

Referee's Comments

Reply to the Anonymous Referee #1

Sr. #	Query	Reply
	1) Title is very long. I recommend making it more concise.	Title has been shortened as suggested
	<p>2) Why were soils of a near neutral pH selected? Would you not expect the least amount of an effect of solubilizing bacteria under those conditions? Does this represent the most common soil type in the region? Please elaborate on why the specific soils were used in the experiment.</p> <p>a. Also, the soil used had a pH of 6.89 while the data in the experiments shows pH values starting at 7.57-8.10. What caused the basifying effect?</p> <p>b. I would argue that the main reason you see a strong acidifying effect is because the addition in the PSB treatments temporarily increased the pH more than other treatments. The decrease during the experiment could have just as well arisen from a "move back to equilibrium" as well as due to any microbial activity. Please revise or defend your position on your PSB acidification rational.</p>	<p>The soil used in the study was not selected on the basis of some specific pH. The pH of the soils in and around Rawalakot (study site) is 6.5 to 7.5, Showing that the soil used represent the most common soil type in the region.</p> <p>a). The initial pH of the soil used was 7.57, correction has been made in Table 1.</p> <p>b). The argument has been fully incorporated on Page 13 Lines 17-20.</p>
	3) You seem to use "mineralization" and "solubilization" interchangeable. Please define the each term clearly and if they do represent the same thing use only one consistently.	Yes! The term mineralization is used throughout the text.
	4) Could you provide some more details on the selected cultures for the experiment? Why were these expected to have an effect?	The inoculant used in this study was a commercialized product containing K-1 (<i>Pseudomonas stutzeri</i>) as a nitrogen fixer, ER-20 (<i>Azospirillum brasilense</i>) as IAA producer and Ca-18 (<i>Agrobacterium tumefaciens</i>) as phosphate solubilizer. Added in the Text on Page 5 Lines17-18 .
	5) Your discussion section is repeats a lot of the result description from the result section. Please tidy up and make more concise. For example: 1) "Application of PSB: : .PSK on RP" seems to just describe results and	The discussion section as a whole has been re-organized, particularly the highlighted sections/paragraphs. Attempts have been made to avoid the repetition of the Results.

	<p>not related to a specific part of the discussion; 2) first sentence on page 1855: "The P released: : .mineral pool"; 3) please make the first paragraph of discussion section 4.2 (page 1856) more concise.</p>	
	<p>6) What is the source of the "thoroughly processed soil" on page 1847?</p>	<p>The "thoroughly processed soil" has been deleted.</p>
	<p>7) Would the logical deduction on mid page 1854 not be that RP works best in acidic soils while poorly in neutral (your study) and alkaline soils? Please include some hypothesis on why or why not you think that might be.</p>	<p>Under acidic conditions, Organic acid anions, with oxygen containing OH⁻ and COOH⁻ groups, have the ability to form stable complexes with cations such as Ca²⁺, Fe²⁺, Fe³⁺ and Al³⁺, that are commonly bound with phosphate in poorly forms. By complexing with cations on the mineral surface, organic acid anions loosen cation-oxygen bonds of the mineral structure and catalyze the release of cations to solution. This is the major reason that why RP is more effective under acidic conditions. This explanation is well incorporated on Page 12 Lines 12-17.</p>
	<p>8) I find the P-fixation mechanism not strong since most of your soils are near neutral. Could you provide some alternative reasoning or provide the reasoning why these soils still have such high sorption capacity. What level of sorption capacity would be expected in the soil type used?</p>	<p>In our case, soil had a neutral pH, belong to Chinasi soil series and parent material is residum-colluvium from shales. Therefore, it is likely that kaolinite may be a dominant clay mineral present in soil composition that adsorb high H₂PO₄⁻. The other possibility may that in the presence of 24% clay content, some of the applied or native P may be fixed on the surface of the clay particles. This argument has been incorporated on Page 11-12 Lines 28 and 1-3.</p> <p>We did not determine the sorption capacity of the soils of this region. However, under similar environmental conditions in DG Khan Pakistan, the sorption capacity of soils amended with 20-140 µg P/ml ranged between 60-188 µg/g.</p>
	<p>9) Figure 3 has only 11 bars and not the 12 needed to represent all treatments, thus, unable to assess what the data suggests. Please correct.</p>	<p>Figure 3 shows the P utilization of efficiency of Chilli in response to added amendments. It is determined by subtracting the values obtained from added amendments to that from the control. Therefore, the control (T0) cannot be included here. The error in the Figure caption has been removed/corrected.</p>

