Optimizing Nematode Efficiency for Precision Pest Biocontrol via Conditional Training and Formulation for Enhanced Endurance

Kongkatitham, Paphawin (School: Bangkok Christian College)
Benjarattananon, Burich (School: Bangkok Christian College)

This study aimed to enhance the efficiency of the biocontrol agent Steinernema carpocapsae, making it superior to chemical pesticides by increasing its speed in targeting pests and improving its resistance to physical factors, which were limitations in using nematodes. S. carpocapsae is a widely used and effective biocontrol agent that serves as an alternative to chemical pesticides while also being environmentally friendly. This research enhanced the efficiency of Steinernema carpocapsae by improving its resistance to UV radiation, humidity, and temperature using hydrocolloids with 0.2% Konjac strengthen mortality rate by 2.3, 1.8 and 1.3 folds, respectively. While combining the nematodes with Bacillus thuringiensis var. aizawai improved their efficiency by 1.7 folds. The researchers also observed that using different parts of the pests could stimulate nematodes to move toward pests. Pest feces were the most effective. Therefore, the researchers conducted a study using pest feces as a chemical cue to train nematodes to elevate their host foraging behavior from an ambush forager to a cruise forager. Experimental results showed that this approach increased their speed toward pests by 5.8 folds. When experimented on Spodoptera spp., Amsacta spp. and Tenebrio molitor, the trained nematodes, combined with Konjac and B. thuringiensis, achieved 89% mortality rate. Field trials in four locations showed that pest damage on leaves decreased by 15, 7.5, 14.2 and 6.3 folds, respectively. Our study found that feces-trained Steinernema carpocapsae with Konjac, Bacillus thuringiensis var. aizawai, and an integrated spraying system enhanced nematode efficiency, resilience, and eco-friendliness. This innovation reduces pesticide use, lowers health costs, and supports sustainability.

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