

Phosphorus Transformations through Different Phosphorous Sources Amended with FYM and PSB

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ABSTRACT

Build up of different inorganic fractions of phosphorus were evaluated after the harvest of green gram crop grown for two consecutive years, through addition of different sources of phosphorus (Mussorie rock phosphate, SSP, DAP) alone or in combination with FYM and/or PSB. P-fractions like saloid-P, Al-P and Fe-P increased with different sources of phosphorus alone or in combination with FYM and/or PSB. Ca-P although increased over control with different sources of phosphorus but superimposition with FYM and/or PSB decreased the Ca-P build up. Among the different fractions Ca-P dominated. saloid-P and Al-P was highest with the application of SSP following the order as SSP > DAP > MRP. Fe-P and Ca-P was higher with the application of MRP following the order MRP > SSP > DAP.

Keywords: Inorganic-fractions, Phosphorus sources, FYM, PSB

INTRODUCTION

Phosphorus is an important plant nutrient present in the soil and its content depends upon the type of matrix, its weathering degree and organic matter content. Intake of this element by plant is determined first of all by dihydrophosphate and some hydrophosphates easily soluble in water and present in the soil. The content of phosphorus compounds in soil determines the plant nutrition and depends on many natural and anthropogenic factors, including soil reaction, applied fertilizer, amount and quality of organic matter as well

as the presence of Ca, Fe and Al ions. Phosphorus efficiency seldom exceeds 15-20%, because soon after its application phosphorus is transformed into different compounds of varying solubility which serve as the potential source of P to plants. The phosphorus is fixed mainly as Fe, Al and Ca phosphate depending upon the reaction of soil. Phosphorus concentration in soil solution at any time is governed by sorption and release of phosphorus from solid phase, besides also depends on the uptake by plants and its replenishment from soil pools.

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Measuring specific inorganic P fractions is therefore important to study the transformation of applied, which in a particular soil depends upon the type of P- fertilizer, crop grown and organic matter content. It has been reported that addition of FYM and bio-fertilizers such as PSB also influence the utilization of P added through different sources such as SSP, RP and DAP by plants and P transformation in soil Sharma et al. (1995). The present study was therefore undertaken to study effect of addition of different P- fertilizers along with FYM and PSB on different inorganic P fractions after the harvest of green gram.

MATERIALS AND METHODS

A field experiment was conducted at AAI-DU, Allahabad using green gram var. K-851, as test crop during two kharif seasons. The soil of the experimental field was sandy loam in texture whose important properties are presented in table 1. Sixteen treatment combinations were made by using three different sources of phosphorus (@ 50 kgP₂O₅ ha⁻¹) along with one control (control, MRP, SSP, DAP) and different bio-organics (control, PSB, FYM, FYM+PSB). The FYM was procured from the Animal Husbandry Department of Allahabad Agricultural Institute- Deemed University, Allahabad. The FYM @ 4tonnes ha⁻¹ was incorporated in the soil 15 days before sowing in respective plots as per the treatments. Seeds were inoculated as per the treatments with *Pseudomonas straita* @ 10g kg seed⁻¹. The treatments were replicated thrice and the experiment was laid out in factorial RBD. Soil samples were taken after the harvest of crop and analyzed for different fractions of P by the method laid out by Peterson and Corey (1966).

RESULTS AND DISCUSSION

Different inorganic fractions of phosphorus in soil after the harvest of crop reveals that saloid-P and Fe-P increased in the control where as Ca-P and Al-P decreased compared to their initial values before the sowing of the crop, suggesting thereby the effect of growing crop on distribution pattern of different inorganic fractions of phosphorus. Hedley et

al. (1982), suggested this phenomenon due to release of H⁺ and HCO₃⁻ ions from roots.

