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Phosphate Rich Organic Manure (PROM)

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Abstract
Since the previous two decades, organic farming has included phosphate-rich organic manure, which is competing with synthetic chemical fertilizers like DAP, MAP, SSP, and nitro-phosphates. The technology and economic viability of producing phosphate-rich biofertilizer (referred to as PROM) by bioconversion of phosphate gemstone ore into usable phosphates (directly accessible by shops) in presence of organic manure similar to vermicompost or anaerobic digester sludge (discharged from biogas units) using a microbial culture of *Bacillus megatherium, varphosphaticum* (phosphate solubilizing bacteria) and *Azotobacter* (nitrogen fixing bacteria). It mostly consists of fine-grained, high-grade rock phosphate minerals and produced organic manure with a 20:1 C:N ratio. The purpose is to show a marketable product's production chain step-by-step using legal requirements from the fertilizer control order.

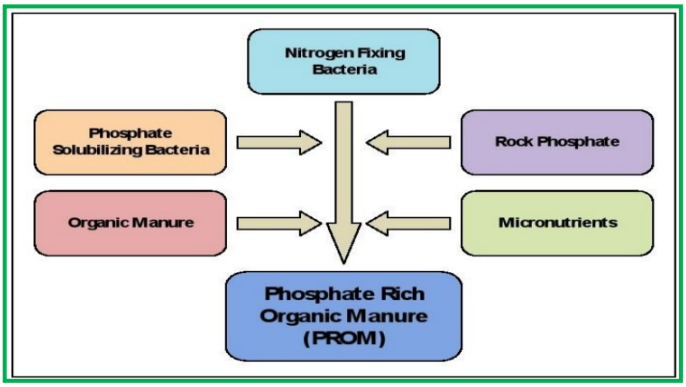
Introduction
By co-composting high-grade (32 % P_2O_5 +/- 2 percent) rock phosphate in very fine size, phosphate rich organic manure (PROM) is created. It is a type of fertilizer used as a substitute for single superphosphate and diammonium phosphate (DAP) (SSP). All plants need phosphorus, but because soil phosphorus levels are low, this presents a challenge for agriculture. Phosphorus must often be supplied to the soil in order to promote the kind of extensive plant growth that is ideal for agricultural production. The solubility is influenced by the soil's pH, the surrounding environment, and the bacteria that exist there. Today, 90 percent of the 140 million tonnes of high-grade rock phosphate material consumed worldwide is used to make DAP. Since artificial fertilizers destroy native soil flora and fauna, they actually lower agricultural yield. Only around 30% of the phosphorus present in diammonium or single super phosphate in the soil is utilized by plants; the remaining 70% is transformed into forms that cannot be utilized by crops. Tricalcium phosphate, a water-insoluble compound, makes up the majority of the phosphorus in rock phosphate mineral. The pH range where phosphorus dissolves most readily in the soil is between 5.5 and 7.0. Aluminum, iron, and manganese ions keep the local pH above 5.5 while magnesium and calcium ions keep the pH above 7 and inhibit the release of phosphorus out of its stable molecule. The slow breakdown of phosphorus from rock phosphate dust added to the soil as a result of organic acids produced by microorganism's increases phosphorus uptake by plant roots. The other elements can't lock phosphorus into insoluble forms when it's in organic manure. Because it is water-insoluble, the phosphorus in phosphate-rich organic manure does not seep into groundwater or enter runoff. The most of the phosphate rocks can be utilised to make phosphate-rich organic manure.

Organic manure that is high in phosphates because it is made by mixing phosphate rock that is finely ground with organic manure. Vermicompost, the sludge produced by

anaerobic digestion of biogas, plant wastes (including water hyacinth, agriculture waste, and garden waste), and municipal/cellulosic wastes are the most recommended advised sources of organic manure. Another benefit of anaerobic digester sludge (ADS) is that it is a byproduct and doesn't require separate production costs. A natural, better, and less expensive alternative to diammonium phosphate is the creation of phosphorus-rich organic manure (PROM) by composting press mud and distillery waste with rock phosphate into a value-added product standardized to contain 18% P_2O_5 with 22% humidity (DAP).The agronomic evaluation of PROM on paddy crops acted in an improvement of 29.41 yield over the DAP. The farmers are not familiar with PROM, still use traditional fertilizers for their crops. This is an actually serious problem for all, these fertilizers harm the soil as well as the environment, animal, humans, etc. extreme use of chemical fertilizers alike as single super phosphate (SSP), diammonium phosphate (DAP), monoammonium phosphate (MAP) etc. in farming mitigates the number of free-living profitable microorganisms; those are directly or indirectly useful for any crop. Because the amount of this fertilizer used by plants up to 30% only. The remaining amount of these fertilizers accumulated in the soil and constantly increases the soil pH. PROM is manufactured and vended in India by different agro industries. PROM is made by combining organic manure, such as compost, vermicompost, cow dung, soy meal, and household kitchen waste, with high-grade (32 % P_2O_5) rock phosphate in actually fine size. The size of the rock phosphate particle has a direct impact on PROM's efficacy. The effectiveness of PROM increases with increasing rock phosphate fineness. As a soluble phosphate, rock phosphate works well in both acidic and alkaline soil.

