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STUDIES ON PHOSPHORUS RELEASE PATTERN OF-CALCAREOUS SOIL AMENDED WITH DIFFERENT PHOSPHORUS SOURCES UNDER LAB EXPERIMENT

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Abstract : An Incubation study was conducted at Krishna College of Agriculture and Technology, Usilampatti to study the release pattern of phosphorus from calcareous soils along with different phosphorus sources. The experiments were laid out in Completely Randomized Design (CRD) with ten treatments and three replications. The treatments were imposed based on the blanket recommendations of maize crop. The P sources viz., Single Super Phosphate, DAP, Rock Phosphate, Vermicompost and Phosphorus Solubilizing Microorganism were used. Experimental results revealed that P release from different sources was influenced by soil pH, EC and Organic carbon. The Applied P sources significantly influenced the Soil available Phosphorus. During the incubation period, the available soil phosphorus increases gradually with the increasing addition of chemical fertilizers up to 40 days after Incubation and then declined trend was observed. Among the treatments, The higher olsen P content at 27.4 mg kg-1 at 20 DAI, and 29.5 mg kg-1 at 40 DAI was recorded in the treatment of T_7(NK 100% RDF + SSP+ PSB) . This was followed by the treatment of T_8 (NK 100% RDF + DAP + PSB) and it was on par with T_{10} (NK 100% RDF + RP+ Vermicompost + PSB) and T_9 (NK 100% RDF + RP+ PSB). The minimum available P was noticed in the control treatment throughout the period of incubation. It was evident that SSP or DAP along with PSB inoculation might be the best source of fertilizer for calcareous soil.

Index terms: Phosphorus, vermicompost, PSB, SSP, Rock Phosphate

1. INTRODUCTION

Phosphorus (P) is one of the macronutrient for biological growth and development [1]. It is an essential element because of the relatively large amount of P is required by the plants. It is the major plant growth limiting nutrient despite being abundant in soil in both organic and inorganic forms. The P content in inorganic soil is about 0.5% (w/w) but only 0.1% of the total P is available to plants because of its low solubility, availability and its fixation in soil .P is the limiting factor to crop productivity on an estimated 40% of the world's arable soil. Soil P is finite, non-renewable and limited resource, Phosphate rock is a general term that describes naturally occurring mineral assemblages containing a high concentration of phosphate minerals about 95% of it is used to produce fertilizers, animal feeds and pesticides. India has reserve of 14.7 Mt of high grade rock phosphate and 190 Mt of low grade with an average of 12% P2O5.Out of total India reserve of 217.2Mt, Rajasthan has the largest reserve of rock phosphate of about 78.8 Mt [2]. P fixation is significantly and positively correlated with clay content of soil. The availability of phosphorus is controlled by the fixation mechanism. Prediction of response to P application is generally based on available P status as well as on the rate and magnitude at which the added P is converted into insoluble forms in soil. Keeping the above facts in view, The present Investigation was conducted to 'studies on Phosphorus Release pattern of Calcareous soil amended with different P sources under Incubation study' with the following objectives to study the effect of Phosphorus application through different sources on soil physio chemical changes, to study the Phosphorus release pattern on Calcareous soil and to evaluate the best P sources under Incubation study.

2.MATERIALS AND METHODS

An incubation experiment was conducted in the soil science Laboratory at Krishna College of Agriculture and Technology, Usilampatti. Before the commencement of experiments, The bulk soil collected from the surface layer (0 – 15 cm) from Thirumangalam was used for this experiment. The collected bulk soil samples were processed to pass through 2 mm sieve and thoroughly mixed to have a composite sample. Phosphobacteria biofertilizer and vermicompost were used in this experiment. They were collected from the nearby KVK. After collection, the manures were dried in hot air oven at 60ºc for overnight and sieved through 2 mm sieve. The incubation experiment were laid out in Completely Randomized Design with 10 treatments and three replications.T1 as Absolute Control , T2 as PSB alone, T 3 as NK 100% RDF + PSB, T4 as NK 100% RDF +SSP, T5 as NK 100% RDF + DAP, T6 as NK 100% + RP, T7 as NK 100% RDF + SSP + PSB, T8 as NK 100% RDF+ DAP + PSB, T9 as NK 100% RDF+ RP + PSB , T10 as NK 100% RDF + RP+ Vermicompost + PSB. (Recommended dose of vermicompost – 5t/ha. Recommended dose of Fertilizer in maize crop – 135:62.5: 50 Kg of N, $P_2 0_5$, K_2O/ ha).

