The Pharma Innovation Journal 2022; SP-11(11): 164-167

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; SP-11(11): 164-167

www.thepharmajournal.com
Received: 01-09-2022
Accepted: 05-10-2022

Ralte Lalmalsawma
Department of Soil Science and Agricultural Chemistry, College of Agriculture, Central Agricultural University, Imphal, Manipur, India

N Surbala Devi
Department of Soil Science and Agricultural Chemistry, College of Agriculture, Central Agricultural University, Imphal, Manipur, India

A Herojit Singh
Department of Soil Science and Agricultural Chemistry, College of Agriculture, Central Agricultural University, Imphal, Manipur, India

Jamkhogin Lhungdim
Department of Soil Science and Agricultural Chemistry, College of Agriculture, Central Agricultural University, Imphal, Manipur, India

Gopimohan Singh
Department of Soil Science and Agricultural Chemistry, College of Agriculture, Central Agricultural University, Imphal, Manipur, India

Ningthoujam Babulu
Department of Soil Science and Agricultural Chemistry, College of Agriculture, Central Agricultural University, Imphal, Manipur, India

Corresponding Author:
Ralte Lalmalsawma
Department of Soil Science and Agricultural Chemistry, College of Agriculture, Central Agricultural University, Imphal, Manipur, India

Effect of rock phosphate, farm yard manure and phosphorus solubilizing bacteria on phosphorus concentration and dry matter yield of pea

Ralte Lalmalsawma, N Surbala Devi, A Herojit Singh, Jamkhogin Lhungdim, Gopimohan Singh and Ningthoujam Babulu

Abstract
A field experiment was conducted to study the effect of rock phosphate and farm yard manure applied in presence or absence of phosphorus solubilizing bacteria on soil available phosphorus, phosphorus concentration and dry matter yield of pea variety VBL-10 at College of Agriculture, CAU, Imphal. Result revealed different pattern of changes of available P, phosphorus concentration and dry matter yield. Application of rock phosphate, farm yard manure and phosphorus solubilizing bacteria significantly influenced available phosphorus, phosphorus concentration and dry matter yield of pea variety VBL-10 and higher values are recorded in soil treated with 50% RD of P_2O_5 from RP + 50% RD of P_2O_5 from FYM + PSB which is at par with 75% RD of P_2O_5 from RP + 25% RD of P_2O_5 from FYM + PSB. Efficiency of rock phosphate is enhanced by the combined application of farm yard manure and phosphorus solubilizing bacteria.

Keywords: Rock phosphate, phosphate solubilizing bacteria, farm yard manure, pea

1. Introduction
Pea (*Pisum sativum* L.) is one of the important vegetables in the world and ranks among the top 10 vegetable crops. Pea is commonly used in human diet throughout the world and it is rich in protein (21-25%), carbohydrates, vitamin A and C, Ca, phosphorous and has high levels of amino acids lysin and tryptophan (Bhat *et al*., 2013) [5]. Its cultivation maintains soil fertility through biological nitrogen fixation in association with symbiotic rhizobium prevalent in its root nodules and thus play a vital role in fostering sustainable agriculture (Negi *et al*. 2006) [12]. Therefore, apart from meeting its own requirement of nitrogen, peas are known to leave behind residual nitrogen in soil 50-60 kg/ha.
Phosphorus (P) is one of the essential plant nutrients. Phosphorous is the second most important nutrient for plants after nitrogen, which influences the plant metabolic processes like signal transduction, photosynthesis, respiration, transport and storage of energy in the form of ATP and ADP (Griffith, 2010) [9]. Phosphorus is known to play an important role in growth and development of the crop and have direct relation with root proliferation, straw strength, grain formation, crop maturation and crop quality. The requirement of P, which is essential for root growth and nodulation, has to be largely fulfilled through inorganic fertilizers. Options for P inputs are organic materials, mineral P fertilizer or rock phosphate (RP). The application of phosphorus fertilizer is usually necessary for crop production. The high cost of soluble phosphate fertilizer like single or triple superphosphate has generated considerable interest within the utilisation of Rock phosphate (RP). It is considered as slow releasing P source and commonly cannot supply P in the rate as per crop requirement. It is less effective than single superphosphate, triple superphosphate or Diammonium phosphate regarding its direct application, Enhancing P availability to crop through phosphate-solubilizing bacteria (PSB) holds promise in the present scenario of escalating prices of phosphatic fertilizers in the country and a general deficiency of P in Indian soils (Alagawadi and Gaur, 1988) [2]. Many micro-organisms have been identified as an agent for promoting better nutrient availability to plant and facilitating its uptake. Bio-fertilizers play an important role in increasing yield through the natural processes of nitrogen (N) fixation, phosphate Solubilization and stimulating plant growth through the synthesis of growth promoting substances, improvement in soil structure and texture, soil pH and other properties of soil. Seed inoculation with PSB can convert fixed phosphorus to available form, which can be easily taken up by the plant.

