Abstract

Food security is a global concern exacerbated by deficiencies in essential micronutrients, impacting human health, especially in low- and middle-income nations. This thesis addresses the prevalent issues of zinc and iron deficiency in Indian soils, focusing on their impact on crop growth, quality, and subsequent human health. A comprehensive exploration of iron and zinc-solubilizing endophytic bacteria as a potential solution for enhancing the nutrient content and bioavailability in finger millet (Eleusine coracana) is presented. The study begins with the isolation and analysis of 112 endophytic bacteria from three finger millet cultivars, selecting six based on their ability to solubilize iron and zinc salts. These isolates were characterized for plant growth-promoting attributes and adaptability to various abiotic stresses.

Two promising isolates, EC3B-22 and EC3B-23, were identified through 16S rRNA gene analysis as *Pseudomonas bijieensis* and *Priestia megaterium*, respectively. In pot experiments, the selected bacterial isolates demonstrated significant positive effects on finger millet growth parameters, including shoot/root dry weight, length, and grain zinc and iron concentrations. *Priestia megaterium* exhibited substantial enhancements in root length and plant height, while both isolates increased grain zinc and iron content compared to uninoculated plants. The study further investigated the mechanisms involved in nutrient solubilization, including the production of organic acids, siderophores, and enzymes by the bacterial endophytes. The findings of this research contribute valuable insights into the potential of bacterial endophytes for enhancing iron and zinc bioavailability in finger millet, addressing deficiencies and improving crop quality. The results suggest that microbiological biofortification can be a promising and sustainable approach to combat zinc/iron-related malnutrition in crops, fostering both agricultural and human health. Future research should focus on developing bacterial-based formulations for widespread agricultural applications and assessing their efficacy in addressing multiple micronutrient deficiencies in edible plant parts.