The incubation experiment was conducted using plastic containers filled with 100 grams of processed soils. Calculated quantities of fertilizers and Organic manures were added and incorporated into the soils as per treatment schedule and the experiment was conducted for 60 days. The moisture of the soil was kept at field capacity by using distilled water. Destructive soil sampling was carried out at 20, 40 and 60 days after incubation (DAI) and subjected to analysis of pH , EC , Soil organic carbon and olsen P in soil.

3.RESULTS AND DISCUSSION

An incubation experiment was conducted to study the effect of different P sources on phosphorus release pattern in calcareous soil. The result obtained from the incubation experiment is given below. The pH of the experimental soil was 8.46 which was calcareous. The soil was free from salinity with an electrical conductivity 0.60 dsm^{-1}. The organic carbon content of soil was 0.24 per cent. The major nutrient status of the soil showed that the available N content of the soil was low (150.5kg ha^{-1}), the available P content of the soil was low (8.12 $kgha^{-1}$)and K status of the soil was medium (204.2 $kgha^{-1}$). The nutrient contents of Vermicompost is N: 2.8 %; P:0.17 %; K -1.2 % . The pH values ranging from from 8.4-8.1, 8.4-7.9, 8.32-7.6, 8.3-7.3 at 0,20, 40, and 60 days respectively. The results were statistically non significant. However, The higher pH values of 8.4, 8.32, 8.3 were recorded in absolute control at 20, 40 and 60 days after incubation respectively. The lower pH values of 7.9 at 20 DAI, 7.6 at 40 DAI, 7.3 at 60DAI was recorded in T_{10}(NK 100% RDF + RP+ Vermicompost + PSB) at all the stages of incubation respectively. This was followed by the treatment of T_9 (NK 100% RDF + RP+ PSB), T7(NK 100% RDF + SSP+ PSB).

Table No:1 Effect of different Phosphorus sources on Soil pH in calcareous soil under Incubation study

Treatments	Incubation period (Days)			
	0th DAI	20th DAI	40th DAI	60th DAI
T_1-Absolute control	8.40	8.40	8.32	8.30
T_2- PSB alone	8.20	8.10	8.00	7.80
T_3- NK 100% RDF + PSB	8.24	8.14	7.90	7.70
T_4- NK 100% RDF +SSP	8.20	8.20	8.20	8.10
T_5- NK 100% RDF + DAP	8.10	8.20	8.25	8.30
T_6- NK 100% RDF +RP	8.18	8.05	8.10	8.12
T_7-NK 100% RDF + SSP+PSB	8.15	8.11	7.60	7.40
T_8-NK 100% RDF + DAP +PSB	8.18	8.11	8.05	7.60
T_9- NK 100% RDF + RP + PSB	8.12	8.00	7.80	7.50
T_{10}- NK 100% RDF + RP+ Vermicompost + PSB	8.10	7.90	7.60	7.30
SEd	**0.190**	**0.190**	**0.189**	**0.187**
CD (P = 0.05)	**NS**	**NS**	**NS**	**NS**

Table No: 2 shows the effect of different P sources on Soil organic carbon content of calcareous soil are given . The results clearly showed that, The values ranging from 0.24-0.69,0.21- 0.76,0.19-0.81,0.18-0.86 g /100g at 0,20, 40, and 60 days respectively. The results were significantly influenced by various P sources. However, significantly higher organic carbon content at 0.76% at 20 DAI, 0.81% at 40 DAI and 0.86% at 60 DAI was recorded in T_{10} (NK 100% RDF + RP+ Vermicompost + PSB) at all the stages of incubation respectively. This was followed by the treatment of T_9 (NK 100% RDF + RP+ PSB), T8 (NK 100% RDF + DAP + PSB and T7(NK 100% RDF + SSP+ PSB). The absolute control treatment T_1 registered the lower values of soil organic carbon content of 0.21,0.19 and 0.18 per cent at 20, 40 and 60 respectively. The results revealed a significant effect on available P along with bioinoculants in soil.

