To Larvicide or Not: Is That The Question?

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Fly metamorphosis

House flies (*Musca domestica*), dump flies (*Hydrotaea aenescens)*, dark-eyed fruit flies (*Drosophila repleta*), stable flies (*Stomoxys calcitrans*), horn flies (*Haematobia irritans*), face flies (*Musca autumnalis*) and all other insects belonging to the Order Diptera go through unique sequential life stages to complete their life cycles. In the house fly, for example, adult female flies **[Fig. 1]** lay eggs **[Fig. 2, page 15]** that hatch into first-stage (instar) larvae or maggots within 48 hours at room temperature (68-72°F). These first-instar larvae transform into second-instar, then third-instar larvae **[Fig. 3, page 15]** within two weeks. Another two weeks are usually needed for third-instar larvae to transform into pupae **[Fig. 4, page 15]**, and then into adult house flies. Thus, at room temperatures, it takes about a month for house fly eggs to transform and go through three larval stages or instars, the pupal stage, and then adult house flies.

> ''It is estimated that 80–90 percent of all house fly individuals in an environment are in the larval stages; expanded use of larvicides can more thoroughly reduce the total house fly number in egg-producing poultry houses.''

The immature stages of the house fly (*Musca domestica*) do not look or behave like adult stage house flies. House fly larvae have chewing mouthparts; they develop and crawl around manure or any decaying organic matter. Adult house flies have wings, sponge-like mouthparts and alight and feed on sugary and protein-laden liquids. Because house fly larvae and adults are quite distinct both in form and function (they follow the so-called holometabolous or complete metamorphosis), different tactics are often necessary to thoroughly control the total existing population of house flies in the environment.

Fig. 1. An adult house fly (*Musca domestica*). (Photo: Mike Catangui)

What are larvicides?

Larvicides are a group of insecticides specifically labeled to control the larval stages of insects; adulticides are aimed at the adult insects. Because of the difference in the environments where the adult and larval stages of flies are found, the insecticide formulations, application rates, application procedures and equipment will also be necessarily different for larvicides and adulticides. Liquid larvicides, for example, are applied as a coarse spray over the manure piles; oil-based on-animal fly adulticides are applied as ultra-low volume (ULV) fogs [Catangui, 2017: Spray, Mist or Fog: Get to Know Your Insecticide Application Equipment, *Poultry Outlook*, Spring 2017, pages 16-18].

Table 1 lists the larvicides that are currently labeled for use in the manure area of egg-producing poultry houses. Contact larvicides impair the nervous system of the fly larva; mortalities are observed within 48 hours after application. Examples of contact larvicides are Elector® PSP, Ravap® EC, and Vapona®. The active ingredient in Elector® PSP (spinosad) is of natural origin; it is derived from the fermentation of a soil actinomycete (a group of soil bacteria) called *Saccharopolyspora spinosa*. The active ingredients of Ravap® EC and Vapona® are man-made organophosphate molecules **[Table 1]**. Because contact larvicides affect the nervous system of the insect, contact larvicides are also adulticides.

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TABLE 1. HOUSE FLY LARVICIDES FOR USE IN POULTRY HOUSES

MFR.	TRADE NAME	ACTIVE INGREDIENT	TYPE	RATE
BAYER	Ravap® EC*	tetrachlorvinphos (23.0%) + dichlorvos (5.3%)	contact larvicide	5.0 fl.oz. per gal. water to treat 100 sq. ft.
	Vapona® Concentrate Insecticide*	dichlorvos (40.2%)	contact larvicide	1.3 fl. oz. per gal. water; 1 to 2 qt. mixture per 100 sq. ft.
CONTROL SOLUTIONS	Tekko™ 10	novaluron (9.3%)	insect growth regulator (IGR)	1.5 to 3.0 fl. oz. per gal. water per 200 sq. ft. area
ELANCO	Elector® PSP	spinosad (44.2%)	contact larvicide	0.20 fl. oz. per 1 gal. water
	Neporex® 2 SG	cyromazine (2.0%)	insect growth regulator (IGR)	1.0 lb. dry granules per 200 sq. ft. or, 1.0 lb. per 1 gal. water to treat 200 sq. ft.
MGK	NyGuard® IGR Concentrate	pyriproxyfen (10.0%)	insect growth regulator (IGR)	0.4 fl. oz. per 1 gal. water to treat 1,500 sq. ft.

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. *Restricted use insecticide.

Insect growth regulators (IGRs) are designed to disrupt the growth and development of the fly larva **[Figs. 2-3]**. Insect growth regulators are mainly larvicides; they do not cause direct mortalities on the adult stage flies. Mortalities are not observed until the larva attempt to molt and transform into its next life stage. Examples of products that contain insect growth regulator larvicides as their active ingredients are Tekko™ 10 (novaluron), NyGuard® IGR (pyriproxyfen), and Neporex® 2 SG (cyromazine) **[Table 1]**. Novaluron is a chitin-synthesis inhibitor, pyriproxyfen is a juvenile hormone mimic, and cyromazine is a moulting disruptor (IRAC, 2017).

