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Research Article

Application of Low Grade Phosphate Rock as Fertilizer with Urea and Urea along with Organic Manure in Alkaline Soil: A Preliminary Study

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Abstract

Studies have been conducted at pot scale to assess the agronomic efficiency of low grade rock phosphate analyzing 20% P_2O_5 along with urea and urea with organic manure (produced from biogas plant) and the results compared with Di Ammonium Phosphate, a standard chemical phosphatic fertilizer. The biomass of *Spinacia oleracea* L. produced after 20 days of sowing under various treatments was noted. The soil pH was 8.8. We conclude that fine sized low grade phosphate with urea @ 16 Kg of nitrogen per hectare is as efficient as Di Ammonium Phosphate on equal P_2O_5 basis.

Key words: Rock phosphate, Urea, *Spinacia oleracea* L.

Introduction

Several scientists around the world have been trying to develop low-cost phosphatic fertilizers. Phosphorous is taken up by the plants in water soluble form as $H_2PO_4^-$, HPO_4^{2-} and PO_4^{3-}. Plants exude organic acids like citric and malic acids through their roots which dissolve some soil phosphates, which in turn are taken up by the plants through their roots. Phosphatic fertilizers are manufactured such that they contain phosphorous in water soluble form[1], e.g. DAP, MAP, SSP, TSP and other nitro phosphates. However, phosphates that contain substantial amount of P soluble in 2% citric acid or neutral ammonium citrate are also used as fertilizers in acidic soils, since plants can also take up phosphorous from these forms[2].

The major engineering problems like ammonia losses, corrosion, removal of hydrofluoric acid are very frequent in industries which are manufacturing DAP, SSP, TSP[3]. Using fine sized rock phosphate along with urea and biogas slurry is an economical method for producing phosphatic fertilizers.

In this study, we report agronomic efficiency of rock phosphate in fine size along with urea which is comparable to diammonium phosphate. The rock phosphate along with the organic manure was directly converted into phosphatic fertilizers *in situ* by the microbes present in the soil[4,5]. This is a one step process which avoids the use of sulfuric acid for converting rock phosphate into super phosphate which is the present industrial method for the manufacture of phosphatic fertilizers.

Materials and Methods

Spinach (*Spinacia oleracea* L.)[6] seeds used in the study were collected from the local Garden Hut shop in Delhi, India. Spinach has a high nutritional value and is extremely rich in antioxidants especially when fresh, steamed or quickly boiled. It is a rich source of Vit A (and esp. high in lutein), Vit C, Vit E, Vit K, magnesium, manganese, folate, betaine, iron, Vit B, calcium, potassium, Vit B_6, folic acid, copper, protein, phosphorus, zinc, niacin, selenium and omega-3 fatty acids. Recently, opioid peptides called rubiscolins have been found in spinach[7]. Polyglutamylfolate (Vit B_9 or

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folic acid) is a vital constituent of cells and spinach is a good source of folic acid. Boiling spinach can more than halve the level of folate left in the spinach, but microwaving does not affect folate content.

Table 1: Chemical composition of the rock phosphate sample used.

%Tri-calcium phosphate(TCP)	%Acid insoluble residues(AIR)	% Loss on Ignition at 900°C(LOI)	Chlorine (Cl) ppm
42.76	32.42	6.56	2977

The experiments were performed in pots of diameter 0.2286 m^2 and the surface area of the upper part of the pot is 0.041022 m^2 square. The average sunshine duration of Delhi in July-August was 13-14 hours per day and the temperature fluctuated between 27° to 34°C. The soil was experimented with the following five treatments: (1) Blank, (2) phosphate rock @ 60 Kg P_2O_5 per hectare, (3) phosphate rock @ 60 Kg P_2O_5 per hectare + urea@ 30 kg N per hectare + bio gas residue (dry basis) @ 4 ton per hectare, (4) diammonium phosphate @ 60 Kg P_2O_5 per hectare , (5) phosphate rock @ 60 Kg P_2O_5 per hectare + urea@ 16 kg N per hectare.

The DAP and urea used were of Fisher Scientific. The phosphate rock tailing slime sample was received from Jordan phosphate Mines Company limited, Eshidiya Mines, Jordan. The chemical composition of the rock phosphate is given in table 1 and the particle size analyses are given in table 2.

Table 2: Particle size analyses of the phosphate rock used.

