# Litter Beetle Management in Poultry Barns

By Danny L. McDonald, Ph.D., Poultry and Livestock Entomologist, MWI Animal Health Technical Services

Litter beetles (*Alphitobius diaperinus*) are a stored product and structural pest commonly found in poultry barns. Their prevalence is due to an abundance of poultry feed made up of their favorite grains and ideal harborage with temperatures and humidity consistent with their ideal breeding conditions. Litter beetles consume poultry feed, are responsible for structural damage to insulation, are a known mechanical vector of numerous pathogens, and negatively impact feed conversion if birds consume them rather than the feed provided (Tomberlin and Drees, 2007). Litter beetle management can be a challenge if an integrated pest management approach is not implemented. Integrated pest management refers to the practice of combining the most effective, economical and practical cultural, sanitation, mechanical, chemical and biological control practices into a comprehensive management strategy.

Litter beetles are an invasive species; that is, they are a non-native species (from Sub-Saharan Africa) that causes economic damage in poultry barns. They have a complete life cycle with egg, larvae, pupae and adult life stages. They complete their life cycle from egg to adult within 45–65 days and adult beetles can live up to a year (Geden and Axtel, 1987). They are highly fecund with each adult female laying up to 800 eggs in 42 days. Their population densities peak in mid-summer and decrease during winter months. Furthermore, they have the ability to fly between barns and even between nearby farms.

The most common practice for managing litter beetles is to apply an insecticide on top of litter before bird placement. Typically this is done within a week of placement after litter has been de-caked or turned and spread back out, but not always (to the detriment of beetle control). There

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are, however, many cultural practices that should be implemented to reduce litter beetle numbers before an insecticide is even applied. Any chemical applied for any reason can only last for a finite time. The more insect pressure, or traffic, on an insecticide, the faster it will be used up.

Annual total cleanouts of used litter is like hitting the reset button on a beetle population. Although this won't remove insects hiding in the walls or individuals pupating in the pad, a significant number of eggs, larvae, pupae and adults will be removed. Don't forget to make an insecticide application on any cake or litter removed from the barn to prevent beetles from migrating right back in. Windrowing is a heat treatment where litter is piled up into rows and is intended to kill pathogens. Windrow piles can reach temperatures between 130–150°F (Coufal et al., 2017). These high temperatures will drive out larvae and adult beetles while killing eggs and pupae. Windrows should be sprayed with an inexpensive, fast-acting insecticide like Bifen I/T to kill larvae and beetles migrating toward the walls. One final note about sanitation and cultural practices is to clean up and dispose of any dead birds and spilled feed immediately to reduce resources for beetles.

It is always a good idea to hire a licensed pest management professional to make pesticide applications. Custom applicators have access to restricted use pesticides (RUPs), they have calibrated and efficient equipment, and they provide consistent applications that lead to better pest management.

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Boric acid has been used in poultry operations against litter beetles for decades, but has been largely underutilized in recent years. Boric acid has the longest residual activity of any insecticide used for crawling insect management (Ware and Whitacre, 2004). It has a triple mode of action as a neurotoxin, stomach poison, and desiccant which makes it difficult for an insect population to become resistant. It is very safe to use around poultry even at eight times the highest label rate of 2 lbs/100 $ft^2$ (Sanders et al., 1991). MWI Animal Health recommends that new litter brought into a poultry barn should get a fresh application of boric acid at 2 lbs/100 $ft^2$. Apply boric acid in 2'–3' bands underneath feed lines, against side walls and around any support posts or treat the entire floor if resources allow it. Reapply boric acid to new litter or at least every three flocks if litter is reused.

Insecticide applications on litter before bird placement can be in the form of liquid or dust application **[See Darkling Beetle Insecticide Comparison Chart].** It is best to choose a formulation that will provide a long residual such as microencapsulated (CS), emulsifiable concentrates (EC) or dust formulations (D).

