

## Combination of *Bacillus thuringiensis* and *Habrobracon hebetor* for the biological control of *Plodia interpunctella*

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### Abstract

In this paper, we review our work on biological control of *Plodia interpunctella* (Hubner) (Zhang et al., 1995) in our laboratory over the years. We isolated, screened and evaluated *Bacillus thuringiensis* strains collected from warehouses against *P. interpunctella* and determined the lethal concentration for 50% of the population (LC<sub>50</sub>) of highly toxic isolates and compositions of crystal proteins and the genotypes of these isolates; evaluated the role of host-instar and refuge on the parasitization behavior of *Habrobracon hebetor* Say (Hymenoptera: Braconidae); investigated the effect of combining *B. thuringiensis* with *H. hebetor* for management of *P. interpunctella* infestation and assessed the influence of *B. thuringiensis* on *H. hebetor* during this combination treatment. The results showed that three strains of *B. thuringiensis* (IMM130, IMM368 and IMM408) were highly toxic to *P. interpunctella* among 122 *B. thuringiensis* isolates obtained from 413 field samples (Zhang et al., 2000a); Isolate IMM408 with LC<sub>50</sub> 1.24 µg/g diet, was most potent (Akinkulere et al., 2007). It belongs to H<sub>7</sub> serotype and contains ~135kDa crystal proteins and *cry1Ab9*, *cry1Ca1*, *cry1Da1* and *cry2* genotypes (Zhang et al., 2000b). It was observed that *H. hebetor* could parasitize all larval stages of *P. interpunctella*, but significantly fewer first and second instars were parasitized under choice and no-choice conditions (Akinkulere et al., 2009a). Parasitized fourth instars were more profitable to *H. hebetor* irrespective of refuge or choice factors, as significantly more adult parasitoids emerged from host instars. Therefore, *H. hebetor* females consistently showed high preference for late instars of *P. interpunctella* when they were offered a choice between early and late host instars. Refuge significantly hindered *H. hebetor* from locating the early instars, but not the late instars (Akinkulere et al., 2009a). *Bacillus thuringiensis*-parasitoid combination treatment significantly evoked more *P. interpunctella* mortality than either treatments (*B. thuringiensis* or parasitoid) when used singly (Akinkulere et al., 2009b). *Bacillus thuringiensis* or *H. hebetor* alone caused 42% and 35% *P. interpunctella* larval mortality, respectively. The *B. thuringiensis*-parasitoid combination treatment significantly evoked more *P. interpunctella* mortality (86%) than other single treatments. Progeny development of parasitoid wasp was dependent upon its susceptibility to *B. thuringiensis* contaminated hosts. *H. hebetor* was able to successfully complete its development on the hosts although, fewer wasps emerged from *B. thuringiensis*-parasitoid combined treatment than in none *B. thuringiensis* treatments (Akinkulere et al., 2009b). *H. hebetor* showed positive response to acetone and hexane extracts from frass and larvae of *P. interpunctella*, and the active compounds are mostly hydrocarbons (unpublished data).

Keywords: *Bacillus thuringiensis*, *Habrobracon hebetor*, *Plodia interpunctella*, Pest management, Parasitoid.

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