Phosphate solubilizing bacteria enhance barley plant growth and phosphate uptake

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INTRODUCTION

Phosphorus (P) deficiency is a common phenomenon in agricultural soils worldwide, thus most of the farmers regularly use chemical P fertilizers which get incorporated into the soil to avoid P limiting conditions in cropping systems. This applied P usually precipitates after their application by the formation of complex non-bioavailable compounds, whether in acid or alkaline soils. The use of P-Solubilizing Bacteria (PSB) as biofertilizers is a sustainable and inexpensive biotechnological strategy.

Taking this into account the objectives of this approach were:

- Isolate and characterize new putative PSB from oats rhizosphere;
- evaluate plant growth promotion of PSB on barley plant comparing to Arbuscular Mycorrhizal Fungi (AMF) under greenhouse conditions.

Table1: Evaluation of phosphate solubilizing ability on PVK plates cultures

Isolate	Colony diameter (mm)	halo zone diameter (mm)	PSI	PSE(%)
MS1B15	0.8	0.6	1.75	75.00
MS2B19	0.9	0.5	1.56	55.56
MS1B11	1.2	0.2	1.17	16.67
MS1B4	0.6	0.3	1.67	66.67
MS1B13	0.8	0.5	1.63	62.50

PSI: Phosphate solubilizing index
PSE: Phosphate solubilizing efficiency

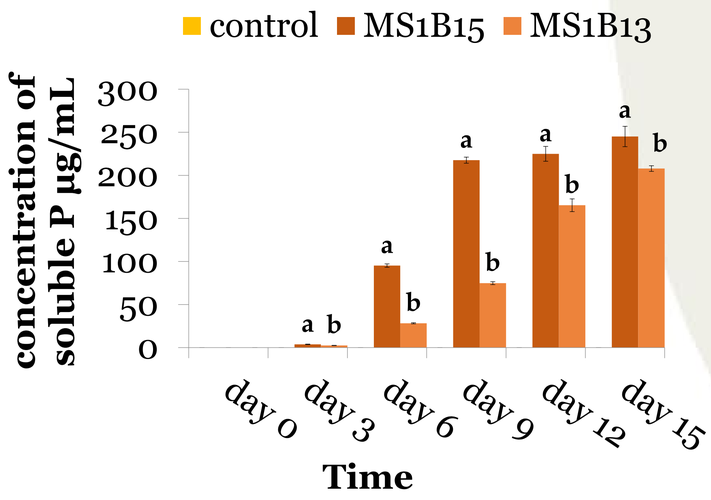
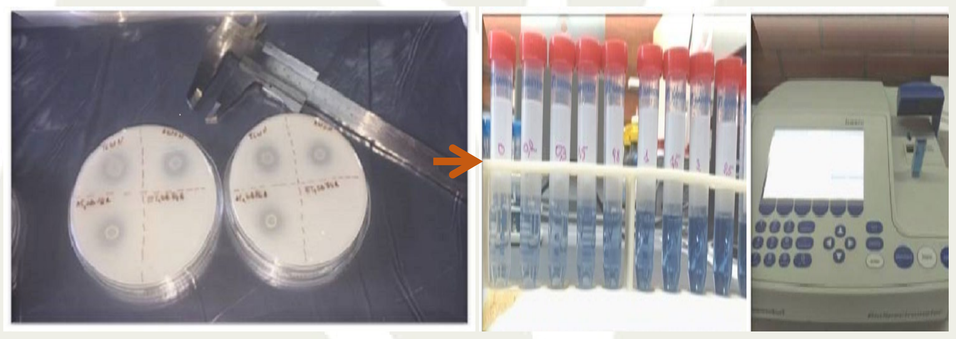


Fig.1 Phosphate solubilizing activity of MS1B15 and MS1B13 isolates during 15 days of incubation.