It is important to make applications of insecticides as close to bird placement as possible and avoid disturbing the treated litter. Insecticides begin to degrade as soon as they are applied. Making applications 2 weeks before bird placement will shorten the residual activity of the insecticide after bird placement by 2 weeks. When feed isn't present, the majority of beetles are hiding inside walls, in cracks and crevices, and deeper in the litter. So, insecticide applied in the middle of a turn is not even contacting most of the target pest population. Making applications of litter amendments on top of insecticides, especially microencapsulated formulations, can also have detrimental effects on insecticide performance.

It is best to treat as much of the litter as possible making sure to spray 1'–2' up all footers and sidewalls. Only treating underneath feed lines and against side walls can lead to behavioral resistance. When a full floor treatment is implemented, there is no place for beetles to avoid a dose of insecticide. Toxicity is a combination of both dose and contact time.

Always use the highest label rate of an insecticide for litter beetles. Using less than the highest label rate can exacerbate resistance issues. Individual insects that receive a sub-lethal dose of insecticide will pass on their genes that allowed them to survive to the subsequent generation. That generation will be more resistant to that mode of action

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than the previous generation.

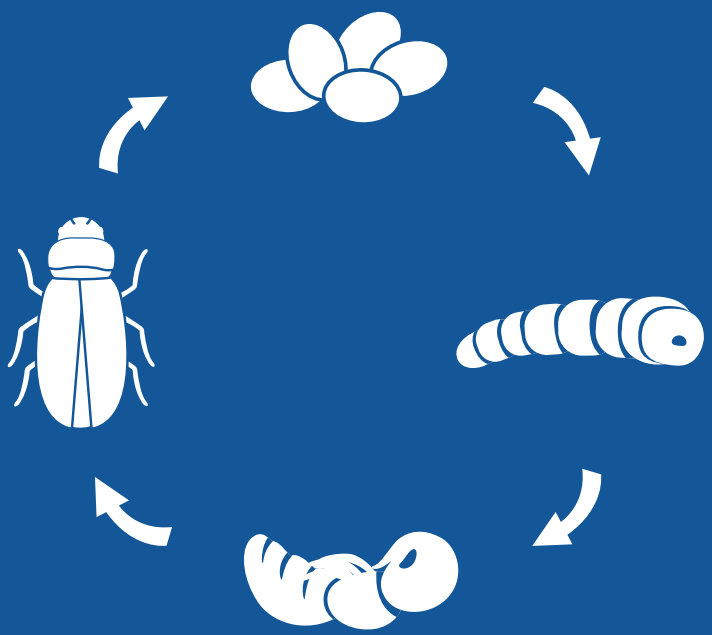
In order to achieve adequate coverage for liquid insecticides, deliver one gallon of solution per 1,000 $ft^2$. The easiest way to achieve the proper amount of insecticide applied is to calculate the actual square footage that insecticide is being applied to. For example, if you are making a full-floor application to a 40' x 500' broiler barn and you are treating 2' up side walls, then you are actually applying insecticide to 22,160 $ft^2$. If the label calls for 4 oz of product per 1,000 $ft^2$, you will need 88.64 oz of product diluted in 22 gallons of water.

Insect growth regulators are insecticides that prevent immature insects from molting into the adult stage. They work by manipulating growth hormones. There are two modes of action used in production agriculture: juvenile hormone analogs (NyGuard®) and chitin synthesis inhibitors (Tekko™ 10). Neither of these modes of action will provide instant gratification nor should they be used as a standalone treatment; rather, they should be tank mixed with a neurotoxin (neonicotinoids, organophosphate, pyrethroid, or spinosyn). The real benefit of adding an IGR to an insecticide rotation will be seen during the second flock after the initial treatment. Even though you may see many larvae late in the first flock after incorporating an IGR, they will not be able to become reproductive adults and the beetle population during the next flock will be significantly reduced.

At MWI Animal Health, we understand both the need for insecticide application to maintain optimal operating efficiency while maintaining insecticide efficacy through resistance management. That is why we have established the MWI Animal Health Entomology Laboratory (The Lab) located in Sioux Falls, South Dakota. At The Lab, hundreds of litter beetle (*Alphitobius diaperinus*) and house fly (*Musca domestica*) samples are processed each year for resistance testing. This has provided us with an enormous data set that we can analyze for trends in insecticide resistance through time and by region. We provide region-specific data results back to our customer in order to help make decisions on insecticide rotation.

