# Contributions toward the integrated pest management of diamondback moth, *Plutella xylostella* (L.), on collards in Virginia

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## Abstract

Diamondback moth, *Plutella xylostella* (L.) (Lepidoptera: Plutellidae) is a serious pest of crucifer vegetables (*Brassica* sp.) worldwide because of a lack of effective natural enemies in certain regions and because of insecticide resistance. In 2003, laboratory and field studies were initiated in Virginia to better understand *P. xylostella*, its primary natural enemies, and their susceptibilities to insecticides in order to develop an economically and environmentally sound integrated pest management program for collards in the state. Ecological life table studies of *P. xylostella* immature stages on collards located on the Eastern Shore and on Kentland Farm, near Blacksburg at the New River Valley, VA revealed that most (98 to 99%) of *P. xylostella* died from natural causes. Mortality factors varied between the two regions. Neonates, small larvae, and large larvae disappearing were major mortality factors. Rainfall, predation, and dispersal probably contributed the most to this mortality. Egg mortality played a bigger role at the New River Valley compared with the Eastern Shore. Three parasitoid species were found that contributed to the mortality of *P. xylostella*: *Diadegma insulare* (Cresson) (Hymenoptera: Ichneumonidae); *Oomyzus sokolowskii* (Kurdjumov) (Hymenoptera: Eulophidae); and *Microplitis plutellae* (Muesebeck) (Hymenoptera: Braconidae). Additional studies conducted in the laboratory using leaf-dip bioassays revealed that *P. xylostella* collected from the Eastern Shore of Virginia, showed significant tolerance levels to esfenvalerate, acetamiprid, methomyl, methoxyfenozide, indoxacarb, and acephate compared with a susceptible strain of *P. xylostella*. The highest tolerance ratio (1,876 fold) was to esfenvalerate, a commonly-used pyrethroid. All of the insecticides tested in this

study were quite toxic to the adult stage of the parasitoids, *D. insulare* and *O. sokolowskii.* The insect growth regulator, methoxyfenozide was considerably less toxic than other insecticides such as esfenvalerate, methomyl, acephate, spinosad, indoxacarb, and emamectin benzoate at field-rate and 1% of field-rate concentrations. The aforementioned insecticides as well as some other insecticides were evaluated several times in the field for efficacy against *P. xylostella* as well as other pests of collards. The most efficacious insecticides over five field experiments included acephate, emamectin benzoate, esfenvalerate, methomyl, methoxyfenozide, novaluron, indoxacarb, and spinosad. These insecticides were followed in relative efficacy by *Bt kurstaki*, acetamiprid, and azadirachtin, which provided relatively inconsistent control of lepidopteran larvae over the experiments. Effective insecticide options in collards that are less toxic to natural enemies and that can fit well into integrated pest management programs include indoxacarb, spinosad, novaluron, emamectin benzoate, methoxyfenozide, and *Bacillus thuringiensis* subsp. *kurstaki*.

# Dedication

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