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Opinion Article

Effect of Rhizosphere Bacteria on Antioxidant Enzymes in Enhancing Plant Development

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DESCRIPTION

Plant development and productivity can be impacted by abiotic stressors like pesticides. A novel method to reduce these adverse effects is to use microbes that encourage plant growth while being herbicide-resistant. the impact of three native plant growth-promoting bacteria isolated from the *Medicago sativa* rhizosphere, including *Serratia rubidaea* (A), *Pseudomonas putida* (B), *Serratia sp*. (C), plus *Synorhizobium meliloti* (R), and their combinations (AB, AC, BC, ABC, AR, BR, CR, ABR, ACR, BCR, and ABCR)

The use of a herbicide reduced plant biomass while increasing microbial population, antioxidant enzyme activities, and hydrogen peroxide and malondialdehyde concentrations in both inoculated and non-inoculated plants. Bacterial injection often boosted plant biomass, microbial population, and antioxidant activity. These increases were more pronounced when herbicides were used. The AB, AR, and ABR inoculums increased these characteristics the most both with and without the herbicide. Under the inoculations BC, CR, BCR, and ABCR, the microbial population, plant biomass, and antioxidant activity all reduced. These bacteria not only promote growth but also improve herbicide stress resistance by limiting free radical-induced oxidative stress and lipid peroxidation through antioxidant enzymes.

High quality and value cow feed, *Medicago sativa L.* (*M. sativa*), is an essential crop rotation crop in sustainable agriculture systems. The most important elements that give this fodder crop a particular position are its high quantitative productivity, low fibre content, high protein content, filled with vitamins and minerals, excellent tolerance against drought and other environmental challenges, etc. Due to *M. sativa* cultivars and environmental factors that reduce output, such as poor soil fertility, disease, the presence of weeds, etc., this crop's ideal productivity is quite diverse. The main strategy for weed and disease control in plants is the use of pesticides. In addition to their negative effects on the environment, such as subterranean water contamination and the eradication of helpful soil microbes, these chemicals' excessive consumption and soil penetration property greatly lower plant yield. Increased reactive oxygen species induce plant damage as a result of herbicide treatment. These substances cause cell membrane damage, lipid peroxidation, and the formation of reactive oxygen.

Due to cell membrane breakdown, the contents of the cell leak out, disrupting particular physiological activities like photosynthesis. Plants turn on their antioxidant defense mechanisms to lessen the harm that reactive oxygen species inflict. Low-weight molecules like ascorbic acid, glutathione, and antioxidant enzymes like Glutathione Peroxidase (GPX), Ascorbate Peroxidase (APX), Catalase (CAT), etc. are all part of this system. Imazethapyr, often referred to as Pursuit, is a selective systemic herbicide that has been used to reduce *M. sativa* weeds and is still in use today. According to studies, *M. sativa* rhizosphere-colonized plant-growth-promoting bacteria increase production under various environmental conditions, particularly under stressful circumstances. By delivering nutrients, secreting hormones that stimulate plant development, and via a variety of other ways, these bacteria aid in plant growth.

Herbicide residues in soil are broken down by bacteria that promote plant development. Herbicides kill weeds and microorganisms, which serve as nutritional carbon and nitrogen sources for other soil microorganisms, allowing them to recuperate and become stronger for the restoration of crop development. Recent research has shown that bacteria that promote plant development have a significant role in plant resistance to environmental challenges, such as the use of herbicides, by activating the antioxidant system. The goal of this study was to investigate the potential of native herbicide-resistant bacteria from *M. sativa* in preventing yield reduction in alfalfa by promoting the activity of antioxidant enzymes under herbicide stress in light of the emphasis placed on biological fertilisers in sustainable agriculture in recent decades. In fact, the majority of research on PGPR has been on how well they can promote growth under normal conditions, with just a few studies focusing on how well they can help plants cope with abiotic challenges.

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