PROM Khad an efficient source of P to replace the costly chemical Phosphatic Fertilizer

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The subsidy on phosphate fertilizers rose to an unacceptable level while alternate cost effective technologies are available. Fertilizer industry needs to develop innovative products using the recent advances in the agricultural sciences. Manure producing industries to be supplied rock phosphate mineral (at subsidized costs) as being supplied to chemical fertilizers industries suitable to produce PROM Khad (Phosphate Rich Organic Manure).

Introduction

Single super phosphate a phosphate fertilizer that contains P in water soluble form was first produced[1] at Rothamsted Experimental Station (England) during the year 1840. This is followed by the development of more complex phosphate fertilizers such as Di Ammonium Phosphate [DAP] *etc*. Today DAP is the unquestioned king among the chemical phosphate fertilizers. The world produces and consumes[2] around 140 million tons of high grade rock phosphate mineral most of which goes into the production of DAP, MAP and SSP. The Government of India used to spend substantial amounts as subsidy to make DAP, MAP and SSP available to Indian farmers at affordable costs. However in the recent past during 2010 and 2011 the expenditure of subsidy on DAP sky rocketed to 120 000 crores of rupees. This trend continues in one form or the other. Today a bag of 50 Kg of DAP is costing around Rs 956/- despite heavy subsidy which used to be Rs 500/- around the year 2000. Because of the "mind set" and "habit" due to the marketing efforts by the producers of DAP and non availability of alternate products, farmers still buy DAP, MAP and SSP even at high costs and in black market.

Use efficiency of P from Chemical fertilizer

It is well known since long that up to 70% of P applied to soils through chemical phosphatic fertilizers including DAP goes to waste[3] either by the way of locking by Al, Fe and Mn ions present in the acidic soils or by Ca and Mg ions present in the alkaline soils. This problem is known to soil scientists as "Phosphate Fixation" by soils. DAP completely fails and shows no effect in saline soils. Often scientists say that DAP is an imbalanced fertilizer from the point of view of P:N ratio which does not meet plant nutrient requirements. That is why DAP

application is accompanied by urea application to make up for the N requirement by the soils and plants. Excessive and imbalanced application of chemical fertilizers destroys soil flora and fauna which are essential for maintaining natural soil health. In fact excessive application of chemical fertilizers reduced agricultural out put in several areas for example wheat production in the district of Sri Ganga Nagar, Rajasthan.

New Technologies

The comfort provided by the subsidy from the revenues of the Government, Fertilizer Industry has surely become complacent and failed to reduce the production costs of DAP and also failed to invent alternate fertilizers that are as efficient as DAP. It is reported[4] that rock phosphate mineral with farm yard manure works as effectively as DAP. The following table shows[5] (treatment 7)that Phosphate Rich Organic Manure (PROM) produced by mixing high grade rock phosphate mineral along with sufficient quantity of farm yard manure (FYM) is as effective as DAP in the alkaline soils (pH 8) of Rajasthan.

Table 1, [ref. 5]

Effect of PROM and DAP on the Output of *Cyamopsis tetragonoloba* (Linn.)

Treatment No.	Treatment	Seed Output per Plant (g)	Seed Output per Plant (g) (residual effect)
0	PR(34/23-d80) @40 kg $P_2 0_5$ ha^{-1}	6.69(+44.8)	8.63 (+25.43)
1	Control (Soil)	4.62	6.88
2	PR(34/23-d80) @40 kg $P_2 0_5$ ha^{-1} + Urea @ 18 kg N_2 ha^{-1}	7.76(+67.96)	7.69 (+11.77)
3	DAP @ 40 Kg $P_2 0_5$ ha^{-1}	7.09(+53.46)	7.61 (+10.61)
4	PR(34/23-d80) @ 40 kg $P_2 0_5$ ha^{-1}+ FYM @ 0.5ton ha^{-1}	5.29(+14.50)	7.92 (+15.11)
5	PR(34/23-d80) @ 40 kg $P_2 0_5$ ha^{-1}+ FYM @ 1ton ha^{-1}	5.28(+14.28)	8.58 (+24.70)
6	PR(34/23-d80) @ 40 kg $P_2 0_5$ ha^{-1}+ FYM @ 2 ton ha^{-1}	6.52(+41.12)	8.60 (+25.00)
7	PR(34/23-d80) @ 40 kg $P_2 0_5$ ha^{-1}+ FYM @ 4 tons ha^{-1}	7.17(55.19)	10.75 (+56.25)
8	DAP @ 40 kg $P_2 0_5$ ha^{-1}+ FYM @ 4 tons ha^{-1}	7.59 (+64.28)	9.76 (+ 41.86)

It may further be noted that the residual effect of PROM khad is as good as the first application where as DAP fails to show any such effect which means that use of PROM leads to the conservation of phosphorous mineral. Interestingly phosphate mineral with urea (treatment 2) is also as effective as DAP. Probably urea greatly enhances soil bacteria that solubilize rock phosphate mineral in the soil.

