Journal of Crop and Weed 7(1): 41-43 (2011)

Influence of different sources of phosphorus and phosphate solubilizing bacteria on productivity of rainfed rice (*Oryza sativa* L.)

S. SAKHEN, L. NABACHANDRA AND N. ANANDO

Central Agricultural University
Imphal, Manipur – 795 001

Received: 11.01.2011, Revised: 23.05.2011, Accepted: 30.05.2011

ABSTRACT

An experiment was conducted during kharif seasons of 2005 and 2006 at the Research Farm, College of Agriculture, Central Agricultural University, Imphal to find out suitable source of phosphorus as well as their compatibility with phosphate solubilizing bacteria under rainfed acidic soil condition. Six different sources of phosphorus (Mussoorie phosphate, di-ammonium phosphate, single super phosphate, M. Phos + DAP, SSP + DAP and M. Phos + SSP) with and without phosphate solubilizing bacteria were tried in factorial randomized block design with 3 replications. Among the different sources of phosphorus, Mussoorie phosphate application resulted in higher values of yield attributes (effectives tiller/hill and filled grains/panicle) and grain yield significantly. However, di-ammonium phosphate was also found equally good with that of Mussoorie phosphate, when it was applied in combination with either Mussoorie phosphate or single super phosphate in 50% proportion. Irrespective of the phosphorus sources, phosphate solubilizing bacteria inoculation showed a significant increase in the values of yield attributes of rice and gave higher grain yield than the uninoculated ones, but with regards to compatibility it was found superior in increasing grain yield of rice when applied in combination with M. Phos to other sources. DAP also can be made compatible with phosphate solubilizing bacteria, by partial combination with either SSP or M. Phos.

Key words: P sources, phosphate solubilizing bacteria, rice productivity

Phosphatic fertilizers occupy an important place amongst the non-renewable inputs of modern agriculture as about 98% of the Indian soil have insufficient supply of available phosphorus .The slow mobility of applied phosphorus and its marked fixation results in low crop recoveries to the order of 20-25%, which call for ways and means for its judicious use. Though, the direct application of phosphorus to rice crop seems to be one of the management option to sustain productivity, there is need to explore other factors like sources of phosphorus, its solubilizing ability etc. to economise phosphorus use in rice production. Hence, the present investigation was taken up to study the effect of different source of phosphorus in combination with phosphorus solubilizing bacteria on the productivity of rainfed rice.

MATERIALS AND METHODS

The field experiment was conducted at the Research Farm, College of Agriculture, Central Agricultural University, Imphal, during *kharif* season of 2005 and 2006.The soil was clay, medium in organic carbon (0.72 %) and available nitrogen (447 kg/ha). The status of available phosphorus (P2O5) and K2O were 24 and 256 kg/ha respectively. The treatment consisting of 6 different sources of phosphorus (single super phosphate, Mussoorie phosphate, diammonium phosphate, SSP + M. phos, M. phos + DAP and DAP + SSP in 50% substitution basis) and 2 levels of phosphate solubilising bacteria (no inoculation and inoculation) were replicated three times in factorial randomized block design.For inoculated treatments, 10 kg rice seeds were treated with 200 gm PSB before sowing. The rice cultivar "Tamphaphou" was cultivated by following the package and practices as recommended by the University (Anon 2004), 27 days old seedlings were transplanted and spacing of 20 x 10 cm The growth and yield attributes of rice in terms of effective tillers/hill, filled grains/panicle and 1000 grain weight as well as grain yield and economic parameters were recorded for assessing the influence of the different treatments on the productivity and economics of rice.

