An Automated Multimodal-Stimuli Integrated Trichogramma Rearing and Release Innovation With Artificial Oviposition-Targeted Eggs to Optimize Pest Parasitization

Termtrirakij, Ratchanut (School: Bangkok Christian College)

Global warming has become a major problem for organic agriculture, as changes in environmental conditions reduce the parasitization rate of Trichogramma, limiting the use and mass rearing of parasitoids. Additionally, pesticide use causes pest resurgence, in which pesticides eliminate parasitoids and pests develop resistance, leading to severe pest outbreaks. To address these problems, parasitoid oviposition behavior was studied to develop artificial host eggs to lower rearing costs, and physical factors were optimized to attract oviposition. Antioxidants were investigated to enhance parasitoid tolerance when used with pesticides, and diet supplementation was examined to increase female parasitoids. The results showed that studies of host recognition, location, and examination behaviors enabled the development of an artificial eggshell, an oviposition attractant, and a synthetic hemolymph with efficiency comparable to real eggs, while reducing rearing costs up to 200-fold. Specific physical factors led to a 5-fold increase in parasitization rate, while antioxidants improved parasitoid tolerance to pesticides and diet supplementation increased Trichogramma female progeny, thereby accelerating population growth and pest parasitization. Combining all results, an innovation using physical factors to attract oviposition and artificial host eggs for rearing Trichogramma was developed. This innovative device can continuously release and attract parasitoids in field experiment, forming an automated cycle in subsequent generations, optimizing parasitization, and remarkably reducing crop damage while increasing crop yield. Thus, this study proposes a sustainable and effective approach that overcomes the limitations of organic agriculture under global warming and pest resurgence.

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