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On-Farm Components of Diamondback Moth Management in Georgia, USA

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Abstract

All too often researchers, farmers and other agricultural consultants overlook the basic principles of on-farm insect management when faced with an insecticide-resistant insect. Although theoretical principles may not always apply when working with farmers, it is important that the researcher/educator becomes the solution to the crisis and not part of the problem. High levels of resistance have been documented in Georgia through the recent National Diamondback Project conducted at Cornell University, New York. Even though very few insecticides currently registered for cabbage or other leafy greens are effective against diamondback moth, *Plutella xylostella* (L.), they can be controlled in cabbage on Georgia farms. On-farm management has become difficult, but we have had continued success using various formulations of *Bacillus thuringiensis* Berliner occasionally tank-mixed with mevinphos, the only organophosphorus compound that continues to perform adequately. We have consistently been able to produce 85% or greater marketable cabbage where these compounds have been used in concert with the following components: use of specially designed high pressure/high volume application equipment; the early, close-interval applications of *B. thuringiensis* with adequate spreader/sticker agents; use of mevinphos only as-needed when diamondback moth populations begin to increase past *B. thuringiensis* sprays; avoidance of the use of insecticides that have proven to antagonize efforts to control diamondback moth. The successful use of these strategies and others have not eliminated the resistance problem, but rather has given us more time to develop other resistance management strategies.

Introduction

The diamondback moth (DBM), *Plutella xylostella* (Lepidoptera:Yponomeutidae), is the single most destructive pest of cabbage and leafy greens in Georgia. Georgia farmers grow 10,000-12,000 ha of turnips, mustard, kale, collards, cabbage and broccoli. In 1989 the economic losses to DBM were about US$16.4 million. Of this, US$2.8 million was spent on cost of control with over US$13.5 million lost in quality and yield (Douce and McPherson 1990). The average farmer in Georgia makes 10 applications of insecticides on DBM-infested crops per growing season. Farmers can produce 2-3 crops/year. Control of DBM on Georgia farms is difficult and many growers lose entire fields and others have poor sales because of quality reductions. However, there are farmers who consistently produce high yields of quality cabbage. The causes of our DBM problems in Georgia and its management principles are discussed below.

Origin of DBM Problem

Georgia's problems begin with the planting of transplants that are often infested with various life stages of DBM. The transplants may have been grown in Georgia or purchased from areas

of the U.S. that are known to have DBM strains with high levels of resistance to insecticides. Also for the last several years, production levels have escalated to meet market demands. This has resulted in growing DBM-attractive crops year-round, thus the DBM problem has been exacerbated through the provision of a continuous high quality food source for DBM and other pests. DBM attacks all types of leafy greens and cole crops during any part of the growing season. The most severe infestations occur from April through October. During this period temperatures range from 21°C at night to 38°C in the day. The potential for 'explosive' population growth is apparent. Since some varieties of cabbage and leafy greens are grown year-round and winter temperatures are mild, DBM populations are present continually.

Insecticide Resistance

High levels of resistance have been documented in Georgia through the recent National Diamondback Project conducted at Cornell University, New York. DBM resistance has been documented for the major insecticide classes: carbamates, organophosphorus and pyrethroids. Populations of DBM from the Tifton area have shown a 180-fold level of resistance to methomyl, a 26-fold level to methamidophos and a 79-fold level to permethrin. And, although very few insecticides currently registered for cabbage or other leafy greens are effective against DBM, they can be controlled in cabbage on Georgia farms.

On-farm Management

On-farm management has become difficult but, we have had good success using various formulations of *Bacillus thuringiensis* Berliner occasionally tank-mixed with mevinphos, the only organophosphorus insecticide that continues to perform adequately. We have consistently been able to produce 85% or greater marketable cabbage where these compounds have been used in concert with the following components: spray delivery systems designed for high pressure/high volume application; early, close-interval applications of *B. thuringiensis* with adequate spreader/sticker agents; use of mevinphos only as-needed when DBM populations begin to increase above marketable thresholds; avoidance of the use of insecticides that have proven to antagonize efforts to control DBM.

Spray coverage of the target is always important for good-to-excellent insect control but, as pests become more tolerant of insecticides, coverage becomes even more important. Sprayers designed to deliver 935 l of water/ha at about 14-28 kg/cm^2 give the greatest practical coverage in our system. Nozzle arrangements vary from sprayer to sprayer but, several drop nozzles arranged at various angles give good results. Broadcast setups perform poorly in general. Delivery speeds should not exceed 6.4 km/hour and boom height should be about 30.5 cm above the crop canopy.

Applications of *B. thuringiensis* should be made every 5 days unless populations are low in the general area. Even then, in Georgia cabbage looper, *Trichoplusia ni* (Hübner), may become the primary pest and frequent applications of *B. thuringiensis* will suppress loopers to an acceptable level. Although field resistance to *B. thuringiensis* in DBM has been shown in other parts of the world (Tabashnik et al. 1990), it has not been documented or observed in Georgia. When DBM infestations develop to five or more per 20 plants, mevinphos is applied for one or two applications. If most of these worms are on the older, nonmarketable foliage, then mevinphos applications may be delayed. Instead, *B. thuringiensis* is applied at either a higher rate or on a closer interval or both. If DBM is the only pest in the field, pyrethroids are avoided because of the antagonism they appear to cause in controlling DBM populations. Pyrethroid sprays are used only when cabbage looper populations exceed threshold levels. Methomyl is also avoided unless beet armyworm, *Spodoptera exigua* (Hübner), develops threshold level populations.

The successful use of these strategies and others is reliant on educational efforts of the extension specialists, researchers, county extension agents, private consultants, agricultural pesticide representatives and farmers. All too often researchers, farmers and other agricultural consultants overlook the basic principles of on-farm insect management when faced with an insecticidally resistant insect. Although theoretical principles may not always apply when working with farmers, it is important that the researcher/educator become the solution to the crisis and not part of the problem.

References

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