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Research Article

# Direct Use of Rock Phosphate along with Lignite on Cowpea

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## Abstract

Pot culture experiments were conducted to study the cumulative agronomic effectiveness of lignite and BGS with high grade rock phosphate [PR(34/74)] on cowpea grown in slightly alkaline soils. Shoot-root length, dry weight and seed weight plant$^{-1}$ were studied to evaluate the various treatment combinations. The results indicate that PR(34/74) + Lignite + BGS @ 10 tons ha$^{-1}$ combination resulted in an enhancement in shoot-root length, dry weight and seed weight, over the control.

**Keywords :** PROM, lignite, rock phosphate, humic substances.

## Introduction

Phosphorus is one of the important major nutrients required by the crops and in many soils its availability limit the crop yield. P deficiency is widespread in soils throughout the world and the efficiency of P-use by plants from soil and fertilizer sources are poor. Furthermore, P is a finite resource. Based on current rate of use, it is expected that the worlds' known reserves of high quality rock phosphate will be depleted within the current century[1]. Beyond this time the production of phosphate-based fertilizers will require the processing of lower-grade rock phosphates at significantly higher cost.

The mere presence of a particular chemical element in the soil is not enough. The real problem in maintaining optimum growing conditions is to have the essential elements not only present, but available when the plant needs them. The best reservoir of nutrient availability in soil is organic matter. The major component of soil organic matter is humus. The most biochemically active components of humus are the humic acids. Lignite is a low rank coal with low calorific value but potentially rich in humic substances (HS's), which are known to be non-polluting organic biostimulants particularly with regard to plant growth.

Naturally oxidized lignite is referred to as "leonardite". This form of lignite is probably the richest in readily available humic substances and is the most widely used raw material for extraction of humic acid by alkali solutions. It contains 5 to 15% humic and fulvic acids. The present study was formulated to test the agronomic effectiveness of high-grade rock phosphate PR (34/74) in combination with lignite and biogas slurry (BGS) on cowpea. Rock phosphate when mixed with some acid producing materials like farmyard manure, biogas slurry and organic wastes has given encouraging results as a fertilizer[2,3,4].

## Materials and Methods

Studies were carried out to evaluate agronomic effectiveness of high grade rock phosphate (HGPR, 34/74) ($P_2O_5$: +34%, MgO: 2.5%, $R_2O_3$: 1%, LOI: 5-6%, F : 3.1% and CaO: 51%) on the yield responses of cowpea. Mineralogically the material is predominantly fluorapatite followed by some carbonate fluorapatite and chlorapatite. Minor minerals are oligoclase, sillimanite, quartz etc. The material is 90-99% less than 74 microns and 85-95% less than 44 microns in size.

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Pot culture experiments were conducted with cowpea [*Vigna unguiculata* (L.) Walp.] at Dept. of Botany, Mohanlal Sukhadia University, Udaipur during the June-October of 2003.

For preparing mixture of PR (34/74) and lignite powder, 1 kg of PR (34/74) was mixed with 1 kg of lignite powder and 200 ml of water. Phosphorus as high grade rock phosphate PR (34/74) was applied at the rate of 60 kg $P_2O_5$ $ha^{-1}$. The treatments comprised the combination PR (34/74) along with BGS at 2 levels (5 and 10 tons $ha^{-1}$). Treatment without any added fertilizer constituted the control. Each treatment was replicated thrice.

Parameters studied for the evaluation of various treatments were: shoot-root length and dry weight per plant and seed weight per plant.

## Results and Discussion

Tables 1-3 show the effect of various treatments of PR(34/74) on the shoot-root length, shoot-root dry weight and seed weight of cowpea. The maximum enhancement in the shoot length (34.57%) was observed with the PR(34/74) + Lignite + BGS @10 ton $ha^{-1}$ treatment followed by PR(34/74)+ Lignite + urea treatment, which showed 23.67% increase, over the control (Table 1). The maximum shoot-root dry weight was also observed with the PR(34/74) + Lignite + BGS@ 10 ton $ha^{-1}$ which was followed by the treatment PR(34/74) + Lignite + BGS@ 5 ton $ha^{-1}$ showing 61.90% and 45.45% enhancement, in shoot and root dry weight, respectively, over the control.

