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Thuricin-17: A promising biostimulant in the agricultural sector

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Bacteriocins are ribosomally synthesised antimicrobial peptides that are secreted by a wide range of bacteria to compete with other closely related or unrelated bacterial species. Besides their utilisation in food and pharmaceutical industries, bacteriocins have also displayed their potential for agricultural applications by promoting plant growth and resisting abiotic stresses. Different plant growth-promoting rhizobacteria (PGPR) along with other bacterial strains in the rhizosphere produce bacteriocins that play an important role in the phytomicrobiome (microbial community associated with plants). Bacteriocins act as non-self-propagating suppressive agents. In this field, the most extensively studied bacteriocin is thuricin-17, which is produced by Bacillus thuringiensis NEB17. This is a single small peptide with a molecular weight of 3.16 kDa. It belongs to the bacteriocin subclass-IId which displays both bacteriostatic and bactericidal activities. The possible formation of two disulphide bridges by the four cysteine residues of the peptide makes it stable even at extreme temperatures (up to 100Ã¢â€žÆ') and pH levels (1.0 to 9.2).

Thuricin-17 acts as an effective biostimulant by inhibiting a wide range of bacterial species, resisting abiotic stresses and promoting plant growth. Under salt stress conditions, thuricin-17 has been found to enhance the activation rate of important plant proteins, such as rubisco-oxygenase, pyruvate kinase, PEP-carboxylase, etc. It also increases the levels of indole-3-acetic acid (IAA) and salicylic acid (SA) which ultimately helps in mitigating stressful conditions. In addition, thuricin-17 has shown its ability to induce a plant-defence mechanism against various diseases by enhancing the production of lignification-related enzymes and antioxidative enzymes, such as peroxidase and superoxide dismutase) in soybean plants. It can also act as a pseudo-stress signal by binding to specific receptors on leaf or root tissues to stimulate different metabolic pathways which, in turn, enhances the rate of photosynthesis to compensate for the decreased photosynthesis in the damaged tissues.

Further, under water-stress conditions, thuricin-17 enhances root elongation by increasing abscisic acid (ABA) levels in the roots and leaves, thus improving the water and nutrient uptake. Besides this, the foliar application of the bacteriocin has some beneficial effects, such as enhancing leaf area, leaf greenness, etc. The excessive administration of chemical fertilisers and pesticides in the agricultural sector is negatively affecting human health and the environment. Therefore, extensive research on thuricin-17 and other bacteriocins (derived from PGPR or other bacteria) is required so that these antimicrobial peptides can be utilised as alternatives to chemical fertilisers and pesticides. In the future, the utilisation of bacteriocins as biostimulants can contribute to the better quality and enhanced productivity of crops in the agricultural sector.

Keywords: Thuricin-17, Bacteriocin, Plant growth-promoting rhizobacteria, Biostimulant, Phytomicrobiome, Chemical fertilisers

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