

Zein-Based Nanoparticles for the Delivery of Bioinsecticides in Sustainable Crop Pest Control

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To limit the use of pesticides and to develop strategies for controlling plant pests and pathogens, researchers have identified some bioactive molecules by exploiting insect-natural antagonist interactions as source of bioinsecticide molecules. These include a dsRNA that silences an immune gene in the chewing insect *Spodoptera littoralis* and peptides derived from parasitoids with neurotoxic effects on caterpillars.

Due to their high sensitivity to environmental degradation, these bioactive molecules must be protected by sustainable and eco-compatible formulations for effective field application. Such formulations should promote bioactive molecules' accumulation into plant tissues and guarantee their delivery into the target insect without compromising their bioinsecticide activity.

Here, we present the characterization of zein-based nanoparticles (NPs) using tomato plants as a model crop.

By using a multidisciplinary approach that integrates microscopy techniques, physiological and molecular analysis, we demonstrate that:

- NPs rapidly penetrate tomato leaves, localize within the apoplast, and do not alter plant physiological parameters up to one week post-delivery by foliar spraying;
- NPs require approximately four hours to transit through the larval gut;
- NPs remain stable under acidic conditions, such as the one of leaf apoplast, but become rapidly unstable under alkaline pHs resembling those of *S. littoralis* larval midgut;
- NPs do not impact the viability of model organisms such as earthworms, zebrafish or human skin and lung epidermal cell lines, thus being fully eco-compatible