Evaluation of Chemical Properties of Different Composts

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ABSTRACT

Rock phosphate enriched composts were prepared by mixing rock phosphate with Farm Yard manure (FYM), straw, dry leaves and green manure with effective microorganism (EM). For this, an experiment was carried out to determine the concentrations of total organic C, N, P, K, Fe, Cu, Mn, Zn, Mo, and B of composted manures. Laboratory results exhibited the extractability of elements of composted manure (C_1, C_2, C_3) which revealed that there was a slow reduction in pH (7.40), EC (3.29 dSm^{-1}) and higher organic carbon by 13.5% in comparison to normal compost (C_4, C_5, C_6) like FYM, vermicompost and compost. There was gradual increase in primary macro (total N, P, K), secondary macro (Ca, Mg, S) nutrients and micronutrients (Fe, Cu, Mn, Zn, Mo, B) as well. Thus, rock phosphate and microbial (N, P, K solubilizing bacteria and bio pesticides - Trichoderma, Pseudomonas) enriched compost could be an alternative and viable technology to utilize low grade rock phosphate.

KEYWORDS: Bio-inoculants, microorganisms, compost, rock phosphate.

INTRODUCTION

The majority of Indian soils are deficient in phosphorus (P) element. Furthermore, the yearly removal of P exceeds the addition of P through phosphatic fertilizers during continuous and intensive cropping. Bio-solids generated in cities, agro-industries and farms typically have low nutrient value, particularly in terms of phosphorus content. Organic farming methods rely on organic inputs and farm waste recycling for nutrient supply emphasizes on crop rotation and soil biological processes for pest management and prohibits the use of synthetic fertilizers and pesticides, which reduces the negative effects associated with conventional farming. Because of higher pesticide residue, more nitrate, heavy metals, hormones, antibiotic residue and genetically modified organisms, conventionally grown foods have significant negative health effects adoption of organic farming would promote agricultural diversification and sustainable production of healthy food, augment family income as well as solve environmental issues (Yadav *et al.,* 2020). Composting from these biodegradable wastes is currently not a financially viable option. If traditional composting technology is improved in terms of nutrient content, it may be able to halt nutrient depletion trends to a greater extent. Furthermore, mineral additives such as rock phosphate and pyrites have been found to be beneficial during composting. A nitrogen enriched phosphocompost (N-phosphocompost) technique has been developed, utilizing the phosphate solubilizing microorganisms, including *Aspergillus awamori*, *Pseudomonas straita* & *Bacillus megaterium*; rock phosphate, pyrite and bio-solids to increase manurial value compared to ordinary FYM and compost. Nutrients content like N was higher in microbial enriched compost as compared to the compost alone. Regular use of higher amount of enriched organic manures will not only reduce the amount of organic manure requirements, but will also increase the use efficiency of the applied manures (Sindhu *et al.,* 2020).

Although, in the post-green revolution age, mounting soil health and environmental quality challenges, as well as declining agricultural output, have sparked disputes concerning the use of synthetic agro-chemicals and fertilizers in agriculture. Aside from that, the rising cost of synthetic agro-chemicals, changes in soil matrix, such as acidification and/or alkalization, ground water pollution, nutrient fixation, degradation of soil flora & fauna and rapid decomposition of organic matter have prompted agricultural researchers to look for a more sustainable way to apply nutrients in agriculture. Inorganic fertilizers and other synthetic agro-chemicals must be replaced with a cost-effective and environmentally friendly alternative. Transformation of organic wastes from on and off farms into nutrient-rich fertilizers and/or soil conditioners, i.e., compost, is an age-old strategy for composting organic resources (Meena *et al.,* 2021).

MATERIALS & METHODS

The study was conducted in the year 2020-21 at the Research Farm of School of Agriculture, Lovely Professional University Jalandhar, Punjab. The all-basic organic raw materials farm yard manure (FYM), straw, dry leaves and green manure and effective microorganism (EM), rock phosphate were collected from Punjab. Lengthy material was chopped into about 8 to 10 cm in length small pieces (Waqas *et al.,* 2018).

Six different types of compost were obtained by mixing cattle manure, different crop residual and effective microorganism and rock phosphate.

