Aviagen Turkeys

Bulletin

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Integrated Pest Management

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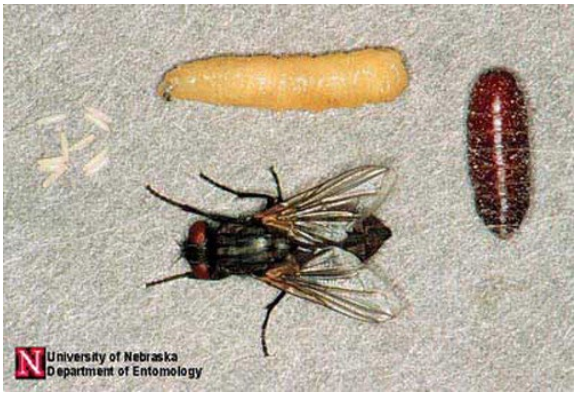
Introduction

Insect pests can quickly cause severe damage at the farm level with resounding effects on the entire production chain. From physical structure and machinery damage to disease concerns and nuisance issues, each farm should have a pest management plan that minimizes the risk insect pests pose to their operation.

What insect pests can cause the most damage?

The two pests that can cause the most damage are the house fly (*Musca domestica*) and the darkling beetle (*Alphitobius diaperinus*). Both house flies and darkling beetles require moisture, warmth, and a constant food source. By optimizing the environment for the birds, we inadvertently create the perfect environment for pests. If left untreated, both species will rapidly build in number and cause damage quickly.

The house fly and darkling beetle share several similarities beginning with four distinct stages in their lifecycles. The immature life stages are the egg, larvae, and pupae. Moisture is critical for immature survival. Adult insects are the most mobile and the only reproductive life stage. For both species, only the larvae and adult life stages are considered effective for control.

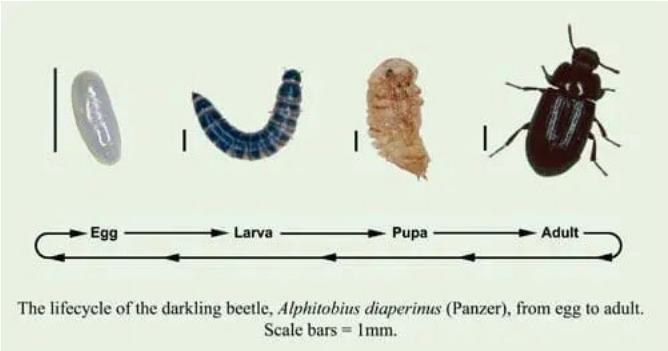


House fly lifecycle in clockwise direction, egg, larva, pupa and adult. House fly lifecycle photo by Jim Kalisch, Univ. Nebraska Lincoln

<u>Specific for house flies:</u>

- Larvae develop in all types of moist, decaying organic matter.
- Adults feed on the ground but mate and rest on higher structures.
- “Fly spots” are the liquids created from regurgitation and defecation while flies eat and digest their food.
- There can be ~ 20 generations of flies produced in a year; females can lay up to 500 eggs per cycle.

Darkling beetle lifecycle, egg, larva, pupa and adult.
Littler beetle image credit – T. Lambkin QDPI&F



The lifecycle of the darkling beetle, *Alphitobius diaperinus* (Panzer), from egg to adult. Scale bars = 1mm.

Specific for darkling beetles:

- Larvae and adults can be found occupying the same habitats, feeding on similar food sources.
- Adults are long-lived and females have the potential to lay ~1200 eggs per month.
- Timeline from egg to reproductive adult can happen in as little as 40 days.

What damages are caused by house flies and darkling beetles?

Structural Damage

- House fly constant regurgitation and defecation behavior can be corrosive, gum up equipment cables, and effect electronics.
- Darkling beetle larvae cause damage to footings, wooden beams, and insulation by burrowing behavior while trying to find a protected place to pupate. Adults contribute damage when leaving the pupation site or searching for pupae to cannibalize.
- Up to 25% of the insulation can be damaged in a year by high darkling beetle populations.
- Energy costs can be 67% higher in houses with darkling beetle damage.

