International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2017; 5(5): 2351-2353

Received: 25-07-2017
Accepted: 26-08-2017

Ashutosh Singh
Department of Soil Science and Agricultural Chemistry, Bihar Agricultural University, Sabour, Bhagalpur, Bihar, India

Amit Kumar Pandey
Department of Soil Science and Agricultural Chemistry, Bihar Agricultural University, Sabour, Bhagalpur, Bihar, India

Correspondence
Ashutosh Singh
Department of Soil Science and Agricultural Chemistry, Bihar Agricultural University, Sabour, Bhagalpur, Bihar, India

Response of phosphorus, PSB and pressmud on dry matter accumulation, phosphorus content and uptake of urdbean

Ashutosh Singh and Amit Kumar Pandey

Abstract
Field experiment was conducted during summer season (*zaid*) of 2005 on silty loam soil at Student Instructional Farm of Narendra Deva University of Agriculture & Technology, Kumarganj, Faizabad (24.4º–26.56º N, 82.12º–83.98º E, elevation 113 m) in Uttar Pradesh state, located at Indo-Gangetic Plain classified as Eastern Plain Zone No. 8. Twelve treatments coded from T_1 to T_{12} were tested in randomized block design with three replications. The objective of the study was to investigate the effects of three phosphorus levels (20, 40 & 60 kg ha^{-1}) with and without PSB or pressmud (5 t ha^{-1}) on the dry matter accumulation, phosphorus content and their uptake of urdbean. The results revealed that 60 kg P_2O_5 along with pressmud 5 t ha^{-1} significantly increased dry matter accumulation per plant. Phosphorus concentration in plants parts and its uptake by a crop of urdbean were maximum with 60 kg P_2O_5 + pressmud 5 t ha^{-1}. On the other hand the lowest values of these parameters were obtained from control treatment.

Keywords: Dry matter accumulation, phosphorus concentration, phosphorus uptake, phosphorus, PSB and pressmud

Introduction
Pulses are the main sources of dietary protein particularly for vegetarians and contribute about 14 per cent of the total protein of average Indian diet. Urdbean (*Vigna mungo* L. Hepper) is an important pulse crop having high nutritive value, contains about 24% and self-pollinated crop which is grown during rainy (*kharif*) as well as summer (*zaid*) seasons in arid and semi-arid regions of India. The duration of the crop is very short; it fits well called as master key element for increasing yield. In India pulse production is very low due to the several factors but most important factor is nutrient management. The nutrient requirement of crop is met by the chemical fertilizers. However, fertilizer alone cannot sustain productivity of land in modern farming. Similarly, nutrient supply through organic manures and biofertilizers can hardly fulfill the need of a crop. So an integration of organic and inorganic nutrient sources sustains the productivity and may improve the soil health.
Next to nitrogen, phosphorus is regarded as the pioneer plant nutrient, since it is needed by the leguminous crops for rapid and healthy root development, energy storage, transfer, nodules development, bacterial activity and nitrogen fixation (Singh *et al.*, 2007) [2]. Biofertilizer (PSB) is natural and organic fertilizer that increase availability of phosphorus in soil besides increase in biological fixation of atmospheric nitrogen and enhance phosphorus availability to crop. Pressmud from sugar mill is enriched source of organic matter and contains substantial quantities of nutrients for improving physical conditions and improvement of soil fertility (Nisar, 2000) [1]. It also contains sulfur, which helps to acidify the soil. This acidification makes soluble calcium available and thus improves soil structure and decreases the leaching of salts. 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 present situation, the present research was carried out to study the effect of phosphorus, PSB and pressmud on dry matter accumulation, phosphorus concentration and their uptake by urdbean.