1. C_1: Compost-Mineral (rock phosphate) enriched
2. C_2: Compost-Microbial (N, P, K biofertilizer + biopesticide - Trichoderma, Pseudomonas) enriched
3. C_3: Compost- Mineral + Microbial enriched (50:50)
4. C_4: Vermicompost
5. C_5: FYM
6. C_6: Compost

The mixtures of wastes were composted in trapezoidal piles (1.5 m high, 3 m width and 80 m long). The piles were turned periodically to maintain adequate O_2 levels. The piles were turned weekly during the maturation phase in order to improve the O_2 level inside the pile. Pile moisture was controlled by adding enough water to keep the moisture content not less than 50% (Barthod *et.al.,* 2016). Samples were taken at the end of the composting process to determine the chemical and physical properties. Each sample was made by mixing five sub-samples taken from five points in the pile randomly. Samples were placed in polyethylene bags and transferred to the laboratory for analysis.

The composting processes of the pit were prepared in approximately three months. Three replicates of compost sampled were analyzed. Compost samples from pit were collected, dried, ground and sieved by passing through sieve and then used for chemical analysis. Samples were oven dried at 70°C and ground to pass through a 20-mesh sieve size.

The pH was determined by glass electrode pH meter. The result was reported as soil pH measured in water (sample and water ratio=1:5). Furthermore, the Electrical conductivity (EC) of collected soil samples was determined electrometrically (1:5 i.e. sample: water ratio) by a conductivity meter using 0.01 M KCL solution to calibrate the meter.

Total nitrogen was determined by Kjeldhal's method where sample was digested with concentrated H_2SO_4 and catalyst mixture. Nitrogen in the digest was determined by distillation with 40% NaOH followed by titration of the distillate trapped in Toshero regent with 0.01% HCl. Total Phosphorus was determined on spectrophotometer after developing colour by vanadomolybdo phosphoric acid yellow colour method. The readings were taken at 440 nm wavelength. Total Potassium was analysed by Percent emission and recorded following the methods outlined by using Eel Flame photometer. Micronutrients were analysed by using atomic absorption spectrophotometer. Organic matter was determined by loss on ignition method. Fivegram sample was taken in pre-weighed the porcelain crucibles which were kept in muffle furnace for 5 hours at 550°C. After cooling the crucibles were weighed to determine the loss on ignition.

RESULTS & DISCUSSIONS

Among the major chemical parameters, the analytical data regarding pH, EC and organic carbon contents of C_1, C_2 and C_3 enriched manure showed great variation in comparison of normal organic manures like (C_4, C_5, C_6) vermicompost, FYM and compost. The pH of enriched compost ranged between 7.40 – 7.90 followed by FYM (6.9) slightly neutral in the nature so it was most suitable for plant growth. Analytical data showed that EC of C_1 (3.4 dSm^{-1}), C_2 (3.1 dSm^{-1}) and C_3 (2.1 dSm^{-1}), organic carbon content of C_1 (12.5%), C_2 (13.1%) and C_3 (13.5%) were found more in the comparison to normal organic manures (Table No. 1). These findings were similar to Surekha *et al.* (2016).

Among the primary macro nutrients N, P, and K of enriched organic manures (1.37%), (1.75%) and (1.14%) contained highest level in the comparison to normal organic manures (Table 1). There was a significant increase in overall nutrient contents after enrichment with rock phosphate and different microorganism like Azotobacter, PSB, KSB, Trichoderma and Pseudomonas (Table 2). Similar results were reported by Kumar *et al.* (2018).

Among the secondary macro nutrients Ca, Mg, S of enriched manures were higher (54760 ppm), (8124 ppm) and (4672 ppm) followed by normal compost (22700 ppm), vermicompost and FYM containing significantly very low level in the comparison of enriched organic manures (Table 2). Similar results were obtained by Mwangi *et al.* in 2020.

Among the Micronutrients (Fe, Cu, Mn, Zn, Mo, and B) of enriched manures were higher. The total Fe, Cu, Zn and B (18100 ppm), (222 ppm), (317 ppm), (101.10 ppm) were found significantly higher in the enriched compost. In normal organic manures these were found in very less amount or absent (Table 3)**.**

In acidic soil as well as in alkaline soils decomposition of applied different organic materials released acids or acid forming compounds that reacted with sparingly soluble salts or at least increase their solubility (Sultana *et al.,* 2021). Further, the carbonic acid and organic acid produced during the decomposition of organic matter solubilized insoluble phosphate in the rock phosphate, resulting in the release of phosphate and calcium into the solution.

