

## ***Bt*: A Foundation for Insecticide Resistance Management**

*A survey of field populations reveals that some “new chemistry” insecticides may not be so new from the pest’s perspective. After a half century of commercial use, Bt still has something to show the “new kids”.*

An unusually severe infestation of diamondback moth in California in 1997 prompted entomologists to examine insecticide resistance patterns in field populations as a possible explanation of this pest outbreak. They collected larvae from broccoli fields in the Central Coast and Imperial Valley to test for susceptibility to insecticides representing different classes and modes of action. Some had already seen extensive commercial use up to 1997: methomyl (Lannate®, a carbamate), the synthetic pyrethroid permethrin (Pounce®), and the microbial insecticide *Bacillus thuringiensis* subspecies *kurstaki* (Javelin®). They also tested some newer insecticides, including two derived from microbial metabolites but not yet commercially available in 1997: emamectin benzoate (Proclaim®) and spinosad (Success®). Bioassays were conducted to determine the susceptibility of each field population to each insecticide, using the response of a laboratory colony not previously exposed to any of the insecticides as a benchmark.

Not surprisingly, field populations from the Central Coast, where year-round cole crop production results in more insecticide applications, were more tolerant of permethrin and methomyl compared to field populations from the Imperial Valley, where cole crops are typically grown for only 3 – 4 months each year. This was especially pronounced for permethrin, with coastal populations 100 – 200 times more tolerant than either Imperial Valley populations or the susceptible laboratory strain.

The surprise came when the investigators began to examine correlations between responses to older and newer insecticides (see the accompanying graph). All of the field populations that were resistant to permethrin were also highly tolerant of spinosad. Methomyl-tolerant field populations were also more tolerant of both spinosad and emamectin benzoate. These correlations were unexpected because the target sites (i.e. mode of action) for these insecticides are not the same.

The clear implication from these results is that new insecticide chemistries may already be at risk of cross-resistance, even before they become widely adopted. Resistance to older products may predispose pest populations to develop resistance even to supposedly novel modes of action soon after their introduction, accelerating the “pesticide treadmill.”

*(continued on reverse)*

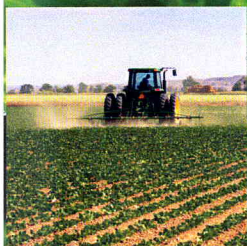
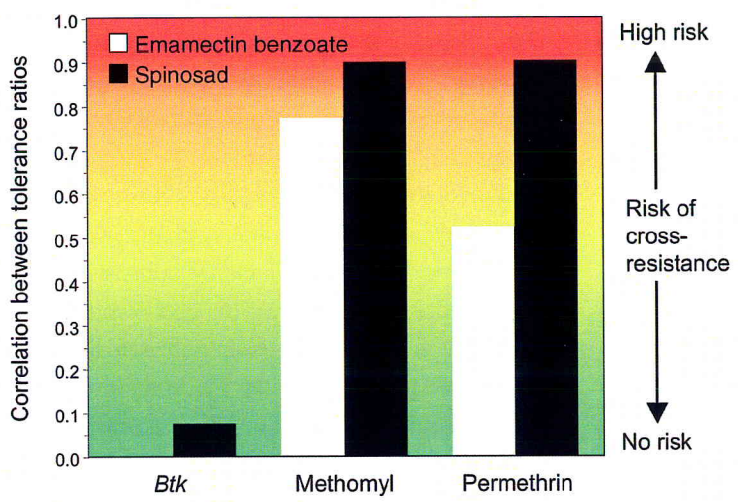


Photo courtesy of the Canola Council of Canada

*Late stage larva of the diamondback moth (*Plutella xylostella*), a common pest of cole crops worldwide.*



*Bt* stands out as the only “older” insecticide in this study that did not raise a concern about cross-resistance. There was no correlation between a field population’s tolerance to a chemical insecticide and its response to *Bt*. As far as these diamondback moth populations were concerned, *Bt* was the only truly unique mode of action in this study. Through a half century of commercial use *Bt* has proven to be a valuable tool for IPM, providing effective crop protection without harmful residues or other impacts. This study now makes it clear that by breaking the threat of cross-resistance, *Bt* also can serve as a foundation product for insecticide resistance management programs as well.



Relationship between tolerance to older insecticides (Btk, methomyl, permethrin) and new insecticides (emamectin benzoate, spinosad) in diamondback moth populations from California broccoli fields. A high correlation (approaching 1) is evidence that a population that has developed resistance to the older insecticide is likely already to be cross-resistant to the new insecticide even before commercial introduction, despite different modes of action.

**Reference:** Shelton, A. M., F.V. Sances, J. Hawley, J. D. Tang, M. Boune, D. Jungers, H. L. Collins, and J. Farias. 2000. Assessment of insecticide resistance after the outbreak of diamondback moth (Lepidoptera: Plutellidae) in California in 1997. *Journal of Economic Entomology* 93(3): 931-936.

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