Materials and Methods
A field experiment was conducted during summer season of 2005 at Student Instructional Farm

of Narendra Deva University of Agriculture & Technology, Kumarganj, Faizabad (U.P.). The soil of the experimental field was silty loam in texture with alkaline in reaction (pH 8.1), low in organic carbon 0.45%, medium available N 262.0 kg ha^{-1}, available P_2O_5 19.65 kg ha^{-1} and available K_2O 272.80 kg ha^{-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. Pressmud was incorporated in soil and seeds were treated with PSB culture using 25 g kg^{-1} seed of urdbean. A uniform and common dose of 20 kg N and 40 kg K_2O ha^{-1} through urea and MOP, respectively was applied in all the treatments at the time of sowing. Whereas, phosphorus was applied as per treatments through DAP. The urdbean variety 'T-9' was sown using seed rate 15 kg ha^{-1} with a row spacing of 30 cm at the depth of 4-5 cm in the last week of March. Other management practices were adopted as per recommendations of the crop. Phosphorus concentration was determined using tri acid mixture (Sulphuric-nitric-perchloric acid) digestion procedure on spectrophotometer at 470 mμ wave length (Jackson, 1973) [3].

Results and Discussion

Dry Matter Accumulation

The dry matter accumulation of urdbean was significantly influenced by phosphorus, PSB and pressmud (Table 1). The dry matter accumulation was maximum when 60 kg P2O5 was applied along with pressmud while under control plots. Increased levels of phosphorus either alone or incombination with pressmud or PSB improved the dry matter significantly but the quantum of increase in dry matter accumulation found to be more with pressmud when compared with PSB inoculation. This may be because of better soil environment and maximum phosphorus availability. The magnitude of dry matter accumulation was recorded maximum in between 300 DAS and 60 DAS. After 60 DAS the quantum of increase in dry matter found to be very meager. Similar result was also obtained by Baboo and Mishra, 2001 [4].

Table 1: Effect of phosphorus, psb and pressmud on dry matter accumulation of urdbean

Treatment	Dry Matter Accumulation Plant^{-1} (g)		
	30 DAS	60 DAS	At Harvest
T_1 – Control	0.437	3.038	3.264
T_2 - 20 Kg P_2O_5 ha^{-1} (P_{20})	0.465	3.257	3.772
T_3 - 40 Kg P_2O_5 ha^{-1} (P_{40})	0.527	3.799	4.884
T_4 - 60 Kg P_2O_5 ha^{-1} (P_{60})	0.637	4.521	5.619
T_5 - PSB alone	0.456	3.198	3.613
T_6 - 20 Kg P_2O_5 ha^{-1} + PSB	0.481	3.319	3.991
T_7 - 40 Kg P_2O_5 ha^{-1} + PSB	0.543	4.214	5.423
T_8 - 60 Kg P_2O_5 ha^{-1} + PSB	0.675	4.635	5.713
T_9 - Pressmud alone (PM) [5 t ha^{-1}]	0.458	3.209	3.637
T_{10} - 20 Kg P_2O_5 ha^{-1} + 5 t pressmud ha^{-1}	0.524	3.683	4.614
T_{11} - 40 Kg P_2O_5 ha^{-1} + 5 t pressmud ha^{-1}	0.646	4.519	5.577
T_{12} - 60 Kg P_2O_5 ha^{-1} + 5 t pressmud ha^{-1}	0.782	4.912	5.905
SEm ±	0.018	0.142	0.170
C.D. (0.05)	0.056	0.418	0.500

DAS: Days After Sowing

Phosphorus Concentration in plants

Data on phosphorus concentration in urdbean plant parts are summarized in table 2. Maximum phosphorus concentration in urdbean plants was estimated at 30 DAS under all treatments which ended to decrease towards maturity of crop. The maximum phosphorus content in urdbean was found in treatment supplied with P_{60} + PM while minimum under control plot. Alone application of PM or PSB inoculation did not improve the phosphorus content in plant significantly. Similar fashion was recorded at different crop growth stages. Concentration of phosphorus in grains increased with increasing levels of phosphorus upto 40 kg P_2O_5 ha^{-1} and further increase in phosphorus dose did not improve the phosphorus content in grain significantly. It was because attributed to adequate availability and utilization of phosphorus by crop plants. The result confirms the finding of Khan *et al.*, 2002 [5].

