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Effect of Phosphorus, PSB and Pressmud on Total Phophorus in Soil, Fertilizer Use Efficiency and Yield of Urd Bean

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A B S T R A C T

A field experiment was conducted during summer season of 2005 at Student Instructional Farm of Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad (U.P.). Three phosphorus levels (20, 40 and 60 kg ha^{-1}) with and without PSB or pressmud (5 t ha^{-1}) were tested in a field investigation on total phosphorus in soil at harvest, fertilizer use efficiency and yield of urd bean. Results revealed that 60 kg P_2O_5 along with pressmud 5 t ha^{-1} significantly increased the grain and straw yield. A considerable improvement in buildup of total p in soil was observed under all treatments except control, alone PSB and pressmud. Buildup of phosphorus in terms of total phosphorus was significantly highest under 60 kg P_2O_5 ha^{-1} + pressmud and 60 kg P_2O_5 ha^{-1}.

Introduction

In Indian agriculture pulses cultivation occupies an important place. The productivity of pulses is usually low because of their cultivation on marginal lands lacking in microbes in rhizosphere. Urd bean is one of the major pulse crop of India but has poor productivity recorded in different parts of the country. Interest in this crop, its multiple use as source of food, livestock fodder and soil fertilization.

Phosphorus is the second most critical plant nutrient over all, but for legumes it assumes primary importance. The soil of Indo-Gangetic Plain is generally low to medium in available phosphorus content and therefore, application of 17-26 kg P ha^{-1} has shown favourable effects in grain legumes (Ahlawat and Ali, 1993). Pressmud is one of the cheapest sources of organic fertilizer which is a byproduct of sugarcane industry. It contains 20-30% organic matter, 0.94-1.3% nitrogen, 1.66-2.74% phosphorus, 0.46-0.89% potassium, 3.11-4.13% CaO, 2.38% MgO and 1.7% Fe_2O_2 and Al_2O_3 (Raman *et al.*, 1999).

Use of the organic fertilizers like pressmud and phosphorus solubilizing biofertilizer to certain extent can provide the required nutrient for optimum growth and productivity.

Considering the advantages of phosphorus, PSB and pressmud the studies were undertaken to investigate the effect of phosphorus, PSB and pressmud on total phosphorus in soil, fertilizer use efficiency and yield of urd bean.

Materials and Methods

A field experiment was conducted during summer season 2005 at Student Instructional Farm of Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad (U.P.). The soil was silty loam having organic carbon 0.45%, available N 262.0 kg ha^{-1}, available P_2O_5 19.65 kg ha^{-1}, available K_2O 272.80 kg ha^{-1} and total P_2O_5 385 kg ha^{-1} with pH 8.1. Twelve treatments *viz*., control without P (T_1), 20 kg P_2O_5 ha^{-1} (T_2), 40 kg P_2O_5 ha^{-1} (T_3), 60 kg P_2O_5 ha^{-1} (T_4), PSB alone (T_5), 20 kg P_2O_5 ha^{-1} + PSB (T_6), 40 kg P_2O_5 ha^{-1} + PSB (T_7), 60 kg P_2O_5 ha^{-1} + PSB (T_8), pressmud (PM) alone 5 t ha^{-1} (T_9), 20 kg P_2O_5 ha^{-1} + 5 t PM (T_{10}), 40 kg P_2O_5 ha^{-1} + 5 t PM (T_{11}) and 60 kg P_2O_5 ha^{-1} + 5 t PM (T_{12}) were replicated thrice in a randomized block design. A uniform dose of 20 kg N and 40 kg K_2O ha^{-1} was applied in all the treatments. Pressmud was incorporated in soil and PSB was used for inoculating the seed as treatment @ 25 g kg^{-1} seed. 'Type-9' urd bean was sown in the last week of March. Other management practices were adopted as per recommendations of the crop. Total phosphorus content in soil was estimated by standard procedure (Jackson, 1973). Fertilizer use efficiency was computed as described by (Yoshida, 1978).

Results and Discussion

Grain and straw yield

Data in respect of grain and straw yield are presented in table 1. Seed yield of urd bean increased with increasing phosphorus upto 60 kg P_2O_5 ha^{-1} but difference in yield between 40 kg P_2O_5 and 60 kg P_2O_5 was not upto the level of significance. Inoculation of PSB did not improve the grain yield significantly while incorporation of pressmud enhanced the yield significantly at 20 kg P_2O_5 ha^{-1} having 12.6% additional yield. Among P solubilizing materials, pressmud was found to be slightly superior over PSB.

The highest increase in grain yield with 60 kg P_2O_5 ha^{-1} + pressmud might be because of association with enhancement in yield attributing characters such as pods per plant and grains per pod (Patel and Thakur, 2003). Similar trend was observed for straw yield.