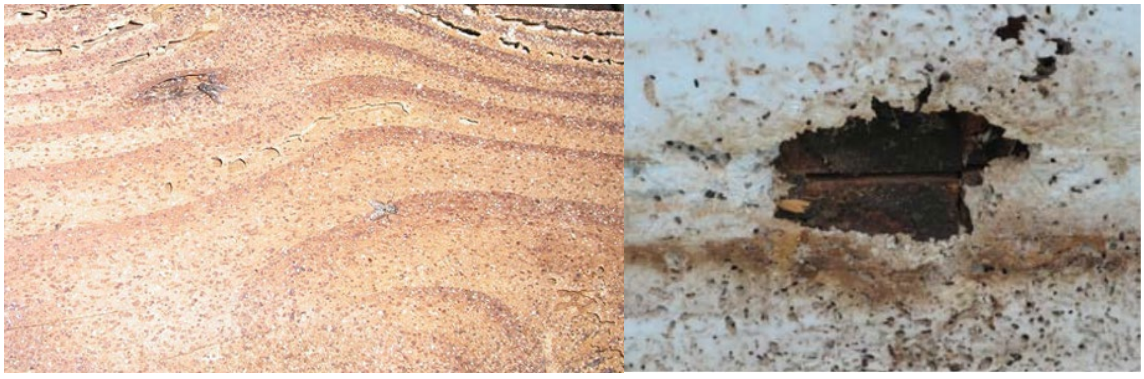


Image left – Damage of wooden pillar caused by burrowing larva. Photo from Cornell University
Image right – Insulation damage by darkling beetles. Photo Robert Rowland

Disease Transmission

- Both house flies and darkling beetles are proven vectors of Highly Pathogenic Avian Influenza (HPAI), *Salmonella* and *E. coli* and other diseases.
- House flies transmit many foodborne illness causative agents like *Campylobacter* and *Shigella* bacteria.
- Darkling beetles are implicated in fowl pox, Marck's, Newcastle and Infectious Bursal Disease outbreaks and serve as a host for the organisms that causes coccidiosis.
- House flies and darkling beetles can incubate and increase the number of disease-causing organisms in the houses as well as serve as a reservoir between flocks and source of infection for incoming flocks.
- Some processing plants are beginning to dock or refuse birds infected with foodborne illnesses to protect the processing plant from contamination.

Nuisance Issues

- Dispersal from the poultry facility can cause nuisance issues with residential areas.
- House flies are strong fliers and can travel up to 20 miles searching for a better habitat.
- Darkling beetles are nocturnal movers and are attracted to light sources.

Personnel Comfort

- High house fly populations make daily tasks difficult and can lead to low personnel retention rates.
- Darkling beetles can crawl into personal items, clothing and have the ability to bite.
- Some people are more sensitive to darkling beetles and can develop a severe allergy to their presence.

Other Damages

- Darkling beetles can feed on live birds and cause blemishes.
- Birds can consume enough insects to inhibit productivity, filling up on nutritionally poor insects instead of the provided feed ration.

What can I do?

Each farm can build an Integrated Pest Management Program or IPM program to best suit their specific needs and pests. Integrated Pest Management is a decision-based strategy that intentionally incorporates multiple methods of control to maximize the suppression of a pest. Any IPM program should be flexible and readily revised, depending on product availability or limiting factors such as time, labor, machinery, or cost. A successful IPM program will plan ahead, recognizing their own unique needs and limitations, implement the plan fully and evaluate if adjustment in protocols is needed.

Within IPM, we sort control measures into four categories: cultural, physical, biological, and chemical.

Cultural

Cultural control measures focus on proper sanitation and should be the basis for any IPM program. Many basic husbandry aspects are not immediately associated with pest management but can have the biggest impact on your success. The easiest way to inhibit population development is to dry or disturb larval habitat and remove adult refuge.

