

Enhanced immune responses induced by endophytic bacterial strains in Indian mustard against stem rot disease

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The growing dependence on chemical fungicide for managing plant diseases has raised serious concerns due to their harmful impacts on human health and environment, creating an urgent need to explore safe, eco-friendly biocontrol alternatives. The present study evaluated the potential of bacterial endophytes viz., *Pseudomonas aeruginosa* (Accession no. OL413676) and *Serratia proteamaculans* (Accession no. OP595540) applied individually and as a consortium for managing *Sclerotinia sclerotiorum*, causal agent of stem rot in mustard through field-based pot experiments. The study further explored the role of these bacterial endophytes in boosting the defense responses through the activation of defense-responsive enzymes and metabolites. The results revealed that the dual application (seed treatment and foliar spray) of the bacterial consortium (T12) significantly boosted the activity of antioxidative and lytic enzymes compared to the fungal pathogen-inoculated control plants (T2). While most of the defense enzymes showed maximum induction at 120 hours post-inoculation (hpi), phenylalanine ammonia lyase (PAL) displayed its highest activity at 72 hpi, suggesting its potential role in early initiation of plant's defense response. Consistent with the defense enzymes activation, the T12 treatment also resulted in the increased accumulation of total phenols and lignin, showing peak accumulation at 72hpi, with lignin levels remaining elevated thereafter, possibly serving to restrict pathogen colonization. The endophytic consortium reduced the lesion length by 21.47% in PBR 357 and 16.91% in RLC3, suggesting it as an effective biocontrol agent. The findings indicate that these endophytic bacteria have the potential to activate the basal defense responses in Indian mustard, making them promising candidates for the management of *Sclerotinia sclerotiorum*.

Keywords: antioxidative enzymes, consortium, lytic enzymes, *Sclerotinia sclerotiorum*, *Serratia proteamaculans*