Synergistic effects of microbial inoculants and bioinsecticides on maize resilience under climate induced abiotic and biotic stress

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INTRODUCTION & AIM

The global stability of maize (*Zea mays L.*) production is currently under severe pressure due to the escalating climate crisis, which manifests through increasingly complex environmental stressors. In regions such as Eastern Europe, agricultural systems face a critical synchronization of prolonged heatwaves and peak activity periods for devastating pests, specifically the Western Corn Rootworm (*Diabrotica virgifera virgifera*) and the Corn Borer (*Ostrinia nubilalis*), leading to catastrophic yield losses. This study aims to evaluate a holistic transition from conventional synthetic chemical inputs toward climate-resilient biological strategies. The primary objective is to investigate how reinforcing a plant's natural defenses and optimizing soil-root interactions can stabilize production in a warming world.

METHOD

This research employs a systematic review and meta-synthesis of recent longitudinal field data to evaluate the efficacy of microbial biostimulants, such as Bacillus spp. and Arbuscular Mycorrhizal Fungi (AMF), in enhancing maize water-use efficiency and root architecture under moderate drought stress. Furthermore, the study analyzes the integration of entomopathogenic fungi as a targeted biological defense against soil-borne larvae like *Diabrotica virgifera virgifera*, assessing their potential to reduce chemical pesticide dependence by 30% within modern Integrated Pest Management (IPM) frameworks.

RESULTS & DISCUSSION

The synthesis of field data demonstrates that the integration of microbial inoculants and bioinsecticides produces a significant synergistic effect on plant health. Findings indicate that these biological agents can successfully reduce dependence on chemical pesticides by up to 30% without sacrificing productivity.

Figure 1. A first instar western corn rootworm larva (*Diabrotica virgifera virgifera*) attacking a maize root. Picture credit: Matthias Held. Source: Lu et al. (2016), "A conserved pattern in plant-mediated interactions between herbivores".

Under conditions of moderate drought stress, the treated maize crops maintained competitive yields, suggesting that the improved root architecture and enhanced physiological resilience provided by the inoculants effectively mitigate abiotic pressure. This research highlights that the combination of biostimulants and biopesticides creates a robust defense matrix that is more adaptable to the dynamic agricultural landscape of the 2020s than traditional monoculture treatments.

CONCLUSION

This study concludes that fostering synergistic interactions between microbial inoculants and bioinsecticides is a vital strategy for securing maize yields against the dual threats of climate change and pest pressure. By prioritizing the plant's intrinsic defense mechanisms and soil-root health, farmers can achieve sustainable stabilization of production. These findings provide actionable insights for the development of next-generation IPM programs that are specifically tailored to the environmental realities of the current decade.

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