During the incubation period, the available soil phosphorus increases gradually with the increasing addition of chemical fertilizers up to 40 days after Incubation and then declined trend was observed (Table No :3). The olsen P content values ranging from 8.12-24.8,8.10-27.4,7.8-29.5, 7.45-27.2 mg kg^{-1} at 0,20, 40, and 60 days respectively. Among the treatments, significantly higher olsen P content at 27.4 mg kg-1 at 20 DAI, 29.5 mg kg-1 at 40 DAI and 27.2 mg kg-1 at 60 DAI was recorded in the treatment of T_7(NK 100% RDF + SSP+ PSB) at all the stages of incubation respectively. This was followed by the treatment of T_8 (NK 100% RDF + DAP + PSB and it was on par with T_{10} (NK 100% RDF + RP+ Vermicompost + PSB) and T_9 (NK 100% RDF + RP+ PSB). The lowest values of olsen P content 8.1,7.8 and 7.45 mg kg-1 were observed in the absolute control treatment (T_1)20, 40 and 60 DAI respectively.

Table No : 2 Effect of different P Sources on Soil organic carbon content (g/100 g) of calcareous soil under Incubation study

Treatments	Incubation period (Days)			
	0th DAI	20th DAI	40th DAI	60th DAI
T_1-Absolute control	0.24	0.21	0.19	0.18
T_2- PSB alone	0.45	0.43	0.39	0.37
T_3- NK 100% RDF + PSB	0.51	0.53	0.57	0.60

T_4- NK 100% RDF +SSP	0.55	0.57	0.59	0.59
T_5- NK 100% RDF + DAP	0.56	0.58	0.60	0.62
T_6- NK 100% RDF +RP	0.54	0.56	0.58	0.64
T_7-NK 100% RDF + SSP+PSB	0.59	0.65	0.68	0.71
T_8-NK 100% RDF + DAP +PSB	0.62	0.62	0.65	0.68
T_9- NK 100% RDF + RP + PSB	0.64	0.68	0.72	0.75
T_{10}- NK 100% RDF + RP+ Vermicompost + PSB	0.69	0.76	0.81	0.86
SEd	**0.016**	**0.017**	**0.018**	**0.019**
CD (P = 0.05)	**0.034**	**0.038**	**0.040**	**0.043**

Table No: 3: Effect of different Phosphorus sources on Available P (mg/kg) in calcareous soil under Incubation study

Treatments	**Incubation period (Days)**			
	0th DAI	**20th DAI**	**40th DAI**	**60th DAI**
T_1-Absolute control	8.12	8.10	7.80	7.45
T_2- PSB alone	11.50	13.20	14.20	13.70
T_3- NK 100% RDF + PSB	16.08	16.24	17.50	15.40
T_4- NK 100% RDF +SSP	18.30	21.34	21.64	20.80
T_5- NK 100% RDF + DAP	19.60	23.30	24.80	24.30
T_6- NK 100% RDF +RP	17.40	19.40	21.20	20.80
T_7-NK 100% RDF + SSP+PSB	24.80	27.40	29.50	27.20
T_8-NK 100% RDF + DAP +PSB	23.60	25.80	27.20	25.90
T_9- NK 100% RDF + RP+PSB	20.40	23.50	25.80	24.20
T_{10}- NK 100% RDF + RP+ Vermicompost + PSB	22.60	24.20	26.70	25.40
S_{Ed}	**0.58**	**0.64**	**0.69**	**0.64**
CD (P = 0.05)	**1.24**	**1.37**	**1.47**	**1.36**

Soil available P increased with increasing P application due to the increase in water-soluble P in the soil. The quantity of the P available in soil solution decides by the physical, biological, and chemical attributes of soil. The effect of P sources on Soil Available Phosphorus of Calcareous soil at different days of incubation period is given. During the incubation period, the available soil phosphorus increases gradually with the increasing addition of only chemical fertilizers up to 40DAI and then declined trend was observed. This may be ascribed to continuous moisture availability that induces solubilisation of P, bounded on the colloidal complexes that would have released P to the labile pool and made it available. The same findings were reported by [3].

