

Residual Effect of Phosphorus Enriched Organic Manures on Yield and P- Availability to Bengal Gram in Vertisol*

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Abstract : Residual application of P-enriched poultry manure with P-levels significantly increased the yield of bengal gram. The increase in yield over no organic manures was 118.92 per cent. Residual application of P-enriched poultry manure alongwith HRDF-P has produced yield equivalent to that of RDF-P alone. Higher uptake of phosphorus by bengal gram was registered due to increased availability of phosphorus.

Introduction

Rabi bengal gram has a great potential in northern transitional tract of Karnataka. It is an accepted practice of farmers to grow short-duration legume during rabi in irrigated situation for efficient utilization of residual fertility value applied to previous maize crop in boosting the legume productivity. Residual effect of phosphorus and /or farmyard manure refers to the carry-over benefit of its application on the succeeding crop. Nutrients present in farmyard manure are not fully available to the crops in the season of its application. Less than 30 per cent N is generally available to the first crop. A smaller fraction of P and not more than half of K may become available to the immediate crop and it varies greatly with the crop and soil. Rest of the nutrients may be partly utilised by the subsequent crops (Gaur,1982). Looking to the varied importance of farmyard manure in the present day energy crisis and that of phosphorus and their residual effects particularly under cereal-legume systems, it was thought essential to

investigate and quantify their residual effects on succeeding rabi bengal gram crop which is of shorter duration and needs more of phosphorus.

Material and Methods

A field experiment was conducted at Main Research Station, University of Agricultural Sciences, Dharwad (Karnataka) on a Chromic Haplustert during rabi seasons of 1997 and 1998, to investigate the residual effect of phosphorus enriched organic manures applied to previous maize crop during 1997-98 under irrigated condition.

The experiment was laidout in split plot which consisted of three main plot treatments viz., control (0 Kg P_2O_5 per ha), 50 per cent of recommended dose of P (37.5 Kg P_2O_5 per ha) and 100 per cent of recommended dose of P (75 Kg P_2O_5 per ha) and nine sub-plot treatments viz., no organic manure, farmyard manure @ 5 t per ha, vermicompost @ 2 t per ha, biogas slurry @ 3 t per ha and poultry manure @ 2 t per ha, P-

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enriched farmyard manure @ 2.5 t per ha, P-enriched vermicompost @ 1 t per ha, P-enriched biogas slurry @ 1.5 t per ha and P-enriched poultry manure @ 1 t per ha. The total content in all the selected farmyard manure (FYM), vermicompost (VC), biogas slurry (BS), poultry manure (PM) were determined and the calculated quantity of each organic manure was taken separately and mixed well with single superphosphate to make exactly the double the quantity of phosphorus in each organic manure. Single superphosphate mixed organic manure were filled separately in

polyethylene bag and required quantity of water was added to each bag to maintain moist condition (50% of maximum water retention capacity of the manure). These bags were kept for a period of one month by adding water as per the requirement to maintain uniform moisture level in the entire incubated time. After the incubation period of 30 days all these manures were dried and applied to soil. Bengal gram variety (Annigeri-1) was grown as a test crop. A basal dose of 25 kg N as urea and 37.5 kg K₂O as muriate of potash were applied. No P-fertilizer was applied

Table 1. Nutrient composition of organic manures (on oven dry basis)

Properties	FYM	VC	BS	PM
pH (1:2.5)	6.70	7.20	5.0	7.1
Phosphorus (P ₂ O ₅) %	0.60	0.50	0.70	1.20

Note: FYM: Farmyard, VC: Vermicompost

BS: Biogas slurry, PM: Poultry manure

so as know the residual effect. The characteristics of this soil were :pH 7.2,EC 0.15dSm⁻¹ CEC 40.60 c mol (P+) kg⁻¹ and available P 13.2 kg/ha. Soil samples were collected at 30 DAS analysed for P by following standard procedure. Plant samples were also collected at harvest stage and analysed for P following standard procedure and nutrient composition of organic manures are presented in table 1.