RESULTS AND DISCUSSION

Yield attributes and yield

The application of phosphorus through DAP + SSP recorded the maximum number of effective tillers/hill but it was statistically at par with that of M. Phos application (Table 1). Higher number of filled grains/panicle was also observed in the said treatments. The possible reason for higher number of effective tiller/ hill as well as filled grain /panicle with M. Phos application might be due to soil type of the experimental field which showed low pH value and contained high amount of organic matter (1.24 %) which enhanced the utilization of phosphorus from mussoorie phosphate by chelation of calcium present in it with the organic anions i,e. citrate, oxalate, tartarate etc. It is an important process in solubilizing the insoluble rock phosphate. Any colloidal material that absorbs calcium with high bonding energy will lower calcium activity in rock phosphate and increases the uptake of nutrients. As a result, the number of effective tillers $hill^{-1}$ and filled $grain.panicle^{-1}$ might be increased. The observation was in conformity with the finding of Tanveer *et al.* (1993). Better result of DAP + SSP, might be due to presence of NH4+ ions in the DAP, which increased

Email: ibomchaleitam@yahoo.co.in

the solubilization of phosphorus from SSP that otherwise generally fixed very quickly in the colloidal complexes of clay in acid soils.The length of panicle and weight of thousand grain remained unaffected by the different sources of phosphorus. Due to increase number of effective tillers. $hill^{-1}$ and filled grain.$panicle^{-1}$ without affecting the thousand grain weight, higher grain yields were recorded with the application of M. phos and DAP + SSP. Significant increase in grain yield with the application of M. phos was also reported by Mohapatra and Jee (1993), Rao and Sukhla (1999). The inoculation of phosphate solubilizing bacteria had a significant effect in all the yield attributes of rice. This might be due to the reason that the phosphate solubilizing bacteria synthesized growth promoting substances and produced vitamins, which augment the root growth resulting into better nutrient uptake. Not only this, phosphate solubilizing bacteria inoculation enhanced the mineralization of organic forms of phosphorus and solubilization of inorganic phosphorus, improving the availability of native soil phosphorus to plants and thereby increased yield attributes resulting to higher grain yield. Similar observations were opined by Lal (2002).

The interaction between different sources of phosphorus and PSB showed a significant effect on the yield attributes viz. effective tiller/hill, filled grains/panicle, 1000grain weight etc. and the best combination was found to be DAP + SSP + PSB, which was at par with M. phos + PSB.

Table 1: Effect of different sources of phosphorus with and without phosphorus solubilizing bacteria on yield attributes, yield and economics of rice (Pooled mean of 2 years)

Treatment	Effective tillers $hill^{-1}$	Filled grains $panicle^{-1}$	Test weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Cost of production (₹ ha^{-1})	Gross return (₹ ha^{-1})	Net return (₹ ha^{-1})	Return ₹$^{-1}$
Sources of Phosporus									
Single super phosphate (SSP)	8.31	76.68	26.96	4.59	6.23	18290	29860	11571	0.63
Mussoorie phosphate	10.03	93.38	28.37	4.87	6.58	17981	31642	13661	0.76
Diammonium phosphate (DAP)	8.57	77.55	27.94	4.62	6.34	17734	30037	12303	0.69
SSP+ M-Phos	9.05	81.93	27.83	4.72	6.37	18137	30654	12517	0.69
M-Phos+DAP	8.96	87.28	28.12	4.82	6.44	17858	31324	13466	0.75
DAP+SSP	9.76	91.88	28.43	4.85	6.54	17935	31519	13584	0.76
SEm(±)	**0.13**	**1.10**	**0.54**	**0.33**	**0.39**	**17858**	**29933**	**12075**	**0.68**
LSD(0.05)	**0.38**	**3.21**	**NS**	**0.95**	**1.11**	**18166**	**31746**	**13580**	**0.75**
Phosphate solubilising bacteria									
No inoculation	8.80	79.51	27.06	4.61	6.27				
Inoculation	9.43	90.06	28.82	4.88	6.57				
SEm(±)	**0.08**	**0.63**	**0.30**	**0.19**	**0.23**				
LSD(0.05)	**0.22**	**1.80**	**0.87**	**0.55**	**0.65**				

Cost of SSP, M-Phos, DAP were ₹5.8, ₹5.4, ₹11.8 kg^{-1} respectively and ₹35/200 g for PSB.

Nutrient uptake

The P applied using different P sources influenced the N, P and K by rice grain and straw significantly (Table 2). The NPK uptake in grain and straw was more in M-Phos and DAP+SSP treated plots. Rao and Shukla (1999) also reported the influence of different P sources on nutrient uptake and uptake was more than that of non-inoculated treatment.

