposition period in manurial products, where decrease in pH varied between 0.2 to 0.4 units. Organics enriched to 0.44, 0.88 and 1.32 per cent P level through rock phosphate recorded consistent increase in water soluble and citric acid soluble phosphorus with the advancement of decomposition time. Organic – P and total –P content of the enriched manurial products also followed the similar trend and it may be recalled that organic and total-P content was higher in manurial products prepared by mixing farmyard manure and waste plant biomass. With the progressive decomposition, total N and its forms namely nitrate and ammonical also increased in their contents in the manurial products. With time lapse C: N ratio decreased considerably. The important index of phytoavailability of phosphorus (C: P ratio) also followed the decreasing trend as the decomposed manurial products has as low as 20 value of C: P ratio. Preparation of P-enriched manorial products through indigenous rock phosphate from locally available organics vis-à-vis farmyard manure and waste plant biomass (*Lantana* and *Eupatorium* etc.) has the practical relevance in phosphorus deficient soils for sustainable crop production in the era of costly chemical phosphatic fertilizers.

References

Asiza A K, Pareek R P, Sunghania R A and Singh S 1984. Effect of method of preparation and enrichment on quality of manure. J. Indian Soc. Soil Sci. **32:** 323–329.

Black C A 1965. *Methods of Soil Analysis*. Part I and II. American Soc. Agron. Medison, Wisconsin, USA.

Chien S H 1979. Dissolution of phosphate rock in acid soils as influenced by nitrogen and potassic fertilizers. Soil Sci. **127**: 371-376.

Kanwar K 1987. Processing and Utilization of *Lantana camara* as an organic manure. Ph D Thesis, Himachal Pradesh Krishi Vishvavidyalaya, Palampur (Unpublished).

Mathur B S and Devnath D 1983. Studies on phosphorus in compost charged with rock phosphate. J. Indian Soc. Soil Sci. **31:** 545 – 548.

Mathur B S, Sarkar A K and Mishra B 1980. Release of nitrogen and phosphorus from compost charged with rock phosphate. J. Indian Soc. Soil Sci. **28:** 206-212.

Sharma C M and Bhardwaj S K 2005. Direct and residual effect of rock phosphate enriched organics on yield in maize-wheat cropping in an acid soil. J. Indian Soc. Soil Sci. **53**:264-266.

Singh C P and Amberger A 1990. Humic substances in straw composted with Rock Phosphate. Biol. Wastes **31:** 165-174.

Singh C P, Mishra M M and Yadav K S 1980. Solubilization of insoluble phosphates by thermophilic fungi. Annals Microbiol. **131:** 289-296.

Tisdale Samuel L, Nelson Werner L, Beaton James D. and Hazelin John L 1997. *Soil Fertility and Fertilizers*, Fifth Edition, Prentice Hall of India, New Delhi, pp. 180-188.

Yadav K, Prasad C R and Mandal K 1992. Effect of enriched compost and Rhizobium culture on the yield of green gram. J. Indian Soc. Soil Sci. **40:** 71-75.