Harvest index (%)

Data on harvest index are summarized in table 1. It is obvious from data that lowest value (31.85%) was found in control plot receiving no P fertilizer while highest value (34.72%) was computed under treatment T_{12} receiving 60 kg P_2O_5 ha^{-1} with PM.

Harvest index of urd bean increased with increasing levels of phosphorus having 33.15%, 34.02% and 34.47% under P_{20}, P_{40} and P_{60}, respectively, however differences were not upto the level of significance.

Test Weight (g)

The data regarding test weight of grains of urd bean are furnished in table 1. Test weight increased with increasing levels of phosphorus upto 60 kg P_2O_5 ha^{-1} having 33.89, 35.62 and 36.86 under P_{20}, P_{40} and P_{60}, respectively but differences were not upto the level of significance.

However, P_{60} + PSB and P_{60} + PM were found slightly superior over the control and rest of the treatments. The trend was similar to these observed by Singh *et al.,* (2003).

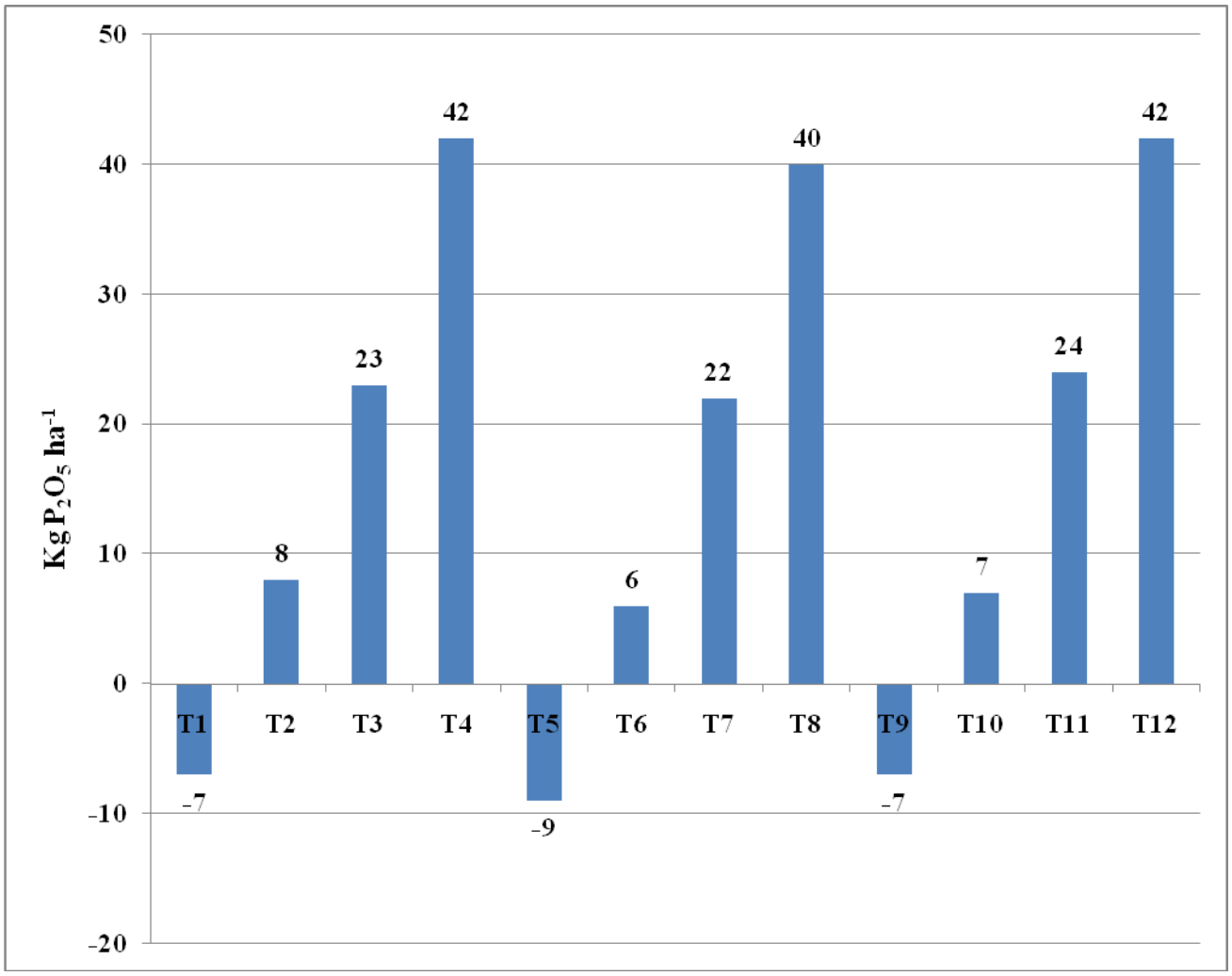
Table.1 Effect of phosphorus, PSB and pressmud on yield, harvest index and test weight