However unusual and surprising the results of treatments 2 and 7 in table 1 may appear, they are based on known sound principles that [1] soil P availability increases as soil organic carbon content increases and [2] applied N fertilizer increases mining of soil phosphates. This suggests that a compact form of PROM khad (containing say +10% or +14% total P_2O_5) along with urea can replace DAP to relieve Government of India from the burden of subsidy. In fact some manufacturers of manure from Municipal Soli Waste (MSW) successfully tested compact PROM in large scale. Providing subsidy on rock phosphate to the MSW industry at least initially will put these industries on equal playing ground. A sugar industry also produced and tested PROM on large scale successfully using press mud a waste from sugar industry.

Indeed PROM Technology is based on proven scientific facts that [1] increased soil organic matter increases[3] availability of soil P which may be noted from treatment 7 of Table1 and [2] applied N increases[6] the mining of soil P which may be noted from treatment 2 of table 1. It is presumed that application of urea (treatment 2 of table 1) enhances the growth of P solubilizing bacteria in the soil as urea is unlikely to react with rock phosphate.

PROM in saline soils

PROM Khad (Phosphate Rich Organic Manure) was tested[7] in saline soils (Electrical Conductivity in µs/cm, 15320.00 and soil pH at 7.22) of Eshidiya mines on Lettuce (*Lactuca sativa*). Two grades of rock phosphates concentrate produced from Eshidiya plant PR (34.31/765) that is concentrate having 34.31% P_2O_5 in the size d80 at 765 microns and rejects from de sliming stream PR (24.48/79) were tested. The results are shown in Table 3. Interestingly even low grade rock [24.48% P_2O_5] in PROM showed better performance than DAP and also high grade rock because the medium grade phosphate mineral is in very fine size. This observation prompts further research on types of medium grade phosphate ores and the particle size at which they are effective in PROM.

Table 2, [ref. 7]

Results of the Lettuce (*Lactuca sativa*) biomass production

SN	Treatment	Average biomass per plant in grams	Percent survival of the saplings
1	32.4 gms of P_2O_5 from concentrate, PR (34.31/765), 132.4 gms oil cake, 2253.5 gms of FYM - per M^2.	67.12	100
2	32.4 gms of P_2O_5 from waste slimes, PR (24.48/79), 132.4 gms oil cake, 2253.5 gms of FYM - per M^2.	69.15	100
3	Absolute control [Nothing added]	0.64	21
4	32.4 gms of P_2O_5 from DAP.	0.74	31

Suggested Action Plan

[1] Instead of selling DAP directly an N-P mixture of suitable proportions may be made using DAP, finely ground high grade rock phosphate and urea. Also Mixture of Urea and high grade rock phosphate be introduced as cheaper and effective fertilizer. Fertilizers such as direct application of phosphate rocks be subsidized again for acidic soils. Partially acidulated phosphate rocks on their own or in the back ground of organic manures may over come the problem of soil fixation of P. Calcium Ammonium Nitrate (CAN) is produced by adding $CaCO_3$ to ammonium nitrate up to 40% by weight followed by fusing the mix. On the similar lines CAN Phos may be produced mixing 40% by weight of fine sized rock phosphate to ammonium nitrate.

[2] Organic manure producers (such as sugar plants, MSW producers, large scale bio gas plants) be supplied rock phosphates at subsidized costs through agencies such as Indian Potash Ltd or Rock Phosphate Mineral Producers in India to produce and market PROM. If need be the new specifications of PROM be arrived at. PROM is a validated technology and be kept out of FCO.

[3] A large quantity of rice crop waste is being burnt by the farmers in a very large scale particularly in Panjab, Haryana, Western UP, part of Rajasthan and other States causing environment pollution, can be utilized in PROM khad production through a Project on PROM by PPP mode in rice producing States.

The biggest hurdle is the Fertilizer Control Order (FCO) of the Government of India which is self defeating and suicidal. FCO should be kept in abeyance in reference to the above suggestions in action plan [1] till large scale field trials are conducted by ICAR scientists.

Closing remarks

Fertilizer industry needs to review the viability of DAP technology and make all efforts to reduce the cost of production of DAP and also by developing a balance fertilizer to replace the DAP. There is a urgent need to conduct large scale field testing of PROM khad along with available chemical phosphatic fertilizer in different agroclimatic condition of the country to utilize the available crop waste and organic waste of industries in the country.

Fertilizer control order (FCO) is the biggest hurdle in promoting PROM and other fortified manures. Manures should not be covered under FCO but should be under Bureau of Indian Standards as is the case with Agriculture Grade Gypsum.

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