International Journal of Applied Life Sciences and Engineering (IJALSE)

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Vol. 1 (1) 62-65, 2014

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IJALSE

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Research Article

Agronomic Efficiency of Rock Phosphate in Fine Size with Ammonium Sulphate and Ammonium Nitrate

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Abstract

We studied the effect of Ammonium Sulphate (AS) and Ammonium Nitrate (AN) separately, along with low grade Phosphate Rock in fine size, on the growth (biomass) of Chick pea, which showed better Relative Agronomic Efficiency (RAE) than commercially available Di Ammonium Phosphate (DAP). RAE of PR + AS > PR + AN > DAP.

Keywords : Rock phosphate, relative agronomic efficiency, ammonium sulphate, ammonium nitrate.

Introduction

It has been reported[1, 2] that high grade rock phosphate in fine size, along with organic manure, shows agronomic efficiency comparable to Diammonium phosphate. Interestingly, a treatment with rock phosphate and urea is also reported[2] as efficient, which is conspicuous, for rock phosphate is inert and is not expected to react with urea. In the present study, we tested low grade phosphate in fine size along with ammonium sulphate and ammonium nitrate separately.

Materials and methods

Chickpea (*Cicer arietinum)* seeds used in this study were collected from a local super market in Vellore, India. Rock phosphate tailing samples with 43.8 % Tri-calcium phosphate (20. 05% P_2O_5) were procured from Eshidiya Mines of Jordan phosphate Mines Company limited, Jordan. The soil was 4.35% gravel, 92.85% sand and 2.8% fines. The commercial grade diammonium phosphate with 46% P_2O_5, used as fertilizer, was purchased from local market.

Prior to experiments, the Diammonium phosphate was sized and sieved to particles lesser than 2.5 mm diameter. Analytical grade Ammonium nitrate procured from Central drug house (P) Limited, New Delhi, India and Ammonium sulphate from Hi Media Laboratories Limited, Mumbai, India were used without further purification. Double distilled water was used to prepare soil solutions for analysis of pH and electrical conductivity.

The experiments were performed in plastic trays of dimensions 44 × 32 × 14 cm (length × breadth × height), filled with local red soil. The average sunshine duration of Vellore in March-April was 12-13h per day and the temperature fluctuated between 22°C to 35°C, and stayed around 29°C most of the time. The soil was experimented with the following six treatments: (1) Blank (absolute control), (2) Diammonium phosphate at 60 Kg P_2O_5 per hectare, (3) Rock phosphate at 60 Kg P_2O_5 per hectare with Ammonium sulphate at 16 Kg per hectare of Nitrogen, (4) Rock phosphate at 60 Kg P_2O_5 per hectare with Ammonium sulphate at 32 Kg per hectare of Nitrogen, (5) Rock Phosphate at 60Kg P_2O_5 per hectare with Ammonium nitrate at 16 Kg per hectare of Nitrogen and (6) Rock Phosphate at 60Kg P_2O_5 per hectare with Ammonium nitrate at 32Kg per hectare of Nitrogen.

The fertilizers were thoroughly mixed with the soil in individual trays, and were watered for two days before initiating the experiment. The trays were divided into four slots, and twelve chick pea seeds, at 2cm

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depth, were sown per slot. However, only ten healthy plants were chosen per slot and allowed to grow. The plants were watered twice a day. In addition, it was ensured that all the trays were uniformly exposed to sunlight. The final biomass was weighed on the day of cropping. To preserve the plant samples, they were subjected to microwave drying using a commercial microwave oven.

The sieved soil samples, after the proof of concept experiments, were analyzed for pH and electrical conductivity using the standard methods [3,4]. The pH values were measured using pH 600 pocket sized pH meter (Milwaukee Electronics Kft., Szeged, Hungary) and the electrical conductivity was measured using Systronics water analyzer (Model 371, Systronics (India) limited. The electrical conductivities were measured after the cropping.