Sieve size	% Weight retained	% Weight passing
+53 micron	17.90	82.10
+45 micron	2.50	79.60
+38 micron	3.20	76.40
-38 micron	76.40	------

80% of particle passing size 46.69 micron. (d80)

The fertilizers were thoroughly mixed with the soil in individual pots and the pots were watered for two days before starting the experiment[8]. All the pots were planted in triplicates in order to eliminate the experimental errors. The applied fertilizer reaches 2 inch deep by gently plugging the pot with the spatula. Water was applied in the minimum quantity so that the water soluble contents are not carried away. After two days seeds of spinach were sown in each pot (10 seeds in one pot). The plants were watered twice a day.The germination and sprouting were observed for twenty days. Only five healthy sprouts were allowed to grow and rest unhealthy sprouts were ploughed out. After twenty days the stems of the plants were cut just above the soil level and the length of the plant and the biomass measured[9].

The samples were washed with 0.2% detergent solution in order to remove the greasy/waxy coating on the leaf surface. Then the samples were washed by 0.1 M HCl followed by washing with plenty of water. The final wash was given by distilled water. The samples were air dried at room temperature for 2-3 days in the dust free atmosphere. At last the samples were kept in an oven and dried at 70°C for 48 hours.

The pH values were measured using pH 600 pocket sized pH meter (Milwaukee Electronics Kft., Szeged, Hungary).

Results and Discussion

The stems of the plants were harvested 20 days after sowing and the biomass was weighed for each treatment[10]. The results are shown in table 3. The result clearly illustrates that phosphate rock when used with urea works as efficiently as DAP at equal doses of P_2O_5. The pH of soil was 8.8. The cost of using phosphate rock along with the organic manure has been found to be less than the diammonium phosphate.

Table 3: Biomass production of *Spinacia oleracea* L. after 20 days of sowing. Soil pH was 8.8

Treatment No.	Treatment Details	Average Biomass per plant (gm.)	% Relative Agronomic Efficiency	% biomass increased with respect to absolute control
1	Blank (Absolute Soil)	3.504	Not Applicable	Not Applicable
2	Normal soil + Phosphate rock @ 60 Kg P_2O_5 per hectare	4.342	26.88	23.91
3	Normal soil + Phosphate rock @ 60 Kg P_2O_5 per hectare + urea@ 30 kg N per hectare + 4 tons/Hect. bio gas residue (dry basis)	8.285	153.38	136.44
4	Normal soil + Diammonium phosphate @ 60 Kg P_2O_5 per hectare	6.621	100	88.96
5	Normal soil + Phosphate rock @ 60 Kg P_2O_5 per hectare + urea@ 16 kg N per hectare	6.997	112.06	99.69

Conclusion

In conclusion, we have weighed the biomass of products of the five different treatments and evaluated their percentage relative agronomic efficiency. Among all the five different treatments screened in the present investigation, rock phosphate @ 60 kg P_2O_5 per hectare+urea @ 30 kg Nitrogen per hectare + biomass slurry (dry basis) @ 4 ton per hectare shows the best relative agronomic efficiency i.e. 153.38 as compared to the commercially used phosphatic fertilizer (DAP). Further modifications are under study in order to improve the activity and find the lead/hit towards the alternatives of DAP and would be reported in due course.

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References

1. Gopala Rao, M. and Sittig M. Dryden's Outline of Chemical Process Technology, Affliated East-West Press, India 1997, 162 p.

2. Shukla S.D. Pandey G.N. A Textbook of Chemical Technology, Vikas Publishing House, New Delhi 1986, 218 p.
3. Austin G. T. Shreve's Chemical Process Industries, McGraw Hill International Editions, New Delhi,1984, 284 p.
4. Sekhar D M R. and Aery N C. Current Science, 2001, 80: 1113-1115.
5. Sekhar D M R. Aery N C. and Gupta D K. Indian Chemical Engineer, 2002, 44: 3.
6. Rolland J. and Carol Sherman C. The Food Encyclopedia: *Over 8,000 Ingredients, Tools, Techniques and People*. Library and Archives Canada Cataloguing and Publication, Toronto 2006, pp 375-480.
7. Ball G F M. Vitamins in Foods: Analysis, Bioavailability and Stability. Taylor and Francis Group, Florida, USA, 2006, 189 p.
8. Rosand C. and Wilid A. Plant and Soil, 1982. 65: 351-362.
9. Sekhar D M R. and Aery N C. PROM Manual, Himanshu Publications, Udaipur pp 119-137.
10. Motsara M R. and Roy R N. Guide to laboratory establishment for plant nutrient analysis, Food and Agriculture Organization, Rome, 2008. pp 80-89.

CONTENTS

Review Articles

Research Articles

Short Communications

Opinion

News and Views

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