Treatment	Yield (q ha^{-1})		Harvest Index (%)	Test Weight (g)
	Grain	Straw		
T_1-Control	7.10	15.19	31.85	31.59
T_2- 20 Kg P_2O_5 ha^{-1}(P_{20})	10.03	20.22	33.15	33.89
T_3- 40 Kg P_2O_5 ha^{-1} (P_{40})	11.62	22.53	34.02	35.62
T_4- 60 Kg P_2O_5 ha^{-1} (P_{60})	12.45	23.67	34.47	36.86
T_5-PSB alone	7.85	16.41	32.36	33.03
T_6- 20 Kg P_2O_5 ha^{-1} + PSB	10.90	21.85	33.30	34.73
T_7- 40 Kg P_2O_5 ha^{-1} + PSB	12.04	23.19	34.14	36.58
T_8- 60 Kg P_2O_5 ha^{-1} + PSB	13.01	24.59	34.60	37.34
T_9- Pressmud alone (PM) [5 t ha^{-1}]	8.07	16.62	32.69	33.67
T_{10}- 20 Kg P_2O_5 ha^{-1} + 5 t pressmud ha^{-1}	11.30	22.48	33.45	35.22
T_{11}- 40 Kg P_2O_5 ha^{-1} + 5 t pressmud ha^{-1}	12.11	23.23	34.30	36.61
T_{12}- 60 Kg P_2O_5 ha^{-1} + 5 t pressmud ha^{-1}	13.16	24.74	34.72	37.80
SEm ±	0.35	0.72	0.66	1.66
C.D. (0.05)	1.03	2.11	NS	NS

Table.2 Effect of phosphorus, PSB and pressmud on total phosphorus in soil after harvest and fertilizer use effecincy

Treatment	Total phosphorus in soil (kg P_2O_5 ha^{-1})	Depletion or buildup over initial P status (kg ha^{-1})	Fertilizer use efficiency
T_1-Control	378	-7	-
T_2- 20 Kg P_2O_5 ha^{-1} (P_{20})	393	+8	14.65
T_3- 40 Kg P_2O_5 ha^{-1} (P_{40})	408	+23	11.30
T_4- 60 Kg P_2O_5 ha^{-1} (P_{60})	427	+42	8.92
T_5-PSB alone	376	-9	-
T_6-20 Kg P_2O_5 ha^{-1} + PSB	391	+6	19.00
T_7- 40 Kg P_2O_5 ha^{-1} + PSB	407	+22	12.35
T_8- 60 Kg P_2O_5 ha^{-1} + PSB	425	+40	9.85
T_9- Pressmud alone (PM)[5 t ha^{-1}]	378	-7	-
T_{10}- 20 Kg P_2O_5 ha^{-1} + 5 t pressmud ha^{-1}	392	+7	21.00
T_{11}- 40 Kg P_2O_5 ha^{-1} + 5 t pressmud ha^{-1}	409	+24	12.53
T_{12}- 60 Kg P_2O_5 ha^{-1} + 5 t pressmud ha^{-1}	427	+42	10.10
SEm ±	7.26	-	-
C.D. (0.05)	21.40	-	-

Fig.1 Depletion or buildup over initial P status in soil as affected by phosphorus, PSB and pressmud at harvest



Total phosphorus in soil

Data on total phosphorus content in soil at harvest are presented in table 2 and depicted in figure 1. The total phosphorus in soil found depleted in control receiving neither P nor solubilizing agents. Similarly, alone application of PSB and pressmud also showed depletion in total P content with a tune of 9 and 7 kg ha^{-1}, respectively over initial status. All other treatments containing phosphorus found to be improved total P status of soil. The buildup of total phosphorus increased with increasing level of P upto 60 kg P_2O_5 ha^{-1} either alone or inoculation with PSB or PM.

Fertilizer use efficiency

The data are presented in table 2 with respect to fertilizer use efficiency in terms of kg grains/kg P_2O_5 ha^{-1}. It is interesting to note that fertilizer use efficiency increased with decreasing levels of P.

This tendency was noticed with alone application of P as well as inoculation of PSB or incorporation of PM with different levels of P. Incorporation of pressmud along with phosphorus found to be more effective in improving the apparent recovery of applied P fertilizer as compare to PSB having 21.00,

12.53 and 10.10 fertilizer use efficiency with P_{20} + PM, P_{40} + PM and P_{60} + PM, respectively.

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