For litter beetles in poultry operations, we have access

Darkling Beetle Life Cycle



to four neurotoxin chemical classes (pyrethroids, neonicotinoids, organophosphates and spinosyns) and two insect growth regulator classes (juvenile hormone analogs and chitin synthesis inhibitors). Each insecticide active ingredient is placed into a chemical class based on its mode of action (how it kills its target organism). It is recommended that at least four chemical classes are used in rotation and that a single chemical class be used no more than 6 months. If a pyrethroid is chosen, adding the synergist pipronyl butoxide (PBO) will prevent pyrethroid-resistant beetles from detoxifying the insecticide using P450 enzymes. PBO significantly increases the efficacy of pyrethroids against litter beetles. Some products already have PBO added such as Onslaught® FastCap and Tobex®.

In order to determine which chemical class will be most effective at this time for your beetle or fly population, we recommend contacting your MWI Animal Health Territory Manager to have your insects tested in The Lab at least once per year.

An application of insecticide to the exterior of barns is a practice that needs to be adopted by all poultry farms. Exterior applications prevent migrating beetles from entering the barn without first being subjected to insecticide. Exterior applications, where production animals are not present, also allows for use of chemical classes not allowed on the interior of barns. Termidor® SC is a phenylpyrazole. It is unlikely any litter beetle population has any resistance to this chemical class. Termidor® SC can be applied only twice per year and it is recommended that the first application occur in the spring when beetle populations begin to increase and again in mid-summer when beetle populations reach their peak density.

The poultry industry needs to adopt an integrated pest management approach to beetle management. MWI Animal Health's data suggests that there is widespread resistance to neonicotinoids, and regional resistance to organophosphates and pyrethroids.

**There are several practices that can improve the efficacy of an insecticide program:** 1) always couple IGRs with neurotoxins and be sure to rotate between insecticide classes; 2) apply boric acid underneath feed lines and against side walls which will provide residual activity long after the neurotoxins have degraded; and 3) make applications of contact insecticides to the exterior of barns after the last frost in early spring, and again during the peak insect populations during mid-summer. Adopting several of these practices along with yearly cleanouts will ensure that we are implementing a comprehensive beetle management program, rather than being complacent with a "Spray and Pray" philosophy.

References

Coufal, C., D. Harmel, and T. Gentry. 2017. *In-House Windrow Composting of Poultry Litter.*

Geden, C. J., and R. C. Axtell. 1987. Factors Affecting Climbing and Tunneling Behavior of the Lesser Mealworm (Coleoptera: Tenebrionidae). *Journal of Economic Entomology* 80: 1197–1204.

Sanders, J. E., L. Dufour, R. D. Wyatt, P. B. Bush, and R. K. Page. 1991. Acute toxicity of boric acid and boron tissue residues after chronic exposure in broiler chickens. *Avian Diseases* 35: 745–749.

Tomberlin, J. K., and B. M. Drees. 2007. Poultry pest management. Texas FARMER Collection.

Ware, G., and D. Whitacre. 2004. *The Pesticide Book*. Meister Media Worldwide: 74–374.