To avoid the environmental hazards, declining human health and producing more crop yields to meet the increasing food demand of world's huge population, the integrated nutrient management comprising combination of chemical and bio-fertilizers may be a useful way as mentioned by Ayoola and Makinde (2007) [3]. It was also reported that PSM in combination with phosphorus fertilizer and organic manure significantly improved seed phosphorus content, tillers m^{-2}, grain and biological yield (Afzal, 2005) [1].

Keeping the above points in view, the investigation was conducted to study the effect of rock phosphate and farm yard manure applied in presence or absence of phosphorus solubilizing bacteria on soil available phosphorus, phosphorus concentration and dry matter yield of pea variety VBL-10.

2. Materials and Methods

A field experiment was conducted during the *Rabi* season of 2021-22 at Central Farm, College of Agriculture, Central Agricultural University, Imphal, Manipur. The climatic condition of Imphal valley is subtropical. The average annual rainfall of Imphal valley is 1212 mm and the winter normally begins from mid-November and extends up to the end of February. The soil of the experiment was clay in texture with medium fertility status and acidic in reaction with a soil pH of 4.9. The chemical composition of the soil indicated that the soil was medium in available nitrogen (294.75 kg/ha), medium in available phosphorus 18.25 kg/ha), medium in available potassium (225.25 kg/ha) and high in organic carbon content (1.22%) (Table 1).

Table 1: Soil Physiochemical properties

Soil Characteristics	Results
Sand (%)	14.8
Silt (%)	23.4
Clay (%)	61.8
Soil texture	Clay
pH (1:2.5,soil:water ratio)	4.59
EC (1:2.5,soil:water ratio, dS/m	0.34
CEC(cmol / kg)	16.50
Organic carbon (%)	1.22
Available Nitrogen (kg / ha)	294.75
Available Phosphorus (kg / ha)	18.25
Available Potassium (kg / ha)	225.25

The experiment was laid out in a Randomized Block Design with nine treatments replicated thrice. The treatments were: T_1 = Control, T_2 = 100% RD(recommended dose) of P_2O_5 from SSP, T_3=100% RD of P_2O_5 from RP, T_4 = 75% RD of P_2O_5 from RP + 25%RD of P_2O_5 from FYM, T_5 = 50% RD of P_2O_5 from RP + 50%RD of P_2O_5 from FYM, T_6 = 100% RD of P_2O_5 from SSP + PSB, T_7 = 100% RD of P_2O_5 from RP + PSB, T_8 = 75% RD of P_2O_5 from RP + 25% RD of P_2O_5 from FYM + PSB, T_9 = 50% RD of P_2O_5 from RP + 50% RD of P_2O_5 from FYM + PSB. A uniform dose of 20 kg N/ha in the form of urea, 40 kg P_2O_5/ha in the form of Rock phosphate and SSP and 30 kg K_2O/ha in the form of muriate of potash were applied in the experimental plots one day before sowing. Size of each plot is 3 x 1.5 m^2 and sowing was done at a spacing 30 x 10 cm^2. Pea seeds were treated with PSB (*Bacillus megatherium*). The inoculated seeds were dried under shade and sown immediately after drying.

Sampling was done at 15th, 30th, 45th, 60th day and at harvest. Available phosphorus was estimated by Bray's method (Bray and Kurtz, 1945) [6]. Plant fresh weight and dry weight were recorded. Plant samples were digested in di-acid mixture of nitric acid and perchloric acid in 4:1 ratio and was analyzed in the digested plant materials by Vanadomolybdo-phosphoric yellow colour method as described by Jackson (1973) [11].

All the data obtained were statistically analysed by the method of analysis of variance to test the significance of the treatment effects as well as result interpretation as given by Gomez and Gomez (1984) [8]. F-test at 5% level of probability was used to test the significance of treatment effect and wherever the "F" test was significant critical difference (CD) values were given at 5% level of significance.