Results and Discussion

The seed yield (Table 2) was increased to the tune of 26.06 per cent due to P-enriched PM residual effect over control. This significant increase in seed yield of bengal gram might be due to increase in soil available nitrogen, phosphorus and potash thereby increasing the

nutrient uptake by the crop (Nimje and Seth,1998).

The seed yield increased significantly due to application of levels of P-fertilizer. The increase in seed yield due to application of 50 and 100 per cent RDF-P over no P-fertilizer was to the extent of 40.74 and 62.96 per cent, respectively (Ramamurthy and Shivashankar, 1996).

The seed yield in no organic manure was 11.10 q/ha, which increased to a maximum of 24.30 q/ha due to addition of P-enriched PM alongwith the application of 100 per cent RDF-P. It accounted for 118.92 per cent increase in yield over absolute control. Such an increase in seed yield may be explained in terms of efficiency of P-enriched organic manures and P-fertilizer due to their combined application and increased

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Table 2. Residual effect of P- enriched organic manures at all levels of P-fertilizer on seed yield of bengal gram (q/ha)

Treatments	Pooled data for 2 years			Mean
	M ₀	M ₁	M ₂	
T ₁ - Control (0)	11.1	17.1	20.0	16.08
T ₂ - FYM @ 5 t/ha	13.2	18.5	21.2	17.67
T ₃ - VC@ 2 t/ha	12.0	17.4	20.5	16.67
T ₄ - BS @ 3 t/ha	12.7	18.0	20.8	17.17
T ₅ - PM @ 2 t/ha	13.5	19.0	22.0	18.18
T ₆ - P-FYM @ 2.5 t/ha	15.0	20.3	23.5	19.62
T ₇ - P-VC @ 1 t/ha	14.2	19.4	22.4	18.70
T ₈ - P- BS @ 1.5 t/ha	14.6	19.9	22.8	19.13
T ₉ - P- PM 2 t/ha	15.4	21.0	24.3	20.27
Mean	13.5	19.0	22.0	
		S.Em±		C.D at (5%)
M		0.020		0.058
T		0.033		0.093
MxT (T at same level of M)		0.058		0.162
MxT (M at same or different level of T)		0.058		0.242

FYM= Farmyard manure, VC= Vermicompost, BS= Biogas slurry, PM= Poultry manure
M₀= No P- fertilizer, M₁= 50 % recommended dose of P-fertilizer (37.5 Kg P₂O₅/ha),
M₂= 100% recommended dose of P-fertilizer (75.0 Kg P₂O₅/ha)

microbial activity which might have increased the uptake of nutrients by bengal gram and thus increased the seed yield (Ramamurthy and Shivashankar, 1996 and Nimje and Seth, 1988)' Mean values of P uptake by bengal gram is presented in table 3. Comparatively higher significant phosphorus uptake was observed due to the application of P-enriched organic manures as compared with organic manures alone. Among P-enriched organic manures PM gave highest uptake of P (11.20 kg/ha).

Bengal gram being leguminous crop requires more of phosphorus for nodule formation. The increased nodules in bengal gram might have fixed higher N supplied by fertilizer and organic

manure. Therefore, both N and P uptake by the crop found to be significantly higher. Similar reasons were given for higher uptake of P by Nimje and Seth (1988) and Ramamurthy and Shivashankar (1996).

In P-enriched poultry manure the increase in the availability of P₂O₅ (Table 4) over control was to the tune of 16.83 per cent. The residual value of P₂O₅ was more in P-enriched organic manure added plots than that in organic manures alone. This beneficial effect may be due to formation of metallo-organic complex with organic ligands, which reduces its susceptibility to soil reaction (Madhumita Das *et al.*, 1991 and More and Ghonsikar, 1988).