# Darkling Beetle Insecticide Comparison Chart

| INSECTICIDES | | | | |
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| PRODUCT NAME | ACTIVE INGREDIENT | INSECTICIDE CLASS | RATE | APPLICATION METHOD |
| AGITA™ 10 WG | Thiamethoxam | Neonicotinoid | 17 oz/gallon | Apply 2 oz of solution as a spot treatment underneath individual feed pans. |
| ALPINE® WSG | Dinotefuran | Neonicotinoid | 10–20 g/1,000 $ft^2$ | Apply as a full-floor treatment |
| CREDO® SC | Imidacloprid | Neonicotinoid | 3 oz/1,000 $ft^2$ | Apply as a full-floor treatment |
| DARLEX® | Clothianidin | Neonicotinoid | 4 oz/1,000 $ft^2$ | Apply as a full-floor treatment |
| DOMINION® 4L | Imidacloprid | Neonicotinoid | 3 oz/1,000 $ft^2$ | Apply as a full-floor treatment |
| DURASHIELD®CS | Chlorpyrifos | Organophosphate | 2–5 oz/1,000 $ft^2$ | Apply as a full-floor treatment |
| PYROFOS™ 42 CS | Chlorpyrifos | Organophosphate | 0.9–2.3 oz/1,000 $ft^2$ | Apply as a full-floor treatment |
| BEETLE SHIELD® 6 | Tetrachlorvinfos | Organophosphate | 1.5–4 oz/100 $ft^2$ | Apply as a full-floor treatment or in 3' bands underneath feed lines and against side walls |
| RAVAP™ EC | Tetrachlorvinfos; Dichlorvos | Organophosphates | 5-10 oz/1,000 $ft^2$ | Apply as a full-floor treatment |
| BIFEN I/T | Bifenthrin | Pyrethroid | 0.33–1 oz/1,000 $ft^2$ | Apply as a full-floor treatment |
| CYZMIC™ CS | Lambda-Cyhalothrin | Pyrethroid | 0.8 oz/1,000 $ft^2$ | Apply as a full-floor treatment |
| OPTASHIELD®CS | Cyfluthrin | Pyrethroid | 1–2 oz/1,000 $ft^2$ | Apply as a full-floor treatment |
| OPTIMATE® CS | Gamma-Cyhalothrin | Pyrethroid | 0.65 oz/1,000 $ft^2$ | Apply as a full-floor treatment |
| PERMACAP CS™ | Permethrin | Pyrethroid | 2.67–5.33 oz/1,000 $ft^2$ | Apply as a full-floor treatment |
| PERMETHRIN CS | Permethrin | Pyrethroid | 2.67–5.33 oz/1,000 $ft^2$ | Apply as a full-floor treatment |
| PERMETHRIN SFR | Permethrin | Pyrethroid | 0.32 oz/1,000 $ft^2$ | Apply as a full-floor treatment |
| TEMPO® 1% DUST INSECTICIDE | Cyfluthrin | Pyrethroid | 0.5–1 lb/1,000 $ft^2$ | Apply as a full-floor treatment |
| TEMPO® SC ULTRA | Cyfluthrin | Pyrethroid | 8–16 ml/1,000 $ft^2$ | Apply as a full-floor treatment |
| TEMPO® ULTRA WP | Cyfluthrin | Pyrethroid | 10–20 g/1,000 $ft^2$ | Apply as a full-floor treatment |
| TOBEX™ | Lambda-cyhalothrin, Prallethrin, Pyriproxyfen, PBO | Pyrethroids, IGR, PBO | 2–4 oz/1,000 $ft^2$ | Apply 4 oz/1000$ft^2$ underneath feed lines and side walls. |
| ZETAGARD™ LBT | Zetacypermethrin | Pyrethroid | 25–50 lbs/20,000 $ft^2$ | Apply in 3' bands underneath feed lines and against side walls. |
| ONSLAUGHT® FASTCAP | Esfenvalerate; Prallethrin, PBO | Pyrethroids, PBO | 1 oz/1,000 $ft^2$ | Apply as a full-floor treatment |
| ELECTOR® PSP | Spinosad | Spinosyn | 0.4–0.8 oz/1,000 $ft^2$ | Apply as a full-floor treatment |
| BORIC ACID | Boric Acid | Borates | 2 lbs/100 $ft^2$ | Apply in 2' bands underneath feed lines and against side walls |
| TEKKO™ 10 | Novaluron | IGR Chitin Synthesis Inhibitor | 1.5–3.0 oz/1,000 $ft^2$ | Apply as a full-floor treatment |
| NYGUARD® | Pyriproxyfen | IGR Juvenile Hormone Analog | 2.67–8 ml/1,000 $ft^2$ | Apply as a full-floor treatment |

Prior to using any product mentioned in this article, carefully read and follow all available instructions, warnings and safety information made available by the product's manufacturer.

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