The effects of insect growth regulators can be better visualized in the pupal stage of the treated flies. **Fig. 5** shows deformed house fly pupae caused by an insect growth regulator. These deformed pupae were collected from poultry manure that was treated with novaluron (Tekko™ 10). **Fig. 6** shows deformed or abnormal pupae collected from poultry manure treated with cyromazine (Neporex® 2 SG). Deformed or affected pupae cannot transform into normal flies, thereby causing mortalities in the treated fly populations.

To larvicide or not?

A common question in fly integrated pest management is whether to larvicide, adulticide or both. In fly integrated pest management, I recommend using both adulticides (fly baits, on-animal sprays, and empty-barn residual sprays) and larvicides [see Catangui, 2017: Controlling Disease-Carrying House Flies in Poultry Houses, *Poultry Outlook*, Spring 2017, pages 11-14, for a complete listing of insecticides for use in poultry houses].

Although adult flies present a more imminent danger in terms of disease transmission in livestock and humans, one should not overlook the fact that adult flies come from fly larvae or maggots breeding within a few distance away from where adult flies are being observed. And in terms of number of individuals per unit area, flies in the larval stage represent over 80 percent of the population in the environment. **Fig. 7** shows a six-by-six-inch sampling quadrat that was used for quantifying the number of dump fly (*Hydrotaea aenescens*) larvae on the manure pile of a commercial egg-laying poultry farm. Six adult dump flies and 36 larval dump flies were observed in the sampling area. That is, about 86 percent of the fly individuals were third-instar larvae; 14 percent were adult flies. By extrapolation, using a larvicide treatment in this situation

could have potentially eliminated close to 90 percent of the dump fly population in the environment, compared to only about 14 percent if an adulticide was used.

Summary

Larvicides are insecticides developed for the purpose of causing mortalities in the larval or maggot stages of house flies and other holometabolous insect pests. They are often overlooked in terms of usage and commercial development of new insecticides. Currently, only about 14 percent of all insecticides available for fly control are labeled as larvicides; 84 percent are labeled as adulticides. It is estimated that 80–90 percent of all house fly individuals in an environment are in the larval stages; expanded use of larvicides can more thoroughly reduce the total house fly number in egg-producing poultry houses.

Reference:

Insecticide Resistance Action Committee [IRAC]. 2017. IRAC mode of action classification scheme. (http://www.irac-online.org/teams/mode-of-action/).

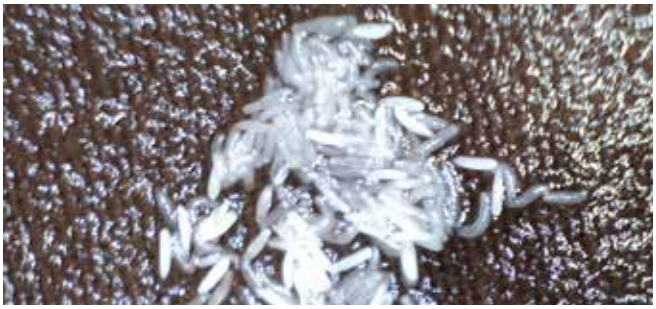

Fig. 2. House fly eggs and newly-hatched larvae. (Photo: Mike Catangui)

Fig. 3. Third-instar house fly larvae. (Photo: Mike Catangui)

Fig. 4. House fly pupae. (Photo: Mike Catangui)

Fig. 5. Deformed house fly pupae caused by novaluron, a chitin-synthesis inhibitor IGR, beside four normal pupae (on right). (Photo: Mike Catangui)

Fig. 6. Deformed house fly pupae caused by cyromazine, a moulting disruptor IGR. (Photo: Mike Catangui)

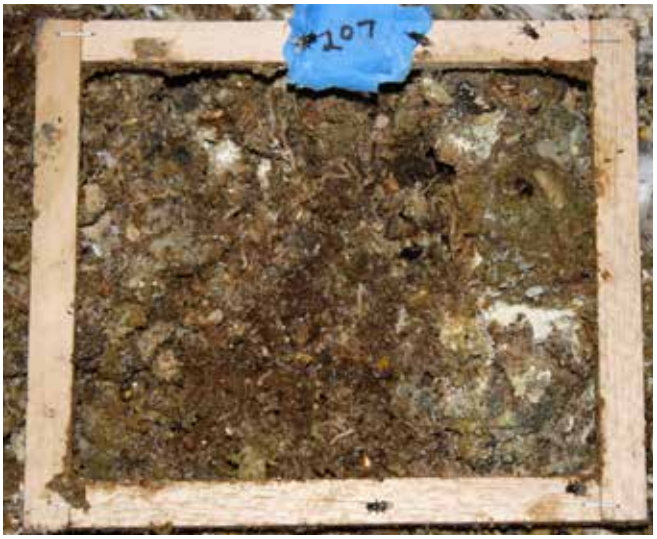

Fig. 7. Adult (resting on wooden quadrat) and larval dump flies on a manure habitat in a caged-layer poultry house. (Photo: Mike Catangui)

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