While considering the seed weight per plant, the treatments of PR(34/74) + Lignite in combination with BGS @10 ton/$ha^{-1}$ and BGS @ 5 ton/$ha^{-1}$ were at par and showed an enhancement of (48.2% & 32.7%) respectively, over the control (Table-3). However, applications of PR(34/74) + Lignite affected all the parameters marginally which can be ascribed to the low availability of phosphorus from the soil to plants. While the maximum increase by the PR(34/74) + Lignite + BGS@ 10 ton $ha^{-1}$ treatment can be due to the lignite which is a complex supermixture of humic substances, and BGS which helped in the release of more $PO_4^{3-}$ anions from hardly soluble rock minerals PR(34/74).

The harmful effects of long-term usage of chemical fertilizers are slowly being realised as they decrease useful soil flora and fauna. It is possible to increase production, by keeping up the soil biology

**Table 1 : Effect of HGPR, lignite and biogas slurry on shoot-root length (cm) of *Vigna unguiculata* (L.) Walp.**

| S.No. | Treatments | Shoot length per plant | Root length per plant |
|---|---|---|---|
| 1. | Control | 32.1 | 23.2 |
| 2. | HGPR + Lignite | 33.5<br>(+4.36) | 24.5<br>(+5.60) |
| 3. | HGPR + Lignite + BGS @5 tons $ha^{-1}$ | 39.5<br>(+23.05) | 25.6<br>(+10.34) |
| 4. | HGPR + Lignite + BGS @10 tons $ha^{-1}$ | 43.2<br>(+34.57) | 33.1<br>(+42.67) |
| 5. | HGPR + Lignite + Urea | 39.7<br>(+23.67) | 24.1<br>(+3.88) |
| 6. | HGPR + BGS @5 tons $ha^{-1}$ | 35.2<br>(+9.65) | 24.8<br>(+6.90) |
| 7. | HGPR + BGS @10 tons $ha^{-1}$ | 38.8<br>(+20.87) | 26.3<br>(+13.36) |

**Table 2 : Effect of HGPR, lignite and biogas slurry on shoot-root dry weight of *Vigna unguiculata* (L.) Walp.**

| S. No. | Treatments | Shoot dry weight per plant (g) | Root dry weight per plant (g) |
|---|---|---|---|
| 1. | Control | 0.42 | 0.11 |
| 2. | HGPR + Lignite | 0.43 (+2.38) | 0.12 (+9.09) |
| 3. | HGPR + Lignite + BGS @5 tons $ha^{-1}$ | 0.54 (+28.57) | 0.13 (+18.18) |
| 4. | HGPR + Lignite + BGS @10 tons $ha^{-1}$ | 0.68 (+61.90) | 0.16 (+45.45) |
| 5. | HGPR + Lignite + Urea | 0.49 (+16.66) | 0.14 (+27.27) |
| 6. | HGPR + BGS @5 tons $ha^{-1}$ | 0.49 (+16.66) | 0.12 (+9.09) |
| 7. | HGPR + BGS @10 tons $ha^{-1}$ | 0.53 (+26.19) | 0.13 (+18.18) |

**Table 3 : Effect of HGPR, lignite and biogas slurry on seed weight of *Vigna unguiculata* (L.) Walp.**

| S. No. | Treatments | Seed weight per plant (g) |
|---|---|---|
| **1.** | Control | 0.58 |
| **2.** | HGPR + Lignite | 0.61 (+5.17) |
| **3.** | HGPR + Lignite + BGS @5 tons $ha^{-1}$ | 0.77 (+32.75) |
| **4.** | HGPR + Lignite + BGS @10 tons $ha^{-1}$ | 0.86 (+48.27) |
| **5.** | HGPR + Lignite + Urea | 0.68 (+17.24) |
| **6.** | HGPR + BGS @5 tons $ha^{-1}$ | 0.66 (+13.79) |
| **7.** | HGPR + BGS @10 tons $ha^{-1}$ | 0.72 (+24.13) |

alive. Use of PR (34/74) along with BGS or lignite, as an alternative source of phosphorus is more relevant and effective. Organic matter has many benefits in the soil. It improves drainage and aeration of the root zone and serves as a source of plant nutrients. It also holds moisture that is readily available to plant roots and serves to increase the availability of micronutrients such as iron and manganese.

