Efficacy of Various Biological and Microbial Insecticides: Does that Really Work?

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Although this presentation is about the efficacy of insecticides approved for organic production I am going to start out with an argument for building the foundation of your insect management program on cultural practices that influence insect pest populations. Because……

* Relying on products is not in line with the spirit or rule of the National Organic Program.
* Insecticides approved for use in organic production systems tend to be relatively expensive.
* With a few exceptions, they kill a smaller percentage of pests than insecticides used in conventional production systems.
* Some are broad spectrum and can have a negative impact on natural enemies.
* We don't have a lot of information about how well they work

These materials should be thought of as "rescue treatments" to use in situations where cultural practices do not maintain pest populations below acceptable levels.

Practices that can help reduce insect pest populations include:

- Promote plant health by maintaining a healthy, microbially active soil
- Rotate away from overwintering sites (works for some pests)
- Maintain nutrients in balance, avoid excess N
- Conserve natural enemies
- Purchase and release natural enemies
- Use row cover to get crops through vulnerable stages (for small acreages)
- Choose resistant or less attractive varieties

Some insect pests have proven to be quite recalcitrant to being managed by cultural practices and are problems year after year on many farms. These include:

- Striped cucumber beetle
- Squash bug
- Tarnished plant bug
- Potato leafhopper
- Flea beetles, esp. on crucifers and eggplant
- "Worms" pests in crucifers
- "Worm" pests in sweet corn

There may be others that you struggle with on your farm. For these pests, it's important analyze the economics of crop loss vs the cost of control, to be familiar with your control options, their cost and efficacy, and to have products on hand prior to detecting unacceptably high pest levels.

Timing becomes more important when using materials with limited efficacy and you want to be targeting a relatively low population or a vulnerable life stage whenever possible. Understand the biology of problem pests so you can anticipate when they will arrive and when vulnerable stages are present.

Excellent coverage is also important, and spray adjuvants may be needed for some crops to improve spreading and sticking of the product. Several spray adjuvants are approved for use on organic farms. Rotate product types whenever possible to slow the development of resistance. Keep in mind that pesticide manufacturers are not required to demonstrate efficacy to list a pest on a product label. The Organic Materials Review Institute (OMRI) is a non-profit that has undertaken the task of interpreting the National Organic Program rules and maintaining a list of products approved for organic production. Many certifiers use the OMRI list as the basis for their list of approved products, but products go on and off the list for a variety of reasons. **Always check with your certifier before using a product for the first time.**

PRODUCTS:

Microbials

Bacillus thuringienisis (Bt) is a bacterium containing a crystalline protein toxin that paralyzes the insect's midgut causing it to stop feeding. They must be ingested to be effective. Bt is specific to its host family and has very little impact on natural enemies. Different strains of bacteria are effective against different families of insects. Bt *kurstaki* and *aizawi* are effective against lepidopterous larvae, for example the "worm" pests that feed on brassicas. Several products containing kurstaki or aizawi strains are OMRI listed. Be very careful to match the product name and formulation exactly with the OMRI listing. Other strains (*tenebrionis* and *san diego*) are available that work against beetles such as Colorado potato beetle, but no products containing these strains are currently OMRI listed. Another strain, *israelensis*, works against fly larvae such as mosquitoes, fungus gnats, and black flies. One product containing Bt *israelensis* (Gnatrol WDG) is OMRI listed.

Beauveria bassiana and *Metarhizium anisopliae* are entomopathogenic fungi that have been formulated into foliar or soil-applied insecticides. The fungal spores germinate on the surface of the insect cuticle and invading the body cavity with threadlike mycelia, eventually killing the insect. When the food resources have been consumed the fungus grows through the surface of the insect and produces spores that can then infect other insects. Entomopathogenic fungi rarely cause epidemics because they require high humidity to infect and sporulate. These fungi tend to have a broad host range and can have a negative impact on natural enemies. Insect mortality is not spectacular, and their residual activity is short because the spores are killed by untraviolet radiation from the sun. They may be most effective for long-term population reduction in insects that pupate in the soil, where conditions are more conducive to infection. Products containing *Beauveria bassiana* are currently on the OMRI list.

Botanicals

Pyrethrin is extracted from the flower heads of a type of chrysanthemum. It is a broad-spectrum nerve toxin with a very short residual on the leaf surface, so often needs to be applied frequently to be effective. In trials pyrethrin products have been shown to be effective against a wide range

of insects including potato leafhopper, striped cucumber beetle (inconsistent results), squash bug, and "worm" pests on brassicas. Some trials have shown that mixing pyrethrin products with azadirachtin (neem) products increases their effectiveness against certain pests, particularly squash but and Japanese beetle.

Neem products are extracted from the seed of the neem tree, which is native to southern Asia. The two main types of products are: azadirachtin extracted by solvents from crushed seeds, and neem oil pressed from the seeds. Azadirachtin acts mainly as an insect growth regulator, but also has anti-feedant and oviposition (egg laying) deterrent properties. It has shown some efficacy against certain caterpillars and squash bug, as well as some aphid species. Azadirachtin products have been shown to improve control against some insects when mixed with pyrethrin products, especially against squash bug and Japanese beetle. Neem oils act similarly to other horticultural oils, smothering and killing small insects such as aphids and mites. Neem oil is also has fungicidal properties. Several azadirachtin-based and neem oil-based products are OMRI listed

Several products that are mixtures of essential oils have been developed for insect control. I have not been able to find trials demonstrating their efficacy or lack thereof.

Fermentation products

Spinosad is a compound produced during fermentation of an actinomycete soil microorganism. It is generally safe for many natural enemies. It is very effective against several important insect pests including Colorado potato beetle larvae, cabbage flea beetles, many species of caterpillars, and onion and western flower thrips. Because it is so effective, it is tempting to use it repeatedly against the same pest population. It's important to use it in rotation with other materials, reserving it for critical times in pest or crop development, to avoid pests developing resistance.

Online resources:

Resource Guide for Organic Insect and Disease Management
www.nysaes.cornell.edu/pp/resourceguide/

Organic Production Guides
http://nysipm.cornell.edu/organic_guide/

Organic Materials Review Institute
omri.org

National Sustainable Agriculture Information Service
http://attra.ncat.org/