Physical

Physical control measures focus on the building structure and upkeep of any physical barriers that can help exclude or trap mobile pests. Includes repairing screening, damaged walls and setting traps to either monitor or inhibit the pest populations.

Biological

Biological control measures utilize the pests' natural predators in the environment to assist in controlling the pest population. Natural predators include various species of ground beetles, parasitoid wasps, fungi, and bacteria.

Chemical

Chemical control measures include both natural and synthetic chemical products used to control a pest population. Most chemical products are adulticides, targeting adults, and will have little effect on the immature stages. There are targeted larvicidal products that are designed to inhibit the immature's ability to survive to the adult stage.

By utilizing strategies from each category, we can create the best-fit program for each farm. Chemical control measures should never be relied on as the sole control method as it will lead to insecticidal resistance, rendering those chemistries ineffective on the pest populations. In addition, chemical insecticide products have strict application requirements, and many are not able to be applied with birds present.

Understanding the difference between Active Ingredients vs Mode of Action

Chemical control relies on active ingredients that affect the insect's biology in specific ways. These pathways are the active ingredients' Mode of Action or MOA. Many of the targeted pathways are unique to insects, but can still affect the birds, pets, other livestock, or humans if misused. Each insecticidal product will have a label listing the active ingredients and approved applications, including dosage, approved areas, if it can be applied in the presence of birds, what personal protective equipment (PPE) is needed and much more.

Just because two products list different active ingredients, does not mean that those active ingredients belong to different MOA groups. This is important since repeatedly using products with the same MOA will quickly contribute to insecticidal resistance on your farm. Many labels now list the MOA group number along with the active ingredient. A free resource available through the Insecticide Resistance Action Committee or IRAC,

allows you to check which active ingredients belong to which MOA group. It is available at https://irac-online.org or as a mobile app.

The table below breaks down the available MOAs and example active ingredients for house fly control based on if they can be applied while birds are present, as empty house residual treatments, larvicidal treatments and are used as scatter baits. Since there are only two MOA groups available for application while birds are present, management programs should focus on utilizing adulticide and larvicide residual treatments between flocks. When rotating MOAs, you can rotate by calendar date or by flock. For example, house fly scatter baits have several available MOAs. You can pick two different MOA products and switch halfway through the calendar year OR switch when a new flock arrives.

While Birds are Present		**Larvicides**	
MOA	Example Active Ingredients	MOA	Example Active Ingredients
1B - organophosphates	Dichlorvos, Tetrachlorvinphos	7C - Juvenile hormone mimics	Pyriproxyfen
3A - pyrethroids and pyrethrins	Pyrethrin, Permethrin, Cyfluthrin, Prallethrin	15 - chitin synthesis inhibitors	Novaluron
Empty House Residual		**Scatter Baits**	
MOA	Example Active Ingredients	MOA	Example Active Ingredients
1B - organophosphates	Chlorpyrifos, Dichlorvos, Tetrachlorvinphos	1A - carbamates	Methomyl
3A - pyrethroids and pyrethrins	Pyrethrin, Permethrin, Cyfluthrin, Prallethrin, Cyhalothrin, Esfenvalerate	4A - neonicotinoids	Clothianidin, Dinotefuran, Imidacloprid, Thiamethoxam
4A - neonicotinoids	Thiamethoxam	22A - oxadiazines	Indoxacarb
5 - spinosyns	Spinosad	28 - diamides	Cyantraniliprole

Table listing MOAs and example active ingredients

Other Considerations

- Larvicides can usually be tank-mixed with adulticides. Only mix insecticidal products with label approval to tank mix. There are several mixed products that are commercially available.
- Many insecticides benefit from lowering the pH of the spray mixture and will be more effective if citric acid or another acidifier is added. Only add approved acidifiers included on the product labels.

- Boric acid is an effective treatment for crawling insects and should be included to assist insecticide resistance.
- Spot and band insecticidal applications are more effective than whole house treatments.