3. Results and Discussion

3.1. Available phosphorus

Data on changes in the amount of available phosphorus in soil applied with rock phosphate, farm yard manure and phosphorus solubilizing bacteria are shown in Table 2. Results revealed that available P content increases up to 30th day irrespective of different treatments and further decline up to harvest. The soil available phosphorus was decreased with the advancement of crop stage. The decrease in phosphorus might be due to the absorption of P by the growing plants due to the refixation of solubilized phosphorus (Veeranagappa *et al.*, 2011; Chikkaraju, 2012) [16, 7]. Significantly lowest phosphorus was recorded in control. Among the different treatments higher available P was observed on T_9 followed by T_8 on 15th and 30th day. Available P content was recorded more in soil treated with T_9 which is at par with T_8 on 45th day onwards till harvest. The results were according with the findings of Banik and Dey (1982) [4] that when RP was applied along with the inocula of Bacillus sp. P availability in soil was improved. The maximum release of RP-P in soil was observed in case of soil amendment with RP with FYM + PSB which might be due to the additive effect of FYM and PSB; both simultaneously released organic acids which released maximum available P in soil. The results were according with the finding of Shehana and Abraham (2001) [15] who reported maximum release of RP-P when RP was used along with PSM and FYM.

Table 2: Changes in Available-P (ppm)

	Sampling days				
Treatment	15	30	45	60	Harvest
T_1	33.47	35.61	25.94	21.69	17.74
T_2	42.38	45.12	29.71	27.59	21.44
T_3	40.57	47.07	32.07	30.13	22.75
T_4	44.9	48.60	34.44	31.69	25.19
T_5	45.82	50.65	36.52	32.84	26.16
T_6	48.85	49.31	33.93	29.44	21.48
T_7	46.2	52.8	40.23	37.91	31.36
T_8	48.95	54.94	44.64	42.03	33.57
T_9	50.37	58.83	45.37	42.72	34.27
S.e.d (±)	0.58	0.96	0.81	0.58	0.48
C.D.(0.05)	1.24	2.04	1.73	1.23	1.02

3.2. Total phosphorus in plant

Data pertaining to the changes in the amount of P concentration in pea grown in soil applied with rock phosphate and farm yard manure in presence or absence of phosphorus solubilizing bacteria are presented in Table 3. Data revealed that irrespective of different treatments, total phosphorus increased up to 30th day followed by a decline till 60th day and again increased at harvest. Exhibition of P decline is due to its crop age reported by Setia and Sharma (2007) [14].

The total P concentration was significantly more in pea grown in soil treated with rock phosphate and FYM in presence or absence of PSB over control at different growth stages of the plant. Comparatively higher P concentration was observed in T_9 which is at par with T_8 on the 30th day and at harvest. On the 45th and 60th day the higher P concentration was exhibited by T9 followed by T8. This may be attributed to the increased soil available P due to the application of PSB and FYM (Chutia *et al*. 1988; Sundra *et al.* 2002; Egamberdiyeva *et al.* 2004) [17, 18].

Table 3: Changes in Total phosphorus in plant (ppm).

	Sampling days				
Treatment	**15**	**30**	**45**	**60**	**Harvest**
T_1	2870.85	3658.38	3235.72	3175.67	3303.82
T_2	2923.24	3860.27	3408.61	3225.14	3380.50
T_3	2956.32	3906.16	3653.51	3306.82	3509.00
T_4	2991.89	4061.38	3690.04	3371.67	3594.00
T_5	3111.40	4334.09	3831.97	3391.08	3789.21
T_6	3114.00	4579.96	3851.68	3347.33	3865.55
T_7	3217.86	4945.75	3877.83	3388.00	3936.94
T_8	3257.05	5167.39	3978.14	3629.96	3917.16
T_9	3256.81	5228.19	4164.99	3705.27	3966.67
S.e.d (±)	46.49	70.04	86.64	44.82	54.9
C.D.(0.05)	98.55	148.47	183.66	95.03	116.38

3.3. Dry matter yield

Data on Dry matter yield of pea grown in rock phosphate, farm yard manure and phosphorus solubilizing bacteria applied are presented in Table 4. The dry matter of the plant is greatly influenced by the different treatments. All the treatments showed better results of dry matter when compared to the control. Irrespective of different treatments, dry matter yield increased progressively up to harvest. Enhanced agronomic practices of rock phosphate was resulted in increased dry matter yield (Ikerra *et al*., 1994) [10].

Among the different treatments soil applied with RP, PSB and FYM significantly more yield than others. Higher yield is seen in T_9 which are at par with T_8. The increase in dry matter yield under PSB and FYM addition could be due to continued availability of P that helped in proliferation of root development and hence, better nutrient acquirement and biomass accumulation. (Saleem *et al*. 2013) [13].

Table 4: Changes in Plant dry weight (g/plant).