Billah *et al.* (2020) reported that composting in agriculture, especially compost enhanced with additions, not only provides varied plant-available macro and micronutrients, but it also had a substantial impact on numerous soil physical, chemical and biological properties. Various research investigations conducted across the world have shown that combining diverse organic manures, such as green manures, FYM, rock phosphate, and waste mica enriched composts, improves soil qualities by chemically improving soil properties (Nutritionally). Organic matter addition through composts has been regarded as a critical source of sustained soil health and crop production in the post-green revolution period. The addition of various additives to organic materials improves nutrient solubility in soil solution, hence improving soil quality and production. Rock phosphate and effective microorganisms being locally available are cheaper sources of nutrient availability with P fertilizer and need to be tested.

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Table 1: pH, EC and organic carbon content in different enriched and normal composts

Macronutrients	**Enriched**			**Normal**		
	C_1	**C_2**	**C_3**	**C_4**	**C_5**	**C_6**
pH	7.90±0.10	7.80±0.10	7.40±0.12	6.50±0.37	6.90±0.24	5.90±0.44
EC	3.40±0.21	3.10±0.06	2.10±0.06	0.18±0.01	0.39±0.03	2.60±0.22
Organic carbon	12.50±0.88	13.10±1.05	13.50±0.93	9.80±0.48	2.29±0.34	7.90±0.24

*Results are expressed as means ± SD of three replicates

Enriched: C1 – Mineral (Rock Phosphate) enriched compost; C2 – Microbial (N, P, K biofertilizer + biopesticide - Trichoderma, Pseudomonas) enriched compost; C3 – Mineral + Microbial enriched compost and Normal: C4 – vermicompost; C5- FYM – Farm yard Manure; C6 – Compost.

Table 2: N (%), P (%), K (%), Ca (ppm), Mg (ppm) and S (ppm) content in different enriched and normal composts

Macronutrients	Enriched			Normal		
	C_1	C_2	C_3	C_4	C_5	C_6
N (%)	1.25±0.03	1.12±0.04	1.37±0.02	1.60±0.15	0.50±0.06	0.80±0.20
P (%)	1.35±0.05	0.50±0.07	1.75±0.04	0.70±0.15	0.20±0.09	0.35±0.03
K (%)	0.86±0.05	0.73±0.12	1.14±0.05	0.80±0.20	0.50±0.06	0.48±0.07
Ca (ppm)	73370.00±12.60	42250.00±12.60	54760.00±5.78	5000.00±92.71	9000.00±57.23	22700.00±34.68
Mg (ppm)	6177.00±13.01	7012.00±166.54	8124.00±7.45	2000.00±117.08	2000.00±99.79	5700.00±30.59
S (ppm)	3683.00±14.85	3453.00±39.05	4672.00±12.68	-	-	-

*Results are expressed as means ± SD of three replicates

Enriched: C_1 – Mineral (Rock Phosphate) enriched compost; C_2 – Microbial (N, P, K biofertilizer + biopesticide -Trichoderma, Pseudomonas) enriched compost; C_3 – Mineral + Microbial enriched compost and Normal: C_4 – Vermicompost; C_5 – FYM; C_6 – Compost

Table 3: Fe, Cu, Mn, Zn, Mo, B (ppm) content in different enriched and normal composts

Treatment	Fe (ppm)	Cu (ppm)	Mn (ppm)	Zn (ppm)	Mo (ppm)	B (ppm)
Normal organic manures						
C_4	175.00±10.42	5.00±1.51	96.50±3.79	24.50±3.10	-	-
C_5	146.50±5.87	2.80±0.35	69.00±3.79	14.50±1.76	-	-
C_6	1.17±0.05	0.0017±0.0009	0.0005±0.0002	0.00006±0.000004	-	-
Enriched organic manures						
C_1	15400.00±88.30	76.84±2.12	352.20±4.98	383.00±6.02	41.66±1.97	127.70±1.37
C_2	10570.00±63.01	130.50±3.01	470.90±7.60	779.00±8.10	36.12±2.84	131.30±2.69
C_3	18100.00±57.80	222.00±4.34	446.90±6.18	317.20±4.40	42.15±1.50	101.10±1.58

*Results are expressed as means ± SD of three replicates

Enriched organic manures: C_1 – Mineral (Rock Phosphate) enriched compost; C_2 – Microbial (N, P, K biofertilizer + biopesticide -Trichoderma, Pseudomonas) enriched compost; C_3 – Mineral + Microbial enriched compost and Normal: C_4 – Vermicompost; C_5 – FYM; C_6 – Compost

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