Darkling Beetle Control

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About 12 years ago I spoke here about the darkling beetle situation in North Carolina and our approaches to control. I wish I had good news today about how much progress has been made, but not much has changed. Our darkling beetle troubles are as bad or worse than they were 12 years ago. In truth beetle infestations seem to have become more severe in broilers than in turkeys, but the relative size of the problem in any particular segment of the industry doesn't really matter. The fact remains that there are still way too many beetles to go around. I suspect most of you would agree with that assessment. It is also likely that an increasing number of non-farm neighbors, having experienced first hand the fun and excitement of a home invasion by beetle, would agree as well. Let's take a look at the current situation and talk about how we might improve things.

Why are we still having so much trouble controlling darkling beetles? In very broad terms a number of things have contributed to the current situation:

1) beetle resistance to key insecticides;
2) loss of insecticides through cancellations;
3) no consistent approach to insecticide rotation, application and other resistance management strategies; and,
4) production practices that aide beetle survival.

Resistance: It's been talked about for some time, but real documentation that it existed has been hard to come by. Now there is solid evidence to confirm that darkling beetles are developing resistance. A Cornell University study (Hamm, *et. al.*, 2006) found resistance to both cyfluthrin (Tempo®) and tetrachlorvinphos (Rabon®) in beetle colonies collected from 4 caged layer farms in New York and Maine, and one collected from a commercial cricket rearing operation. An Australian study (Lambkin and Rice, 2006) detected cyfluthrin resistance in adult beetles in samples collected from 11 broiler farms. The resistance status of darkling beetles to permethrin, esfenvalerate, cyhalothrin, chlorpyrifos and other actives is not as clear. However, all of them fall into the same two classes of insecticides (pyrethroids or organophosphates) represented by cyfluthrin and tetrachlorvinphos. Experience tells us that at best all these actives are at risk, and that past control failures may be due to more than poor application.

Cancellations: The recent lose of insecticides through EPA actions or voluntary cancellations have limited control options even further. Dimethoate, carbaryl, malathion have all lost animal use labels. In the case of carbaryl, although still approved for use around poultry houses, its new label is so restrictive as to be virtually useless for beetle control. Carbaryl's lose means we've also lost a third class of insecticides (carbamates).

Tetrachlorvinphos and dichlorvos (Vapona®) are under EPA review, their future status uncertain. If either or both dichlorvos or tetrachlorvinphos is lost, it is likely to eliminate Ravap since it is made up of the other two. I've also learned that current formulations of permethrin may no longer be optimized for beetle control or other livestock and poultry uses. Although still labeled for animal uses, "new" permethrin may not work as well as "old" permethrin. Only time will tell if such is the case. At present then, we essentially have 5 old pyrethroids (cyfluthrin, cyhalothrin, permethrin, esfenvalerate and pyrethrum), three old organophosphates (chlorpyrifos, tetrachlorvinphos and ravap), and one old inorganic (boric acid). The macrocyclic lactone, spinosad (Extinosad®), and an insect growth regulator (pyriproxyfen) round out the list. It's not a very impressive list with only one new class of chemistries, and that limited to a single active. It also appears there's nothing really new coming down the road any time soon.

Insecticide treatment and other practices:

The darkling beetle's biological inertia works against us every step of the way. Their life cycle matches up nicely with the length of broiler and turkey brooder cycles. Secondly, the warm and food-rich litter environment is ideal for the beetle growth and development. Third, there are no natural beetle controls (broilers and poults excluded) to speak of in poultry houses. Fourth, none of the insecticides currently in use last an entire flock, and it appears that the beetles readily make up loses from early insecticide and litter treatments by the end of the flock. This is especially true during the summer. The take home message here is that treatments made when the beetles are most vulnerable will optimize control efforts. There are only three periods that fit the bill: 1) As soon as the flock is removed while beetles and larvae are at or near the litter surface; 2) just before birds are placed in anticipation of an upsurge in beetle activity as the building warms; or, 3) when larvae and beetles are concentrated along feed lines. The first two approaches help reduce beetle and late stage larvae for 3 – 4 weeks early in the cycle by reducing starting populations as much as possible. The third reduces adult and early to late stage larvae for an additional 3 – 4 weeks midway into the flock by simply renewing insecticides in critical areas.