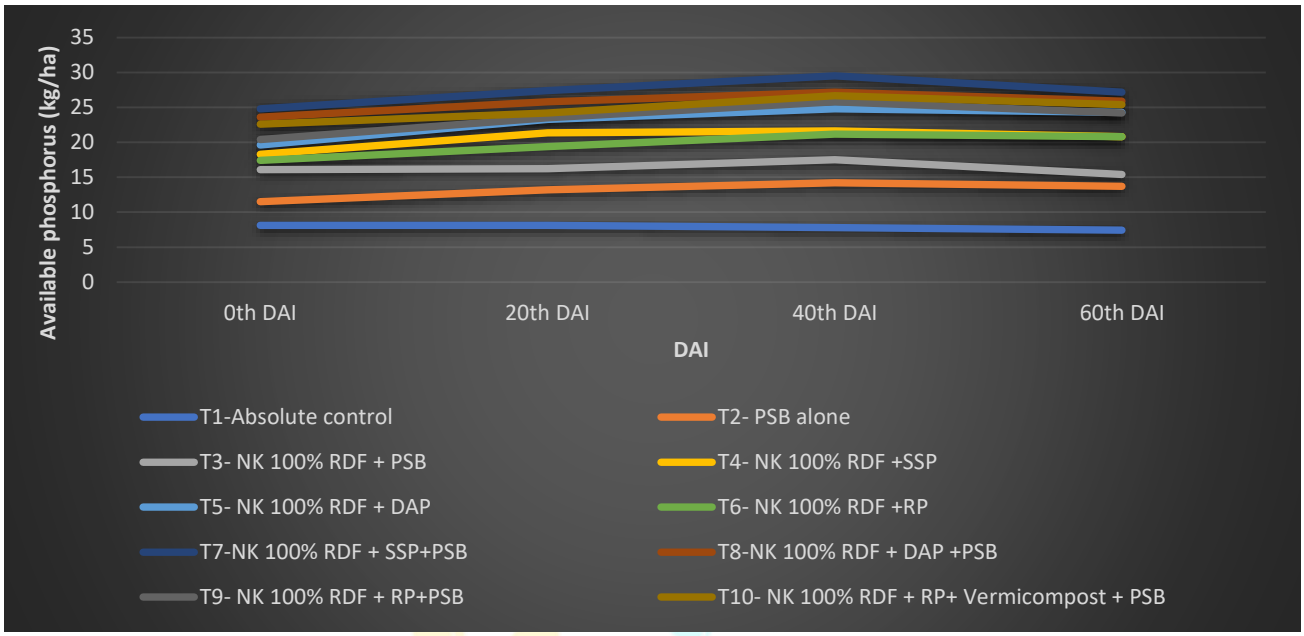

Fig. No .1 Effect of different phosphorus sources on available P in calcareous soil under incubation study

The further the decline in P content after the 40 DAI could be attributed to the fixation of phosphate with calcium carbonate . Among the treatments , the highest olsen P content at 27.4 mg kg-1 at 20 DAI, 29.5 mg kg-1 at 40 DAI and 27.2 mg kg-1 at 60 DAI was recorded in the treatment of T7(NK 100% RDF + SSP+ PSB) at all the stages of incubation respectively. This was followed by the treatment of T8 (NK 100% RDF + DAP + PSB and it was on par with T_{10} (NK 100% RDF + RP+ Vermicompost + PSB) and T_9 (NK 100% RDF + RP+ PSB). Several findings were reported the conjoint application of organic inputs and bio inoculants improves the P in the soil solution by producing organic acids which render the dissolution reaction on precipitated/ unavailable Phosphorus in the soil. The constant increase in the P release may be influenced by P solubilizing microbes[4]. The fertilizer of SS + PSB inoculation could have solubilized more P from the soil than un-inoculated with PSB or treatment without P fertilizers. PSB might have helped in increasing the availability of insoluble P in the soil pool. Further, the addition of P solubilizers stimulated the growth and activities of microorganisms, which increased N and P release. These results are in corroboration with those of [5]; [6]; [7].

CONCLUSION

In this study ,We conclude that the availability of P increased significantly due to the application of different P fertilizers compared with control. Available P significantly increased with the application of SSP or DAP along with the application of PSB.This finding has useful implication of P Fertiliser Management to reduce P fixation and increase the availability of P in solution.

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