Managing Natural Insecticides– It's Not as Easy as It Sounds

By Susan McGinley

Working with a biological insecticide involves more than just a direct swap with the usual chemical insecticide in the spray tank.

Growers find that natural insect controls are not an easy answer to their pest problems because these substitutes don't achieve the range of kill possible with conventional pesticides. Natural controls also require a more thorough knowledge of the biology and ecology of both the pest and the crop.

Yet, with the increased pressure from consumers for produce grown without chemical insecticides, the agricultural industry is interested in using natural pest control measures where possible. One of those controls is a bacteria, called Bt.

Widely available for nearly a decade, *Bacillus thuringiensis*, or Bt, works by paralyzing the gut of the *Lepidopterous* insect larva as it feeds on sprayed leaves. The larva stops feeding, dies, and falls off the plant a few days after ingestion.

John Palumbo, assistant research scientist in vegetable crops entomology at the UA Yuma Valley Agricultural Center, recently began working with Bt. Local pest control advisers wanted to know more about how it could fit into a total pest management plan.

In an experiment performed last year, Palumbo first examined the biological cycles of such insect pests as the beet armyworm and cabbage looper, which infest lettuce and cole crops. He wanted to pinpoint their vulnerabilities. Then he screened different formulations of Bt on these crops to determine which formulations were most effective.

Now he is experimenting with ways to fit Bt into commercial cropping schemes by using different application times, sprayer types and tank mixes. Cost of the material is a factor, and so is the grower's perception of Bt's range of control.

Bt is a relatively expensive compound to use, compared to chemical pesticides. But, growers may be able to reduce its cost by applying the material in bands rather than broadcasting it, Palumbo says.

As for control, his lettuce trials in Yuma indicated that Bt does not subdue the beet armyworm as well as standard insecticides. Applications of Bt alone at 5-day intervals did not achieve the control that growers were used to having.

The beet armyworm and cabbage looper cause heavy damage on lettuce from August through October in Yuma. Reducing the pest's population during the crop's early growth stages helps prevent a reduction in plant stands and later damage to the heads.

Palumbo explains that since Bt works as the insect ingests it, rather than by direct contact, crops will sustain some damage before the insects die. "With Bt, a grower won't get perfect lettuce," Palumbo says. "The goal with Bt must be to reduce the pest, not eliminate it."

On the other hand, chemical insecticides have drawbacks as well.

"Insecticides are a nice insurance policy," he admits, "but pounding away with too much insecticide can

What Happens Next? It's Not A Simple Question

By Rita Connelly

Michael Stoklos

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Raina Miller (left). Rocio Estrella, Mark Brusseau (center) and Ian Pepper.

It's a simple-sounding question. What happens to chemicals like pesticides in the soil? Finding an answer brought together a trio of researchers at the University of Arizona College of Agriculture.

Mark Brusseau, a chemist; Raina Miller, a microbiologist; and Ian Pepper, a soil microbiologist, joined to study the relationship between the soil and a weed-killer 2,4-dichlorophynoxyacetic acid (2,4-D). This herbicide is no longer widely used in field applications in the United States. However, the research team is primarily focusing on using the chemical as a model compound to represent the behavior of a variety of chemicals, not on the weed-killer per se.

Joe Wehrle

John Palumbo

"With Bt, a grower won't get perfect lettuce."

produce secondary pest outbreaks after the primary pest is controlled."

The quality of the marketable product is really the bottom line.

"The question is, how much reduction in quality would the customer be willing to accept? We are working to find that out," Palumbo says.

A middle ground for incorporating Bt into a cropping plan does exist. He suggests tank mixing Bt with a conventional chemical insecticide for the armyworm as a more conservative approach. Growers are currently using Bt in this way.

Bt trials on cauliflower have been more successful. Since cabbage loopers attack the leaves more than the head, the cauliflower plant can endure more infestation without a lot of economic damage. Growers can use Bt to keep the loopers in check.

Catching the worms when they are small is the key to using Bt alone on both cauliflower and the seedling stage of lettuce.

"You don't always get the best yield or the premium price, but there is a market for residue-free produce," Palumbo says.

He recommends using Bt alone on cauliflower as a way to qualify for the Nutri-Clean label in the groceries. The Nutri-Clean designation applies to produce that tests free of the residues of several major pesticides. However, most lettuce and cauliflower grown in Yuma with conventional insecticides are free of pesticide residues when harvested.

"The public needs to be aware that, regardless of production methods, the vegetables grown in Arizona are safe and free from harmful residues," Palumbo stresses.

Nonetheless, Nutri-Clean is a selling point because grocers feature the label prominently on produce displays.

Finding ways to manage pests as part of a total crop management plan is the heart of Palumbo's work. He addresses problems specific to the Yuma area.

"Yuma growers are on top of the situation and working together with the UA to solve problems," he says. "We have growers here in the valley who are thinking and practicing environmental stewardship." Innovative uses for Bt and other natural controls is one path growers and researchers are pursuing to reach that goal.

Contact Palumbo at the Yuma Valley Agricultural Center, 6425 W. 8th Street, Yuma, AZ 85364, or call (602) 782-3836.

"Our purpose is to see whether 2,4-D is mobile and if it can move through the soil," Miller says. "We want to see if it makes it to the ground water."

With the professors' guidance, graduate student Rocio Estrella looked at biodegradation, which is defined as the decomposition of contaminants by bacteria naturally occurring in the soil. She measured sorption, which is the amount of chemical that sticks to the soil particles. Finally, she used a soil column to study the movement of the chemical through the soil. Water, mixed with 2,4-D, was run through a soil-filled tube, measuring about 15-inches by 2-inches. With the help of a fraction collector, she measured the amount of 2,4-D remaining in the soil after the water had drained.

"This is going to lead to technology

"A soil's fingerprint could be just as unique as human fingerprints are."

that we can eventually use with other components for their potential contamination of ground water," Brusseau says.

But, it's a complicated situation because the soil is such a complex system. Finding ways to exploit existing soil organisms to increase biodegradation during transport of pollutants in soil is the impetus behind the UA research. The soil is alive with microorganisms that can play an important role in cleaning up contaminants.

"Soil doesn't just sit there, things happen to it... such as the summer heat and rains," Miller says.

The work of the three researchers is interrelated. Miller's interest is studying soil bacteria and the chemistry of biodegradation. She has developed methodologies to track the fate of the 2,4-D, and works to develop ways to increase contaminant destruction by existing soil bacteria.

Brusseau focuses on the chemistry and physics of the interaction of 2,4-D with the soil. This includes sorption/desorption and movement of the 2,4-D in soil. Sorption is reversible, and 2,4-D can be sorbed to the soil and then released back into the water that is moving toward ground water. His work is vital for determining the length of time that 2,4-D will be in the soil for degradation by soil bacteria.

Pepper's research involves the interaction of bacteria with the soil environ-