Humic substances positively affect the nitrogen (N) and phosphorus (P) dynamics in soil[5], stimulate nutrient uptake by plants by affecting some enzyme activities[6], and so increase dry matter production[6,7,8]. Lignite contains 5 to 15% humic and fulvic acid. Several authors assume that it is the functional groups (hydroxyl and carboxyl groups) contained in humic substances which are mainly responsible for the responses obtained[9], because they naturally chelate and transport cations and trace metals and make them more available to roots.

In the present investigations, the beneficial effects of rock phosphate with organic acidulants on dry matter production is due to the conversion of insoluble rock phosphate into soluble form and further reduction in the reversion of phosphorus. Earlier studies [3,10,11,12] have also observed beneficial effects of partially acidulated rock phosphate in the neutral and alkaline soils.

The positive influence of the mixture of PR (34/74) with lignite and BGS can be ascribed to the fact that after addition to the soil, such organic materials undergo microbial decomposition, which causes the evolution of $CO_2$ and the production of weak organic acids (e.g. oxalic, citric, tartaric, gluconic). This results in lowering of the soil pH and dissolution of PR as reported by many workers[13,14] thus making the phosphorus available to plants. The organic acids released also cause a reduction in the reversion of released phosphorus by making complexes with the iron, aluminium and calcium present in the soil.

## References

1. Isherwood, K.F. Mineral fertilizer use and the environment. International Fertilizer Industry Association/United Nations Environment Programme, Paris, 2000.
2. Jaggi, T.N. Fert. News, 34: 43-50, 1989.
3. Aery, N.C., DMR Sekhar, D.K. Rana and K.A. Sangeet. In: Phosphate Rich Organic Manure (Ed. by MS Shaktawat, NC Aery, M Singh, BN Swami and MK Katewa), Himanshu Publications, Udaipur, 111-119, 2004.
4. Soni, P. and Aery, N.C. In: Phosphate Rich Organic Manure (Ed. by MS Shaktawat, NC Aery, M Singh, BN Swami and MK Katewa), Himanshu Publications, Udaipur, 148-152, 2004.
5. Biondi, F.A., Figholia, A., Indiati, R. and Issa, C. In Humic Substances in the Global Environment and Implications on Human Health, ed. N. Senesi and T.M. Miano, Elsevier, New York, 1994, p. 239.
6. Rauthan, B.S. and Schnitzer, M. Plant and Soil, 1981, 63, 491.
7. Tan, K.H. and Tantiwiramanond, D. Soil Sci. Soc. Am. J., 1983, 47, 1121.
8. Ayuso, M. , Hernández, T. , Garcia, C. and Pascual, J.A. Biores. Techn., 1996, 57, 251.
9. Piccolo, A., Nardi, S. and Concheri, G. Soil Biol. Biochem., 1992, 24, 373.
10. Rastogi, R.C., Mishra, B. and Ghildyal, B.P. Pantnagar J. Res., 2: 161-164, 1977.
11. Sekhar, D.M.R. and Aery, N.C., Current Science 8o; 9: 1113-1115, 2001.
12. Fried, M. and Mackenzie, A., J. Soil Sci. Soc. Amer. Proc., 14: 226-231, 1950.
13. Choudhary, M.L. and Mishra, B., J. Indian Soc. Soil Sci., 28: 295-301, 1980.
14. Awasthi, P.K., Luthra, K.L. and Jaggi, T.N. Ferti. News, 12: 44, 1976.

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