	10) The paper has a decent amount of typos. Please read carefully and correct. See specific comments for details on the once I caught.	The possible corrections and improvements marked by the blue color have been made.
Specific Comments:		
	1) Page 1841, line 24: workout should be worked out.	Correction has been made on Page 2 Line 18
	2) Page 1845, line 23: change to "were"	Correction has been made on Page 5 Line 20
	3) Page 1845, line 23-25: correct to "Soil samples were pre-incubated: :	Correction has been made on Page 5 Line 21
	4) Page 1846, line 12: and "the" weight	Correction has been made on Page 6 Line 5
	5) Page 1853, line 19: access incorrect word usage, for example determine would work. Pleas correct.	Correction has been made on Page 11 Line 17
	6) Page 1855, first sentence: poor sentence, unclear what is meant. Please rephrase.	This paragraph is merged with previous section and deleted from here
	7) Page 1857, line 11: wordy, for example: : : :full DAP saving almost 50%	Corrected as suggested on Page 14 Lines 11-12.
	8) Page 1855, line 8: Poor sentence structure; should be: : :that "the" combination	This paragraph has been changed and merged with earlier discussion
	9) Figure 2 and Table 3 seem to show duplicative information. Do not see the value of figure 2. Please remove or justify its usage.	Table 3 highlights the changes in soil pH in response to added amendments at different incubation periods while Figure 2 indicates changes in soil pH due to added amendments across (average) incubation periods. Figure 2 actually shows general impact of added amendments to pH, which is useful for a reader who would like to an overview of general impact rather than going in detail of impact at different timings. Hence, I feel that Figure is also useful.

Reply to the Anonymous Referee #2

Overview: The study examined the effect of poultry manure (PM) and PSB on efficiency of rock phosphate (RP), soluble P fertilizers (SSP and di-ammonium phosphate, DAP) on the capacity of a soil to release P, growth, yield, P-uptake and P utilization efficiency (PUE) of chilli (*Capsicum annum* L.) grown under greenhouse conditions. Given the importance of find ways to improve the PUE in agricultural systems to increase yields and to reduce the P footprint in the environment, this type

of studies are of high relevance.

General comments: 1) The title could be more concise, for example: Effect of phosphate solubilizing bacteria and poultry manure on plant growth and P utilization efficiency of Chilli (*Capsicum annuum* L.).

Reply: The title is changed. However, the emphasis on P mineralization in this study cannot be neglected/ignored. Our major emphasis in this study is to know the effect of PSB and PM on changes in P release capacity (mineralization) of added P sources especially the RP. That is an important aspect how to utilize a cheap and easily available source of P i.e. RP for the benefits of Agriculture? Therefore, I feel that the amended title is now appropriate.

2) The soil used for the study showed initial pH values of 7.57 (lightly alkaline). There is evidence that in this type of pH, the phosphate could be in a complex form with Calcium. Therefore, some data is desired on Calcium and Magnesium contents. Please include this aspect on the discussion section.

Reply: The concentration of Ca, Mg and CaCO₃ in the soil used in the study have been included in Table 1. The possible effect of Ca on P availability has been included and discussed on Page 11 Lines 302-305.

3) RP works best in acidic soils, then what the purpose of evaluate RP in the selected (slightly alkaline) soil?

Reply: Yes! Under acidic soils, RP works best and can be applied directly to the soil. On the other hand because of low or negligible efficiency of RP in neutral or alkaline soils, application of RP with different amendments have been successfully tried in the past to improve the efficacy of low grade phosphate rocks. Therefore, in this study RP along with PSB and organic manures was tried on the basis of the facts that both PSB and organic manures may release low molecular weight organic acids and generated the acidic environment in the rhizosphere which may affect P release capacity of the soil. The detailed explanation is give in the introduction section Page 03Lines 66-78. Two important papers are cited here (included in the Reference section) for Reference.