Table 2: Effect of phosphorus, psb and pressmud on phosphorus concentration in plant of urdbean

Treatment	Phosphorus Content in Plant (%)			
	30 DAS	60 DAS	At Harvest	
			Grain	Stover
T_1 – Control	0.604	0.230	0.576	0.176
T_2 - 20 Kg P_2O_5 ha^{-1} (P_{20})	0.694	0.264	0.661	0.227
T_3 - 40 Kg P_2O_5 ha^{-1} (P_{40})	0.879	0.335	0.838	0.289
T_4 - 60 Kg P_2O_5 ha^{-1} (P_{60})	0.889	0.339	0.847	0.296
T_5 - PSB alone	0.670	0.256	0.639	0.208
T_6 - 20 Kg P_2O_5 ha^{-1} + PSB	0.793	0.302	0.756	0.259
T_7 - 40 Kg P_2O_5 ha^{-1} + PSB	0.939	0.357	0.892	0.295
T_8 - 60 Kg P_2O_5 ha^{-1} + PSB	0.960	0.372	0.916	0.304
T_9 - Pressmud alone (PM) [5 t ha^{-1}]	0.677	0.258	0.645	0.217
T_{10} - 20 Kg P_2O_5 ha^{-1} + 5 t pressmud ha^{-1}	0.866	0.339	0.825	0.266
T_{11} - 40 Kg P_2O_5 ha^{-1} + 5 t pressmud ha^{-1}	0.946	0.368	0.894	0.298

T_{12} - 60 Kg P_2O_5 ha^{-1} + 5 t pressmud ha^{-1}	0.966	0.384	0.920	0.308
SEm ±	0.008	0.006	0.011	0.004
C.D. (0.05)	0.023	0.016	0.032	0.011

DAS**:** Days After Sowing

Phosphorus Uptake

The data regarding total phosphorus (grains and stover) uptake by urd bean are furnished in table 3. Application of 60 kg P_2O_5 + pressmud 5 t ha^{-1} significantly improved the total phosphorus uptake over rest of the treatments however, it was at par with 60 kg P_2O_5 + PSB. The fraction of P uptake by grains found to be more as compared to uptake by stover under all treatments. It is well documented that P uptake by crop largely depends on dry matter accumulation (DMA) and concentration of P in the plant parts at cellular level and increased availability of P in the soil due to solubilization of added phosphorus. These findings are in close conformity with Tanwar *et al.*, 2003 [6].

Table 3: Effect of phosphorus, psb and pressmud on phosphorus uptake by urdbean at harvest

Treatment	Phosphorus Uptake (Kg P_2O_5 ha^{-1})		
	Grain	**Straw**	**Total**
T_1 – Control	4.089	2.673	6.762
T_2 - 20 Kg P_2O_5 ha^{-1} (P_{20})	6.629	4.589	11.218
T_3 - 40 Kg P_2O_5 ha^{-1} (P_{40})	9.737	6.511	16.248
T_4 - 60 Kg P_2O_5 ha^{-1} (P_{60})	10.545	7.006	17.551
T_5 - PSB alone	5.016	3.413	8.429
T_6 - 20 Kg P_2O_5 ha^{-1} + PSB	8.240	5.659	13.899
T_7 - 40 Kg P_2O_5 ha^{-1} + PSB	10.739	6.852	17.591
T_8 - 60 Kg P_2O_5 ha^{-1} + PSB	11.917	7.475	19.392
T_9 - Pressmud alone (PM) [5 t ha^{-1}]	5.205	3.606	8.811
T_{10} - 20 Kg P_2O_5 ha^{-1} + 5 t pressmud ha^{-1}	9.322	5.979	15.301
T_{11} - 40 Kg P_2O_5 ha^{-1} + 5 t pressmud ha^{-1}	10.826	6.910	17.736
T_{12} - 60 Kg P_2O_5 ha^{-1} + 5 t pressmud ha^{-1}	12.107	7.619	19.726
SEm ±	0.163	0.104	0.270
C.D. (0.05)	0.482	0.308	0.797

Acknowledgement

Author is grateful to Dr. Room Singh University Professor, Director Seed & Farm and Dr. L.P. Verma, Associate Professor and Dr. P. N. Tripathi, Associate Professor, for their help and guidance.

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