Components of PROM

A. High grade rock phosphate
B. Organic manure (Vermicompost, anaerobic digester sludge)
C. Phosphate solubilizing microorganisms (*Bacillus species*)
D. Nitrogen fixing microorganisms (*Azotobacter*)
E. Micronutrients such as copper, zinc & cobalt



Advantages of PROM

- PROM is slow release fertilizer, more effective in farming as compared to synthetic fertilizers similar as single super phosphate (SSP), diammonium phosphate (DAP) or monoammonium phosphate (MAP).
- Since the raw rock phosphate ore is biochemically transformed into soluble phosphates, plants can be fed on it directly.
- Contains three major nutrients – A). Phosphorous, B). Organic carbon, C). Nitrogen
- Provides micro-nutrients like cobalt, copper, and zinc along with primary nutrients.
- Acts as an option to DAP and makes soil soft and nutritious with nutrients for a long time.
- Supplies P_2O_5 to another crops planted in a treated area as efficiently as the first.
- High yield and better quality production is obtained.
- Improves soil physical properties like soil structure, porosity and binds soil particles into aggregate porosity.
- CO_2 is emitted during decomposition and helps in decreasing soil alkalinity.
- Improves the water holding capacity and increases infiltration.
- Acting as buffering agents, they help to minimize soil degradation caused by high acidity and alkalinity.
- Used in the synthesis of proteins, oils, and amino acids.

- It can be produced using acidic waste solids recovered from the discharge of biogas plants, hence making the environment sound and helps to mitigate climate change.
- Due to organic manure presence, leaching and runoff are averted, improves soil health and fertility.
- It is completely free to produce phosphoric acid or elemental phosphorus from phosphate rock.
- Production of PROM is largely cost-effective as it's a low energy process that doesn't demand high temperature or high pressure, needs no chemical catalyst, and doesn't consume any costly chemicals.
- PROM is actually effective as phosphatic fertilizer truly in saline soils where DAP completely failed.
- Enhances the growth of soil microorganisms that support the dissolution of P either applied to the soil or naturally present in the soil.
- The use of PROM will reduce the cost of fertilization to the cultivators and will also act in the conservation of phosphate mineral, a non-renewable resource due to the high residual effect.
- The agronomic efficiency of this new P-fertilizer is improved than that of the complex phosphatic fertilizers available on the market present. PROM is suitable for neutral and alkaline soils, which will prove to be a boon to the Indian farmers.

Composition of phosphate rich organic manure:-

Moisture per cent (%) by weight	**25.0 (max)**
Particle size (Passing through 4.0 mm sieve)	90% (min)
Bulk density (g/cm^3)	Less than 1.0
Total organic carbon (%)	7.9 %
Total nitrogen (N) per cent by weight	0.4 (min)
Total phosphates (P_2O_5) per cent by weight,	10.4 % (min)
C:N ratio	20:1
pH (1:5 solution)	6.7 (max)
Conductivity (d Sm^{-1})	8.2
Heavy metal content (mg/kg)	
Arsenic (As)	10.00 (max)
Cadmium (Cd)	5.00 (max)
Chromium (Cr)	50.00 (max)
Copper (Cu)	300.00 (max)
Mercury (Hg)	0.15 (max)
Nickel (Ni)	50.00 (max)
Lead (Pb)	100.00 (max)
Zinc (Zn)	1000.00 (max)

Usage: This phosphate rich organic manure can be used in all cereals, pulses, vegetables, fruits and flower crops.

S. No.	Crop	Dosage per acre (While Sowing)	Dosage per acre (Standing Crop)
1.	Soybean	100 kg	-
2.	Potato	100 kg	-
3.	Onion	100 kg	-
4.	Garlic	100 kg	-
5.	Wheat	100 kg	-
6.	Gram	100 kg	-
7.	Green Chilies	100 kg	100 kg
8.	Tomato	100 kg	100 kg
9.	Cotton	100 kg	100 kg
10.	Vegetables	100 kg	100 kg
11.	Fruit Orchards	100 kg	500 g per plant, Every 3 months

PROM in Agriculture

Plants can be fed PROM because it has been found that they can easily assimilate it. Both in alkaline and acidic soils, it works just as effectively. Several field trials have shown that PROM performs comparably to (and frequently better than) synthetic fertilisers such as SSP, DAP, or MAP in terms of crop output. Below, in Table no.1, are some typical findings on agricultural yields for grains like soybeans and groundnuts, crops like rice, wheat, and barley, as well as vegetable yields for things like cabbage and onions. The synthetic phosphatic fertilizers that are frequently used like SSP (Single Superphosphate) for wheat and soybeans and DAP (Diammonium Phosphate) for rice, barley, groundnuts, cabbages, and onions, are being compared. The yield of vegetables, grains, and crops obtained with PROM is often superior to and very comparable to that obtained when synthetic phosphatic fertilisers (SSP, DAP) are used in the soil.

Table – 1. Comparison of PROM with synthetic phosphatic fertilizer.

Type of crop	Yield of crop, quintals/ hectare				
	SSP	**DAP**	**PROM**	**PROM with ADS**	**PROM with vermicompost**
Wheat	28.9	-	29.5	29.09	28.8
Soybean	10.37	-	11.69	11.55	11.0
Groundnut	-	30.29	31.08	31.33	30.67
Rice (kg/ ha)	3000	3910	4385	4375	4250
Barley	-	5623	6969	7020	67.25
Cabbage (q/acre)	-	4666	54.44	53.75	54.50
Onion	-	165.19	167.16	166.66	164.55

Conclusion

Raw phosphate rock and organic manure, such as vermicompost or anaerobic digester waste, can be used to successfully create phosphatic biofertilizer (PROM) (ADS). To improve the quality of the biofertilizer, microbial cultures such as those of *Azotobacter* and *Bacillus megatherium* could also be used in the second and third stages of preparation. The physical, chemical, and biological properties of the soil are enhanced by this phosphate-rich organic manure, which also boosts crop production. It increases the electrical conductivity of the soil and the activity of the soil's beneficial microorganisms. Additionally, the pH of the soil is maintained. It encourages the formation of humus. Additionally, it promotes effective root formation and raises the percentage of seed germination. It enhances a crop's capacity to fight severe diseases. The product is entirely eco-friendly.

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