		Sampling days			
Treatment	**15**	**30**	**45**	**60**	**Harvest**
T1	0.31	0.6	1.02	2.12	5.66
T2	0.36	0.71	1.16	2.45	6.11
T3	0.35	0.77	1.31	2.47	6.39
T4	0.32	0.72	1.18	2.59	6.57
T5	0.35	0.74	1.11	2.66	6.06
T6	0.34	0.75	1.24	2.86	6.69
T7	0.34	0.78	1.32	2.98	6.59
T8	0.42	0.81	1.74	3.31	7.51
T9	0.45	0.91	1.85	3.49	8.48
S.e.d (±)	0.04	0.11	0.04	0.26	0.54
C.D.(0.05)	0.08	0.23	0.10	0.55	1.14

4. Conclusion

Application of rock phosphate, farm yard manure and phosphorus solubilizing bacteria significantly influenced available phosphorus, phosphorus concentration and dry matter yield of pea variety VBL-10 and higher values are recorded in soil treated with 50% RD of P_2O_5 from RP + 50% RD of P_2O_5 from FYM + PSB which is at par with 75% RD of P_2O_5 from RP + 25% RD of P_2O_5 from FYM + PSB. Efficiency of rock phosphate is enhanced by the combined application of farm yard manure and phosphorus solubilizing bacteria.

4. References

1. Afzal AFTAB, Ashraf M, Asad SA, Farooq M. Effect of phosphate solubilizing microorganisms on phosphorus uptake, yield and yield traits of wheat (*Triticum aestivum* L.) in rain fed area. International Journal of Agricultural Biology 2005;7(2):207-209.
2. Alagawadi AR, Gaur AC. Associative effect of Rhizobium and PSB on yield and nutrient uptake by chickpea. Plant and soil. 1988;105:241-246.
3. Ayoola OT, Makinde EA. Complementary organic and inorganic fertilizer application: Influence on growth and yield of cassava, maize, and melon intercrop with a relayed cowpea. Australian Journal of Basic and Applied Sciences. 2007;1(3):187-92.
4. Banik S, Dey BK. Available phosphate content of an alluvial soil as influenced by inoculation of some isolated phosphate solubilizing microorganisms. Plant Soil. 1982;69:353-364.
5. Bhat TA, Gupta M, Ganai MA, Ahanger RA, Bhat HA. Yield, soil health and nutrient utilization of field pea *Pisum sativum* L. as affected by phosphorus and Bio fertilizers under subtropical conditions of Jammu, International journal of modern plant and animal science. 2013;1(1):1-8.
6. Bray RH, Kurtz LT. Determination of total, organic and available forms of phosphorus in soils. Soil Science. 1945;59:39-45.
7. Chikkaraju SN. Studies on impact of nitrogen management practices on soil properties, growth and yield of rice. M.Sc. (Ag) thesis, University of Agricultural Sciences, Bangaluru; c2012
8. Gomez KA, Gomez AA. Statistical procedures for agricultural research. John Wiley & Sons, New York; c1984. p. 8-20.
9. Griffith B. The Efficient Fertilizer Use Manual, Phosphorus. The Mosaic Company, Plymouth, MN; c2010.
10. IKerra TWD, Mnkeni PNS, Singh BR. Effects of added compost and farmyard manure on P release from Minjingu phosphate rock and its uptake by maize. Norwegian Journal of Agricultural Science. 1994;8:13-23.
11. Jackson ML. Soil Chemical Analysis. Prentice Hall of India Pvt. Ltd., New Delhi; c1973.
12. Negi S, sing RV, Dewivdi OK. Effect of Bio fertilizers, nutrient and lime on growth and yield of garden pea, Legume research. 2006;29(4):282-285.
13. Saleem MM, Arshad M, Yaseen M. Effectiveness of various approaches to use rock phosphate as a potential source of plant available P for sustainable wheat production. International Journal of Agriculture and Biology. 2013, 15(2).
14. Setia RK, Sharma KN. Dynamics of forms of inorganic phosphorus during wheat growth in a continuous maize-wheat cropping system. Journal of Indian Society of Soil Sciince. 2007;55:139-146.
15. Shehana RS, Abraham A. Efficiency of phosphorus solubilizing organisms in acid laterite soil. Journal of

Tropical Agriculture. 2001;39:57-59.
16. Veeranagappa P, Prakasha HC, Ashoka KR, Venkatesha MM, Mahendra Kumar. Effect of zinc enriched compost on soil chemical properties and nutrients availability. An Asian Journal of Soil Science. 2011;6(2):189-194.
17. Chutia RN, Prasad CR, Yadav K. Reaction of soluble and insoluble phosphate carriers in a calcifluvent with respect to phosphate and its adsorption behaviour. J. Indian Soc Soil Sci. 1988;36:671-5.
18. Egamberdiyeva D, Höflich G. Effect of plant growth-promoting bacteria on growth and nutrient uptake of cotton and pea in a semi-arid region of Uzbekistan. Journal of Arid Environments. 2004 Jan 1;56(2):293-301.