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ECOLOGICAL INTENSIFICATION OF CEREAL CROP PROTECTION THROUGH SOIL MICROBIOME RESTORATION

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Purpose: This study examined how restoration of beneficial soil microbiomes can strengthen natural plant defence, suppress economically important cereal diseases and improve crop resilience under sustainable production systems. The work explored ecological plant protection approaches that reduce dependence on synthetic fungicides while maintaining productivity under changing climatic conditions.

Materials and Methods: Field experiments were conducted for two seasons using a randomized complete block design. Compost-enriched organic amendments, microbial bioinoculants and disease-tolerant cereal cultivars were integrated across replicated plots. Disease severity, soil enzymatic activity, microbial biomass, grain yield and beneficial rhizosphere organisms were monitored throughout crop development. Data were analysed using analysis of variance to compare ecological treatments with conventional crop protection practices.

Results: Integrated ecological treatments consistently lowered disease incidence, improved soil biological activity and enhanced crop vigour. Beneficial microbial populations increased substantially, while disease severity declined and grain yield improved relative to conventional management. Improved nutrient cycling and healthier root systems contributed to stronger crop establishment and greater tolerance to environmental stress. The ecological strategy also reduced chemical input requirements and supported biodiversity conservation within the production system.

Conclusions: Restoration of functional soil microbiomes provides a practical pathway for future plant protection programmes by combining biological resilience, environmental sustainability and stable cereal productivity. Integrating microbial technologies with resistant cultivars offers significant achievements and perspectives for sustainable crop protection.

Keywords: Soil microbiome; Biological control; Cereal protection; Sustainable agriculture; Disease management

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