Phosphorus added through different sources undergoes transformation and partitions into different forms, which showed an appreciable build up in soil over the control. The relative amount of different forms followed the order Ca-P> Al-P> Fe-P> saloid-P. Predominance of Ca-P in these soils could be attributed to low solubility of Ca-P as compared to Fe and Al-P in experimental soil which was neutral in reaction. Significant differences in the formation of different P forms was observed due to application of different sources of phosphorus. Highest saloid-P (13.80ppm) and Al-P (22.2ppm) were observed with SSP and lower saloid-P (12.7ppm) and Al-P (20.3ppm) was observed application of MRP. Highest Ca-P (50.15ppm) and Fe-P (13.75ppm) was observed with DAP. Higher Ca-P fraction due to MRP and SSP than DAP is primarily due to calcite form of phosphorus in MRP and SSP. The Ca-P form was significantly more with MRP than SSP. Singh and Sarkar, 1986, also reported the similar differences in the building of Ca-P fraction in soil with application of MRP, DAP and SSP.

Both the PSB and FYM either alone or in combination increased the saloid-P, Al-P and Fe-P where as Ca-P was decreased. However, different P fractions were highest with conjoint application of FYM and PSB. Significant build up of different forms of P could be attributed to solubilisation of native fixed forms of P and their redistribution as inorganic P fractions. Mathan and Joseph, 1998 also reported increase in saloid-P, Al-P and Fe-P with PSB inoculation in different inorganic fractions due to mineralization of phosphorus from FYM is expected. Sujito, et al. (2001) and Sihag, (2005) also reported an increase in saloid-P, Al-P and Fe-P in soil due to application of FYM.

FYM and/or PSB applied with different sources of P enhanced the build up of saloid-P, Al-P and Fe-P in soil, whereas the Ca-P decreased. Significantly higher P fractions saloid-P (15.2 ppm), Al-P (23.9ppm)

and Fe-P (13.2ppm) were observed with application of SSP in conjunction with FYM and PSB. Significant decrease in Ca-P build up in soil was observed due to application of different phosphorus sources in presence of

FYM, PSB or FYM+PSB over their respective controls. Significant increase in Saloid-P, Al-P, Fe-P and decrease in Ca-P as a result of application of phosphorus with FYM were earlier reported by Kaistha, et al. (1999).

Table 1: Important properties of experimental soil

Available nitrogen mineralised (kg ha ⁻¹)	220
Available phosphorus (kg P ₂ O ₅ ha ⁻¹)	20.0
Available potassium (kg K ₂ O ha ⁻¹)	268
Organic carbon (%)	0.26
pH (soil water suspension 1:2 w/v)	7.9
EC _{25x10} ³ (soil water suspension 1:2 w/v)	0.29
Phosphorus fractions (ppm)	
Saloid-P	9.6
Fe-P	10.0
Al-P	19.0
Ca-P	43.0

Table @: Inorganic fractions of phosphorus (ppm) in soil (pooled data of two years)

Treatment	Saloid-P	Al-P	Fe-P	Ca-P
Control	10.35	18.9	10.90	42.15
PSB	10.85	19.1	11.20	41.60
FYM	11.10	19.5	11.60	41.30
FYM+PSB	11.45	19.8	11.80	40.80
MRP	12.70	20.3	13.75	5.15
DAP	13.70	21.9	12.35	45.80
SSP	13.80	22.2	12.70	46.75
MRP+PSB	12.95	21.6	14.00	46.25
MRP+FYM	13.60	22.3	14.15	45.30
MRP+FYM+PSB	14.05	22.7	14.30	45.10
DAP+PSB	14.00	22.8	12.60	44.15
DAP+FYM	14.15	22.3	12.85	43.05
DAP+FYM+PSB	14.70	22.5	13.00	41.40
SSP+PSB	14.20	23.2	12.95	45.20
SSP+FYM	14.70	23.7	13.05	44.20
SSP+FYM+PSB	15.20	23.9	13.20	44.95
	<i>CD(P=0.05)</i>	<i>CD(P=0.05)</i>	<i>CD(P=0.05)</i>	<i>CD(P=0.05)</i>
Sources of P	0.021	0.019	0.019	0.073
Bio-organics	0.021	0.019	0.019	0.073
Interaction	0.083	0.075	0.076	0.291

CONCLUSION

From the experimental findings it can be concluded that inorganic P fractions were increased in the soil with the application of different sources of phosphorus and the Ca-P dominated which was decreased by the application of FYM and PSB. But the other three forms saloid-P, Al-P and Fe-P were increased by application of FYM and PSB either alone or in combination with different sources of phosphorus.

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