Table 3. Residual effect of P- enriched organic manures at all levels of P-fertilizer on phosphorus uptake (kg/ha) by bengal gram at harvest

Treatment	Pooled data for 2 years (1997-98 and 1998-99)			Mean
	M ₀	M ₁	M ₂	
T ₁ - Control (No - P)	4.6	8.6	10.5	7.92
T ₂ - FYM @ 5 t/ha	6.3	9.9	11.6	9.28
T ₃ - VC@ 2 t/ha	5.4	9.2	11.1	8.58
T ₄ - BS @ 3 t/ha	5.9	9.6	11.5	9.00
T ₅ - PM @ 2 t/ha	6.3	10.3	12.2	9.62
T ₆ - P-FYM @ 2.5 t/ha	7.3	11.1	14.6	11.02
T ₇ - P-VC @ 1 t/ha	6.7	10.4	12.4	9.85
T ₈ - P- BS @ 1.5 t/ha	7.1	10.8	13.4	10.47
T ₉ - P- PM @ 1 t/ha	7.6	11.5	14.4	11.20
Mean	6.38	10.17	12.43	
		S.Em±		C.D at (5%)
M		0.071		0.197
T		0.171		0.474
MxT (T at same level of M)		0.296		NS
MxT (M at same or different level of T)		0.296		NS

FYM= Farmyard manure, VC= Vermicompost, BS= Biogas slurry, PM= Poultry manure
M₀= No P- fertilizer, M₁= 50 % recommended dose of P-fertilizer (37.5 Kg P₂O₅/ha),
M₂= 100% recommended dose of P-fertilizer (75.0 Kg P₂O₅/ha)

The residual value of P₂O₅ increased significantly due to application of levels of P-fertilizers. The increase in the availability of P₂O₅ over no P-fertilizer at 50 and 100 per cent RDF-P was to the tune of 40.40 and 51.37 per cent, respectively,

Addition of P-enriched PM alongwith the application of 100 per cent RDF-P was found to be superior to all other treatments in obtaining residual effect of phosphorus in soil. Similar

observations were reported by (Nimje and Seth, 1988 and Ramamurthy and Shivashankar, 1996).

It could be inferred from the above results that residual application of P-enriched poultry manure @ 1 t per ha with levels of P-fertilizer increased the crop yield of bengal gram (24.30 q per ha) by 118.92 per cent over no organic manure, increased the uptake of phosphorus due to increase in the availability of phosphorus in Vertisol of North Karnataka.

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Table 4. Residual effect of P- enriched organic manures at all levels of P-fertilizer on available P_2O_5 content (kg/ha) of soil at 30 DAS

Treatment	Pooled data for 2 years (1997-98 and 1998-99)			
	M_0	M_1	M_2	Mean
T_1 - Control (No.P)	23.70	32.70	34.40	30.30
T_2 - FYM @ 5 t/ha	25.80	36.40	39.30	33.80
T_3 - VC@ 2 t/ha	24.40	34.60	36.80	31.90
T_4 - BS @ 3 t/ha	25.00	35.50	37.50	32.70
T_5 - PM @ 2 t/ha	26.40	37.20	40.70	34.80
T_6 - P-FYM @ 2.5 t/ha	26.30	37.00	38.00	34.50
T_7 - P-VC @ 1 t/ha	25.10	35.00	40.10	32.70
T_8 - P- BS @ 1.5 t/ha	25.90	36.10	39.10	33.70
T_9 - P- PM @ 1 t/ha	26.90	37.80	41.50	35.40
Mean	25.50	35.80	38.60	
		S.Em±	C.D at (5%)	
M		0.069	0.191	
T		0.117	0.326	
MxT (T at same level of M)		0.203	0.564	
MxT (M at same or different level of T)		0.203	0.843	

FYM= Farmyard manure, VC= Vermicompost, BS= Biogas slurry, PM= Poultry manure
 M_0 = No P- fertilizer, M_1 = 50 % recommended dose of P-fertilizer (37.5 Kg P_2O_5 /ha),
 M_2 = 100% recommended dose of P-fertilizer (75.0 Kg P_2O_5 /ha)

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