The first two treatment windows are subject to the necessity of between-flock cleanout, caking, and placement schedules. A number of companies encourage growers to get caking or clean out done quickly so that treatments can be made. End of flock treatments delayed a week after birds are removed remain effective during the warm summer months. However, delays of more than a few days during the winter reduce the treatment's effectiveness. Rapid cooling in the upper inch or two causes beetles to move out of the treated zone. If flock placement is delayed insecticides may be considerably degraded by the time houses receive birds and beetle activity resumes. Season is less critical for treatments made just before bird placement, but if schedules are tight there may not be time to get it done.

The third treatment window does not lend itself to standard practices at all. It does, however, offer promise as a way to enhance control, and can be effective year round. A banded treatment beneath feeders about three weeks into the flock cycle will impact beetles and larvae before they begin to disperse throughout the house. Because this type of treatment covers a small area, exposure of the birds is minimal with about *half of the* treatment physically protected under the feed pans. The treatment is limited of course to those insecticides (permethrin, rabon and ravap) that can be used while birds are present; and in the case of permethrin and ravap, at the lower label rates only. Spinosad may soon have clearance to be used in this way as well.

Some combination of the above treatments may be necessary to bring severe infestations under control. Certainly, houses where beetle numbers are high should be treated at least once every flock. The only exception might be when beetle numbers are high and the first freeze of the season is likely. Cold weather will dramatically reduce the beetle population on its own. But, resume treatments after the skip to drive beetle populations even lower before summer arrives.

What about insecticide rotations? Your options are limited to about 10 insecticides and four classes. Doesn't sound bad, but remember that significant resistance is documented in one pyrethroid (cyfluthrin) and one organophosphate (tetrachlorvinphos), which effectively eliminates (cyfluthrin, rabon and ravap). For the moment assume that resistance does not seriously affect permethrin, cyhalothrin, esfenvalerate or pyrethrum. Pyrethrum, however, has no residual activity and has limited effectiveness for beetle control. Also assume that chlorpyrifos is still an effective organophosphate. The new macrocyclic lactone (spinosad) is highly effective for now. Boric acid is marginally good with spotty results at best, but no evidence of beetle resistance. Exclude pyriproxyfen (an IGR) from rotation plans since it is added to the others in a tank mix, and is not a direct toxicant.

Here's a quick guide to rotations:

1) Rotate only between classes. Use the table below. For example, Cyfluthrin and esfenvalerate are in the same class; cyfluthrin and tetrachlorvinphos are not.
2) Avoid short rotations (<1 year) to limit repeated exposure at frequent intervals to different classes of insecticide.
3) Rotate between classes every 2 – 3 years as a rule. One-year rotations are acceptable so long as they include more than two classes, and are necessary due to known resistance rather than for convenience.

Pyrethroid	**Organophosphate**	**Macrocyclic Lactone**	**Inorganic**
Cyfluthrin	Tetrachlorvinphos	Spinosad	Boric Acid
Cyhalothrin	Ravap		
Permethrin	Chlorpyrifos		
Esfenvalerate			
Pyrethrum			

Production practices: Some production practices may hamper efforts to control darkling beetles. Full cleanouts every one or two flocks, or at least once a year, were a common practice not so long ago. This practice simply removes large numbers of beetles, and if the litter is promptly land applied at some distance from the farm, limits beetle migration back into the poultry houses. Insecticide applied to bare floors and walls will reduce beetle numbers more efficiently than treatment of 4 – 6 inches of old litter. If nothing else, beetle eggs and pupae sitting in deep litter well outside the treatment zone pose a major problem for control efforts. Similarly, litter storage in close proximity to the houses represent a significant source of reinfestation if no effort is made to control beetles there. Perhaps litter stockpiles should be treated in much the same way as production houses. They should at least be inspected after cleanout to assess the need for treatment to control adult beetles on the surface of the litter. Land application too should be considered. Darkling beetle adults will continue to fly from application sites for nearly a month. Heavily infested litter should therefore be considered a major source of reinfestion. In so far as possible, litter should be applied no less than 500 yards away from residences and other poultry houses.

Changes in production practices, careful and informed rotation of insecticides, consistent timing of treatments, and consideration of alternative treatment approaches are key to better beetle control. At this moment in time a good chemical rotation plan is particularly important. To be honest, rotation efforts are complicated by the need to treat nearly every flock. It is certainly possible that rotations may become more complicated if beetles are resistant to most of the remaining chemistries. Even so, a consistent rotation plan will help maximize the impact of minimally effective products until more useful, new products come along. Appropriate rotations and consistent treatment methods will then conserve the newer chemistries by limiting overuse.

References:

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