Short Communication

Phosphate Solubilization by *Alcaligenes faecalis* over *Pseudomonas fluorescens*

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ABSTRACT

Phosphate is the key macronutrient required for the growth of plant. The soluble forms of phosphorus when applied to soil are rendered insoluble by undergoing chemical fixation. The soil collected from selected area of Dehradun valley, Uttarakhand, was investigated for screening the phosphate solubilizing microorganisms. In the present study, soil sample prepared by collecting from wheat rhizosphere, from selected sites of Doon valley, were screened. The two dominant genera were isolated and studied. Their phosphate solubilizing ability was screened by halozone test on solid agar plate after the incubation at 28 ± 2 °C. Their observations were recorded till 21 days. The bacteria identified were *Alcaligenes faecalis* and *Pseudomonas fluorescens* SSC. The microbes showed the formation of clear zone around their colony on agar plate. Thus, it was observed that both the PSMs have the ability to reduce the phosphate unavailability by making it available to plants and can be used as biofertilizer in soil because these microorganisms neutralizes the soil and releases acid in minute quantity during phosphate solubilization. Also, it is found that *A. faecalis* can also solubilizes phosphate, though it solubilizes less as compared to *P. fluorescens* SSC.

Keywords: Phosphorus; phosphate-solubilizing microorganisms (PSM); *P. fluorescens*; *A. faecalis*

INTRODUCTION

Phosphate is referred as ‘master key’ element in crop production (Saxena and Sharma, 2003). The soluble forms of phosphorus, when applied to soil as phosphatic fertilizers, are rendered insoluble by undergoing chemical fixation.

The poor availability of the nutrient may influence plant quality and yield. The availability of phosphate element to plant depends mainly on the concentration of the inorganic forms (orthophosphates, H$_2$PO$_4^-$ and HPO$_4^{2-}$ ions) in the soil and it is about 0.2% of the plant dry weight (Schachtman, 2005). Therefore, the maintenance of a suitable P concentration in soil solution is very essential for increasing the production of agricultural crops.

Generally, *Pseudomonas*, *Flavobacterium*, *Alcaligenes* and *Agrobacterium*, the short gram-negative rods represents significant part of the bacteria associated with the rhizosphere (Rodriguez, 1999). Their number increases significantly upto 5 to 20 fold in rhizosphere when compared in soil outside of the rhizosphere. These organisms propagate very quickly, and are able to use amino-acids and water-soluble sugars and are resistant to some antibiotics. Thus, to circumvent P deficiency, PSMs could be exploited as biofertilizer to increase the availability of accumulated phosphates in an environmental-friendly and sustainable manner. The current study reveals the capacity of isolates from Doon valley in solubilizing phosphate.

MATERIAL AND METHOD

Soil sampling: The soil samples were collected from the rhizosphere of Wheat (*Triticum aestivum*) plants, from four different selected sites – Raipur, Doiwala, Majra and Sahaspur located in different locations of Dehradun, Uttarakhand. A compound sample of soil also prepared...
Table 1. Richness of bacterial fauna in different soil sample types collected from Dehradun valley.

<table>
<thead>
<tr>
<th>Sample Site</th>
<th>10³</th>
<th>10⁴</th>
<th>10⁵</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raipur</td>
<td>1.7</td>
<td>2.0</td>
<td>1.3</td>
</tr>
<tr>
<td>Doiwala</td>
<td>1.0</td>
<td>1.0</td>
<td>1.2</td>
</tr>
<tr>
<td>Majra</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Sahaspur</td>
<td>1.3</td>
<td>1.7</td>
<td>1.2</td>
</tr>
</tbody>
</table>

Figure 1. Comparison of slide presenting the halozone formed by (A) Alcaligene faecalis and (B) P. fluorescens SSC on media plate at 21 days after incubation.

Isolation and Identification of PSM: Bacterial strains were isolated from the soil by serial dilution and plating on Nutrient agar and Pikovskaya’s agar media (Pikovskaya, 1948), respectively. Media plates were observed for microbial growth. Further, the dominant genera screened from compound sample were isolated and identified by studying morphological characteristics such as gram staining, shape, spores and motility (Aneja, 2007). Final identification was done at IMT, Chandigarh.

Efficiency study: Phosphate solubilizing efficiency study was carried out by performing an experiment of halozone formation around the bacterial colony when incubated for 7, 14 and 21 days at 28°C on Pikovskaya’s agar media. The bacteria that possesses the ability to solubilize phosphate forms a clear zone around them. The diameter of zone will be observed at periodic intervals (Arora, 1979).

RESULTS AND DISCUSSION

In the present study, soil samples of 4 different sites of Dehradun valley, were used individually to determine the microbial count. During screening, each sample shows the presence of rich microbial fauna but the soil sample of Raipur favours richest bacterial count as shown in Table 1. The dominant genera identified were Alcaligene faecalis and P. fluorescens SSC by IMT, Chandigarh. The halozone formation test revealed that both bacteria’s have the ability to solubilize phosphate and can behave as PSM (Figure 1). The diameter of zone of phosphate solubilization on 7th, 14th and 21st day by Alcaligene faecalis and P. fluorescens SSC is presented in Figure 2.

Observation revealed that diameter of zone of phosphate solubilization was bigger during first 1-15 days as compared to last 15-21 days. The comparative study in the figure 2 revealed that P. fluorescens SSC is a better phosphate solubilizer (Anand, 2007) as compared to A. faecalis. Similar results were earlier observed (Rajankar et al., 2007) with bacteria and fungi. Thus, it is found that A. faecalis though considered as pathogen, also solubilizes phosphate, yet its solubilizing ability is less as compared to P. fluorescens SSC. Hence, there is a further need to develop and explore the strains of bacteria to act as phosphate fertilizer because their application as biofertilizer would be helpful in mineralization of unavailable phosphate in soil by neutralization phenomenon by releasing acid in minute quantity (Subba Rao, 1982).
Figure 2. Efficiency of Phosphate Solubilization shown by halozone diameter (in mm) by *Alcaligene faecalis* and *P. fluorescens* SSC at constant intervals.

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REFERENCE