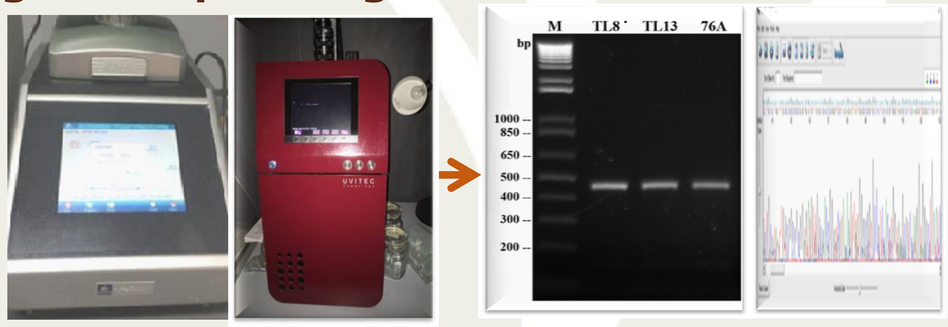
MATERIALS AND METHODS

1. Isolation of bacterial strains from oats rhizosphere

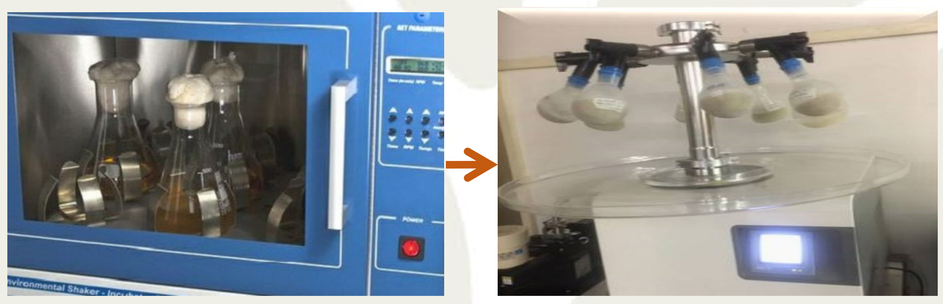
2. Screening of P-solubilizing activity on Pikovskaya's medium



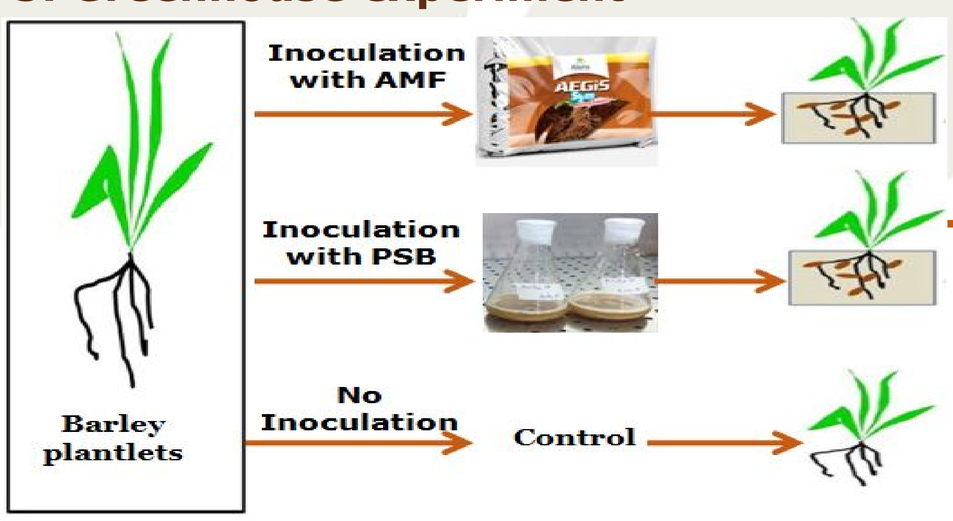
3. Molecular identification by 16S rRNA gene sequencing



4. Production of inoculum



5. Greenhouse experiment



6. Data collection and analysis

RESULTS

Sixteen bacterial strains were isolated in this study from oats rhizosphere, out of them, 31.3 % were able to solubilize the P showing a clear halo zone around the colony. Maximum PSI was observed by the strain MS1B15 (PSI > 1.75) followed by MS1B13 (PSI > 1.63) (Table 1).

Under liquid assay, the strains MS1B15 and MS1B13 showed positive P-solubilizing efficiency ranging from 207.92±3.28 mg/l to 245.6±11.82 mg/l respectively (Figure 2). Maximum P solubilization was observed by MS1B15 which is consistent with the highest PSI.

Moreover, the two selected bacterial strain were further characterized by applying molecular analysis. According to the sequence of the 16S rRNA gene, the two isolates belong to *Streptomyces* genus.

Hence we tested the ability of the strain MS1B15 to enhance barley growth and P availability comparing to AMF and un-inoculated control. The results showed a significant increase in most of the variables measured in this study when the seeds were inoculated with the selected PSB compared to the un-inoculated plants.

Overall results showed that the selected bacterial strains possess a high P-solubilization activity and therefore, they could represent potential candidates for sustainable agricultural practice to enhance organic farming with minimal chemical inputs. Production and utilization of a biofertilizer formulation with these rhizobacterial strains in agricultural fields could increase P availability and improve plant growth as well as its productivity.