Results and discussion

The stems of the plants were cropped 12 days after sowing and the biomass produced was weighed for each treatment. The results are shown in tables 1 and 2. The results clearly illustrate that low grade rock phosphate in fine size, either with 16 Kg of Nitrogen per hectare of Ammonium sulphate or Ammonium nitrate, works as efficiently as Diammonium phosphate, at equal doses of P_2O_5. Increasing the amount of Ammonium nitrate, from 16 Kg of Nitrogen per hectare to 32 Kg of Nitrogen per hectare, did not show proportionate increase in the agronomic efficiency. Along with low grade fine sized rock phosphate, Ammonium sulphate at 16 Kg of Nitrogen per hectare shows better results than Ammonium nitrate at 16 Kg of Nitrogen per hectare, presumably due to the presence of additional nutrient, Sulphur. The residual effects of these treatments, shown in table 2, are similar to the results of the original experiment, shown in table 1.

As these are proof of concept experiments, the duration between sowing and cropping has been deliberately kept short. Detailed tests are being conducted. It may be noted that the soil pH is alkaline, where it is generally thought that direct application of rock phosphate is not effective. A question that

Table 1. Direct Application of Rock Phosphate along with N Containing Fertilizers: Study with Chick Pea (*Cicer arietinum* L.), Soil pH = 8.0, E.C of Soil measured after cropping

Treatment No.	Treatment detail	Biomass of 40 plants after 12 days of sowing (in grams)	% biomass increased with respect to absolute control	Relative Agronomic efficiency index	Elect. Conductivity (µS/cm)
1	Absolute control	49.96	--	--	385
2	Di Ammonium Phosphate @ 60 Kg P_2O_5/ hectare (control)	52.31	4.703	--	467
3	Rock phosphate. PR (20.04/14.74) @ 60 Kg P_2O_5/ hectare + Ammonium Sulphate @ 16 Kg/ hectare of N	60.03	20.156	4.286	394

4	Rock Phosphate, PR(20.04/14.74)@ 60 Kg P_2O_5/ hectare + Ammonium Sulphate @ 32 Kg/ hectare of N	61.08	22.25	4.731	414
5	Rock Phosphate, PR (20.04/14.74) @ 60 Kg P_2O_5/ hectare + Ammonium Nitrate @ 16 Kg/ hectare of N	54.26	8.607	1.820	413
6	Rock Phosphate, PR (20.04/14.74) @ 60 Kg P_2O_5/ hectare + Ammonium Nitrate @ 32 Kg/ hectare of N	51.72	3.523	0.750	426

Table 2. Residual Effect of Treatments shown in Table 1

Direct Application of Rock Phosphate along with N containing Fertilizers : Study with Chick Pea (*Cicer arietinum* L.), Soil pH = 8.0. EC of soil measured after cropping.

Treatment No.	Treatment detail	Biomass of 40 plants after 12 days of sowing (in grams)	% biomass increased with respect to absolute control	Relative Agronomic efficiency index	Elect. Conductivity (µS/cm)
1	Absolute control	51.36	---	---	405.6
2	Di Ammonium Phosphate @ 60 Kg P_2O_5/ hectare (control)	54.88	6.85	---	473.3
3	Rock phosphate. PR (20.04/14.74) @ 60 Kg P_2O_5/ hectare + Ammonium Sulphate @ 16 Kg/ hectare of N	61.28	19.31	2.82	430.0

4	Rock Phosphate, PR(20.04/14.74)@ 60 Kg P_2O_5/ hectare + Ammonium Sulphate @ 32 Kg/ hectare of N	62.61	21.9	3.20	441.3
5	Rock Phosphate, PR (20.04/14.74) @ 60 Kg P_2O_5/ hectare + Ammonium Nitrate @ 16 Kg/ hectare of N	55.72	8.49	1.24	419.0
6	Rock Phosphate, PR (20.04/14.74) @ 60 Kg P_2O_5/ hectare + Ammonium Nitrate @ 32 Kg/ hectare of N	52.19	1.62	0.24	433.6

demands an answer in the light of the present study is whether it is required to convert phosphorus from rock phosphate in to water soluble forms, as is done in the case of Single Super Phosphate (SSP), Triple Super Phosphate (TSP) and Diammonium Phosphate (DAP)?

Conclusion

The present study shows that the direct application of low grade rock phosphate mineral along with nitrogen containing fertilizers, even in slightly alkaline soils, is as effective as diammonium phosphate.

Acknowledgement

We are sincerely thankful to Dr. D.M.R. Sekhar of Jordan phosphate mines company limited, Eshidiya Mines for facilitating to carryout this investigation, and Dr. Prabhu Linghiah for providing the phosphate rock slime samples. We like to acknowledge the management of VIT University for supporting the research.

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