1: Toor, G.S.: Enhancing phosphorus availability in low-phosphorus soils by using poultry manure and commercial fertilizer, *Soil Sci.*, 174, 358–364, 2009. (pH of the soil used in the study was **7.9**).

2: Begum, M., Narayanasamy, G., and Biswas, D. R.: Phosphorus supplying capacity of phosphate rocks as influenced by compaction with water-soluble P fertilizers, *Nutr. Cycl. Agroecosyst.*, 68, 73–84, 2004. (pH of the soil used in the study was **8.5**).

4) What was the logic behind the mixtures of treatments of 50%:50%?

Reply: The logic behind the Combinations of 50:50 is to make comparison with full dose treatments to examine the efficiency of either RP or PSB or PM if these added amendments or combinations may give results equivalent to full dose. These combinations give very important findings presented in Table 5, Figures 1 and 3.

5) Did you measured the basal level of PSB of the evaluated soil? It would be important to determine the effect of the basal PSB present in the soil in the capacity to release phosphorous. Consequently, autoclaved soil would be an option in order to differentiate the PSB treatment as the soil used could have had a native PSB activity. Hence, fungi and mycorrhizae play a role in P mobilization affecting the P use efficiency.

Reply: The basal level of PSB of the evaluated soil was not measured because we do not have this facility in our Lab. However, the most probable number of the soil used in the study was measured those were 8.0×10^6 CFU g^{-1} soil. The study presented here covers all aspects of the title and objectives of the work, therefore my request is to ignore this point. The study presented here is the work conducted by an MPhil student who after completing here degree had left this University. Further, additional study will not be possible.

6) As the value of organic matter is low in the soil used for the study, could this be a reason for the low solubilization of phosphorus that is retained in the soil? Please discuss.

Reply: Yes! Organic matter plays an important role in P solubilization through the acidifying and chelation mechanisms. The low organic matter in our soil may be an important factor for low P solubilization/availability. This point has been added and discussed in Discussion section on Page 12 Lines 307-309.

7) What do you think is the reason behind the high levels of phosphorus in the day 0 of the incubation study. In fact for some treatments this time point show the highest P levels when compared to the other time points. Please discuss.

Reply: This is a common trend for all phosphatic fertilizers applied to soil. Please see the paper Begum et al. (2004). The reason behind the lower level of P with incubation timings is the possibility of P fixation and retention in soil with incubation periods. The discussion has already been made on Page 11 Lines 300 to 303.

8) What were the criteria to select Chilli to perform the study?

Reply: Chilli was used as a test crop because of its popularity among the farming community of the region and its daily use in every kitchen.

Specific Comments: 1) Page 1840, line 9: Correct soil type named as sandy loam, according to Table 1 is loam.

Reply: The soil type is loam according to the data presented in Table 1. Correction has been made as suggested on Page 1 Line 11.

2) Please correct the pH value in Table 1 according to Table 2.

Reply: The pH value has been corrected as mentioned in Table 2.

3) Please correct the phosphorus value of Table 1 with the data of Table o 3 of the soil incubation test.

Reply: Corrected as suggested

4) Page 1844 Materials and Methods section 2.1 line 10, having discussion on complexation with iron and aluminum and this binding occurs more in acidic soils, that is not the case of soil in this study.

Reply: From the discussion section sub-section "P release capacity of added amendments" the explanation of iron and aluminum and this binding effects under acidic soils have been deleted as suggested. However, in the introduction section, the reasons for Low P availability has been discussed where under both acid and alkaline conditions have been discussed which is fine.

Page

5) Please name treatments T₀... T₁₁ in the tables as named in figure 1.

Reply: In Figures T₀, T₁ –T₁₁ is written so these symbols have been explained while in the Tables Treatments names have been fully written. Therefore, there is no need to further explanation in the Tables.

In addition to above amendments, the manuscript has fully been reviewed and the English language of the draft has been improved by a native English scientists cited in the Reference section i.e. G. S. Toor, Soil and Water Quality Laboratory, Gulf Coast Research and Education Center, University of Florida–Insitute of Food and Agricultural Sciences, 14625 C.R. 672, Wimauma, FL, USA.

Hopefully the manuscript will now be accepted for publication

Regards

Prof. M. Kaleem Abbasi