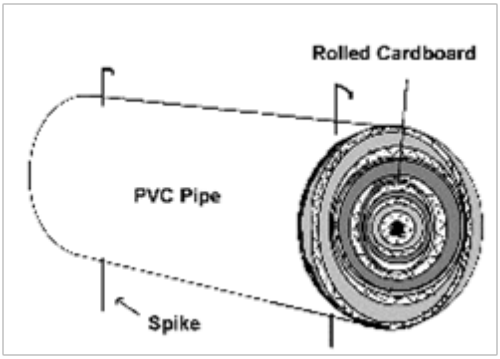
Setting action thresholds and target populations

Action thresholds are a target pest population that indicate treatment must be taken to prevent economic losses. As a part of IPM, an action threshold must be set according to each facilities economic needs and limiting factors. A target population of zero for house flies or darkling beetles (and most livestock pests) is unattainable, uneconomical, and inefficient to attempt to obtain. Focus on setting sincere action thresholds and obtainable target pest populations.

For house flies, one of the simplest methods for estimating populations is to use a sticky trap or a spot card. A spot card is a 3x5 inch index card hung in fly resting area to estimate population by the number of regurgitation and defecation “spots”. A minimum of five cards should be hung up in the resting areas for a seven-day period. At the end of the week, pull the cards and count the number of spots. An average of 100 or more spots typically signals a high house fly population for most facilities.

Index cards divided into grids can assist in counting house fly spots. Photo by Erika Matchinger

For darkling beetles, pest presence signals the need for a year-round pest management plan. Brand new facilities will observe darkling beetle populations building within a few flocks. The darkling beetle population should be monitored to check effectiveness of chemical applications and test for insecticidal resistance. Estimating darkling beetle populations can be done in a few different ways. An effective trap is a 9-inch-long piece of 1-1/2 inch PVC pipe that contains a rolled up piece of 8 inch X 11 inch corrugated cardboard. Three PVC traps should be placed in the middle of the houses, anchored in place, and checked either every week or every other week. Be consistent on timing of counts to get a proper estimate of population changes.



A cross section of a PVC Trap

Another method is to visually look for darkling beetles in the bedding underneath the feed line. Dig into the bedding 2-3 inches every 20-30 foot along the house and look for the adults and larvae moving through the litter. Record population visuals and differences throughout the house. Just like the PVC traps, visual monitoring should be done consistently to be helpful.

Putting it all together

By preparing an Integrated Pest Management program for house flies and darkling beetles, poultry producers can lower the physical destruction, disease transmission and nuisance risks these pests pose to their operation.

<u>For a successful IPM program:</u>

- Proper ID of pest and areas of larval habitat and adult refuge
- Utilize management methods from multiple types of control, focusing on preventative control.
  i.e.: proper litter and compost management (cultural), trap utilization for population estimates (physical) and larvicide use on areas of fly development (chemical)
- Have a decisive MOA rotation for any insecticidal treatments.
- Set guidelines for pest population monitoring and action thresholds.

IPM sounds great but what if I have a house fly problem now?

The great thing about IPM is the flexibility. Even if you are battling a high house fly population now, there are control measures from the four categories you can begin any time.

First, make sure that house flies are the actual flies of concern. An emergency or rescue insecticidal treatment approved for application with birds present can be made to rapidly decrease the adult population inside the houses and premise treatments can be made along the exterior walls.

Next, you need to identify where your house flies are developing. Those developmental sites should either be dried, disturbed, or removed. Remember that until that area of development is dealt with, it will keep producing new adult house flies and the rescue insecticidal treatments will seem ineffective.

Once the adult population is knocked down and the larval development site cleaned up, you can begin planning your IPM program and utilizing management measures from all four of the control types. After a rescue treatment is needed, intensive sanitation measures and specific insecticidal treatments for both adults and immatures should be included. If you live in a temperate climate, house fly populations should naturally decline in Winter and cold temperatures can serve as a population reset for house flies developing outside of climate control areas.

Thank you to Central Life Sciences for their contributions to this technical bulletin centrallifesciences.com

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