Phosphate solubilisation and gluconic acid production by endophytic bacterial strains and ability to promote plant growth in oil seed rape (*Brassica napus*)

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ABSTRACT

Phosphate solubilising bacteria (PSB) are able to convert insoluble phosphate into soluble forms and have been used to enhance the solubilisation of otherwise insoluble soil phosphate for plant growth promotion. Several studies have shown that the release of low molecular weight organic acids is a major mechanism for solubilising insoluble phosphate. In this study the production of gluconic acid during inorganic phosphate solubilisation in conjunction with liberation of soluble phosphate and the influence on plant growth as a function of phosphate solubilisation by endophytic strains was analysed. Solubilisation of $Ca_3(PO_4)_2$ in National Botanical Research Institute's Phosphate (NBRIP) growth medium varied among the endophytes with strain L132 recording the highest P-liberated (1109.33 µg/ml) followed by L228 (*Pseudomonas* sp) (912.00 µg/ml) while *Escharachia coli* JM109 used as a negative control had below detection limit. In all cases, the final supernatant had a significant pH decrease with L228 recording the highest decrease, 2.74 units (6.08 – 4.06 pH) compared to M109 that had 0.75 units (6.08 – 6.05 pH). High Performance Liquid Chromatography (HPLC) analysis of the culture filtrate to quantify gluconic acid produced by the strains showed that L321 (*Pseudomonas sp*) produced the highes gluconic acid level (33.21±2.34 mg/ml) followed by L132 (31.46±3.71 mg/ml) and these were significantly different from the rest of the strains. The results suggest that acidification was the main strategy for solubilising phosphate. In this study, a clear relationship was observed between supernatant acidification and P solubilisation from $Ca_3(PO_4)_2$. However, no significant difference was observed for key growth parameters in oil seed rape (OSR) between PSB treatments and uninoculated control treatments. More research is needed to investigate the performance and use phosphate solubilising bacteria as bacterial inoculants particularly in field experiments. The result of this study indicates in planta expression of P solubilisation traits may be more complex than those *in vitro* studies. Thus future research should investigate the stability and performance of the phosphate solubilising traits once the bacteria has been inoculated.

Keywords: Phosphate solubilisation, gluconic acid production, promote plant growth, endophytic bacterial strains, oil seed rape