Economics

The highest capital investment was required with the application of phosphorus as SSP + PSB as the cost of SSP was higher as compared to other phosphatic fertilizers, while the lowest investment was incurred in DAP due to its lower cost. As a result application of either DAP + SSP or DAP + M. Phos seemed to be an alternative option of M. Phos from economical point of view and higher net return values were also observed in these treatments. The highest net return per rupee investment (0.76) was recorded (Table 1) with the application of M. phos and DAP + SSP, while that of DAP + M. Phos was 0.75.

Table 2: Effect of different sources of phosphorus with and without phosphorus solubilising bacteria on nutrient uptake of rice (Pooled mean of 2 years)

Treatments	Nutrient uptake								
	Nitrogen (kg ha^{-1})			Phosphorus (kg ha^{-1})			Potassium (kg ha^{-1})		
	Grain	Straw	Total	Grain	Straw	Total	Grain	Straw	Total
Sources of Phosphorus									
SSP	47.38	22.93	70.31	9.53	3.17	12.70	18.75	58.85	77.60
M-Phos	51.78	26.32	78.10	10.68	3.96	14.64	20.94	68.82	89.56
DAP	47.95	23.79	71.74	9.86	3.51	13.37	18.98	61.73	80.71
SSP+M-Phos	48.81	24.51	73.32	10.03	3.58	13.61	19.27	63.58	82.84
MPhos+DAP	50.15	25.49	75.64	10.39	3.76	14.15	19.89	66.05	85.94
DAP+SSP	51.58	26.75	78.33	10.62	4.02	14.64	20.74	69.88	90.62
SEm(±)	**0.34**	**0.35**		**0.15**	**0.13**		**0.44**	**0.95**	
LSD(0.05)	**0.97**	**0.99**		**0.42**	**0.36**		**1.25**	**2.70**	
PSB (Phosphatika)									
P_0	48.11	23.38	71.49	9.72	3.31	13.03	18.98	60.63	79.61
P_1	51.11	26.55	77.66	10.65	4.02	14.67	20.54	68.94	89.48
SEm(±)	**0.20**	**0.20**		**0.08**	**0.07**		**0.25**	**0.54**	
LSD(0.05)	**0.57**	**0.57**		**0.24**	**0.20**		**0.73**	**1.55**	

From the above findings it can be concluded that phosphorus plays a pivotal role in governing growth, development and yield of transplanted rice crop. The response of rice crop to P is also governed by the different sources of phosphorus and combination of these phosphatic fertilizers with biofertilizers can further enhance the fertilizer use efficiency. Among the different sources of P, M-Phos was found to be the best source in increasing the grain yield of rice (K.D. 2-6-3) for the acidic clay soil of Manipur. Moreover the inoculation of M-Phos with phosphate solubilizing bacteria i.e., Phosphatika increases the availability of P from M-Phos due to the activity of micro-organisms, which exerts positive effect on growth, development and yield of rice crop. Thus M-Phos with PSB can be used as an effective and cheap substitute for highly priced synthetic phosphatic fertilizers like DAP in acidic soils of Manipur, which can also sustain the fertility of the soil.

REFERENCES

Anonumous. 2004. Package and Practices for Cultivation of Tamphaphou. Published by Director of Research, Central Agricultural University, Imphal.

Lal, L. 2002. Phosphatic Biofertilizer. Published by Agrotech Publishing Academy, Udaipur.

Mohapatra, A. K. and Jee, R. C. 1993. Response of lowland rice (*Oryza sativa*) to green manuring, levels and sources of phosphatic fertilizer in coastal Orissa. *Indian J. Agron.*, **38**: 374.

Rao, P. C. and Shukhla, D. N. 1999. Yield and nutrient uptake of rice (*Oryza sativa*) as influenced by sources and levels of phosphorus and zinc under transplanted condition. *Indian J. Agron.*, **44**: 94-98.

Tanveer, R. A., Baroova, S. R. and Rajkhowa, D. J. 1993.Direct and residual effect of Farm Yard Manure, sources and levels of phosphorus in summer rice-rainy season rice cropping sequence. *Indian J. Agron.*, **38**: 457-59.