

Darkling Beetle Management: New Product, Old Problem

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Darkling beetles or lesser mealworms (*Alphitobius diaperinus* Panzer) are the primary insect pest of broiler production. Their success in the broiler house is largely due to production practices that favor beetle development and survival. Deep litter, extended periods between complete litter replacement, longer production cycles for heavier birds, and a warm, largely dry and food-rich environment make for thriving darkling beetle populations. In fact, it can be said that in spite of our best efforts, we take better care of the beetles than we do the birds.

There are problems with the insecticides we use to control darkling beetles as well. Labeled active ingredients are limited, and the best of those have been over used. Two recent articles (Lambkin and Rice, 2006; Hamm, *et al.*, 2006) clearly demonstrate that varying levels of cyfluthrin resistance in darkling beetles may be the rule rather than the exception. Hamm *et al.* further demonstrated much higher levels of resistance to tetrachlorvinphos are likely. The resistance profiles of other insecticides used for darkling beetle control are unknown. New chemistries are needed.

One such material was introduced earlier this year. Spinosyn was first introduced in animal agriculture for fly control, and is now labeled for darkling beetle control. A GLP trial was completed last year by N. C. State University. Banded applications at the high label rate were significantly better than cyfluthrin in suppressing beetle populations for up to 5 weeks following treatment. As with most insecticides, the bad news is that the spinosyn formulation did not suppress beetle populations through the end of a flock cycle. The good news is that the labeling for this product allows it to be applied while the birds are present. That's a rare thing for new insecticides these days. This flexibility allows the grower to time a secondary treatment under feed lines to significantly extend beetle control, perhaps through the end of a 9 week flock cycle. The other bad news about this product is that it is sensitive to sunlight and certain types of disinfectants (iodines and peroxidases), which brings us to the second part of this discussion... the handling and application of insecticides.

It does little good to have the best insecticide available for darkling beetle control if you mishandle it. Tank mixes of insecticides and disinfectants are at best, risky. The efficacy of one or both of the chemicals in the mix is likely to be compromised (Axtell, *et al.*, 1987). Similarly, exposure to sunlight for extended periods, or to temperature extremes, may seriously diminish the efficacy of an insecticide before the package is even opened. Degraded efficacy may also occur when water soluble insecticides are mixed with water. Neutral to alkaline water will begin to reduce the efficacy of sensitive

insecticides as soon as the two come into contact. The process is called alkaline hydrolysis, and can degrade pyrethroids (permethrin, cyfluthrin) rapidly. Tetrachlorvinphos (an organophosphate) is affected as well. Alkaline hydrolysis is a likely culprit in the loss of insecticide efficacy when tank mixed with disinfectants.

Application presents its own assortment of pitfalls. Speed and time, for example, should not govern application practices. Although it is tempting to treat a broiler house as quickly as possible, doing so may short-circuit control efforts. High output nozzles and pumps may not distribute insecticides effectively. Relatively fast ground speed may not help either.

Dry application is not necessarily better than liquid application. True, it's a way to cover exposed surfaces quickly, but it does not penetrate into cracks and crevices as well as one might think. The adult "kill" achieved by a dusting with cyfluthrin may look impressive, but in the long run it kills about the same proportion of the population as does a carefully applied spray treatment.

Here are some common sense guidelines for the proper care, handling and application of insecticides for beetle control.

Storage:

1. Think dark, cool and dry for insecticide storage. Doesn't have to be climate controlled, but should moderate the extremes. Don't forget it should be secure as well.
2. Don't set liquid products in the truck bed to bake in the sun on treatment day. Although the package may protect the product from sunlight, an extreme in temperature may not be a good thing.
3. Don't expect spray solutions to keep more than a few hours without losing efficacy even under the best conditions.

Mixing:

1. For liquid formulations, use the least amount of water possible. Spinosyn labels, for example recommend application in 12 to 15 gallons of water for a 20,000 sq. ft. house.
2. Read and follow label directions. If the maximum amount of concentrate for a 20,000 sq. ft. house is 16 ounces, you may use less, but not more. The same is true for dusts.
3. If well water is neutral to basic, consider lowering the pH to 6 or less with vinegar or other acidifier.
4. **DO NOT** mix insecticides and disinfectants unless both labels explicitly permit or recommend a tank mix including both products.

Application:

1. A lawn sprayer equipped with a 7 to 8 foot adjustable boom and flat fan nozzles allows greater application flexibility and precision than a sprayer

equipped with a single flooding nozzle; or, a high pressure sprayer designed for wash down and disinfection.

2. Timing is everything. In general, treatments should be made immediately after broiler houses are caked. Many adult beetles and larvae will have been removed, and those remaining are actively crawling over the litter surface or just beneath it. Where houses have been cleaned to the ground, treatments applied just before new litter is spread may be most effective. If new litter is in fact, recycled litter, treatment should be made after it is spread. Even composted litter is likely to contain some live adults, eggs, large larvae and pupae.

3. Band spray treatments from outboard drinkers to walls. Darkling beetle numbers fluctuate during the course of the flock cycle, but the greatest concentrations will occur between the walls and feeders. Center sections of the house are seldom heavily infested until the latter stages of the flock.

4. Apply secondary treatments (where permitted by labeling) in an 18 to 24 inch band beneath feeders 3 to 4 weeks after the initial treatment. Use the highest permissible rate since adult and larval beetle numbers are likely to be quite high.

5. Companies might consider hiring one or more application specialists to treat all of their farms. This approach will insure more uniform beetle control. It has the added advantage as a means of insuring uniform adherence to insecticide rotations to better manage existing and potential insecticide resistance.

References:

Lambkin, T. A. and S. J. Rice. 2006. Baseline responses of *Alphitobius diaperinus* (Coleoptera: Tenebrionidae) to cyfluthrin and detection of strong resistance in field populations in eastern Australia. *J. Econ. Entomol.* 99:908-913.

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