ABSTRACT

Soil health is crucial for ecosystems, but industrial activities, waste, and hazardous chemicals have significantly degraded soil quality, with 35% of global agricultural land affected (Smith et al., 2022). Conventional detection methods, such as laboratory analysis, are expensive and impractical in remote areas. As an alternative, microbial biosensors provide an efficient solution. Bacillus subtilis, a soil microbe, exhibits specific biological responses to pollutants, such as changes in enzyme activity or gene expression, enabling highly sensitive detection of heavy metals (Johnson et al., 2021).

This study aims to identify and utilize soil microbes as biosensors for pollution detection. The research focuses on selecting microbial strains with high sensitivity to specific pollutants and analyzing their response mechanisms. The integration of IoT-based bio-networked sensors allows real-time monitoring, increasing data collection efficiency and reducing costs by up to 40% compared to conventional methods (Gupta et al., 2021).

The experimental method involves collecting soil samples, introducing Bacillus subtilis, and observing biochemical reactions over 24-48 hours. Parameters such as pH changes and soil density variations are analyzed. This innovation presents an environmentally friendly and cost-effective approach to soil pollution monitoring, supporting global environmental conservation efforts.

Keywords: Bacillus subtilis, biosensor, soil pollution, microbial detection, IoT