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# Using Parasitoids to Control House Flies in Confined Animal Facilities

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Confined animal facilities (CAFs) such as dairies can use biological, cultural and chemical controls to keep house flies at manageable levels. Such measures are part of integrated pest management programs designed to (1) avoid, prevent and limit economic loss and (2) minimize environmental and health risks often caused by misuse of pesticides as a primary or sole pest control alternative.

Biological controls use pests' natural enemies to suppress them, reducing both pest numbers and pest damage. Using biological controls in CAFs requires basic knowledge about the pest's biology and natural enemies in order to evaluate commercially available biological control agents and select the best one. This fact sheet will update managers about using biological control practices in their CAFs to combat house flies.

## House Flies and Their Parasitoid Enemies

Like all insects, house flies, *Musca domestica*, undergo metamorphosis. Adult flies lay eggs on manure and other substrates such as calf bedding materials, wet feed or silage. The eggs hatch, and maggots emerge to feed for a few days on the substrate. Once maggots ingest sufficient nutrients, they transform into pupae protected by reddish-brown shells, from which adult flies emerge once their development is complete. House flies' natural enemies included predatory beetles and mites that feed on eggs and maggots and several parasitoid wasp species that attack pupae.

***Parasitoids*** are unlike most parasitic insects because they usually kill their hosts. Adult parasitoids are free-living; only their immature stages are parasitic, feeding on or inside their hosts. The most common house fly parasitoids belong to the family Pteromalidae (Hymenoptera), a large group of beneficial wasps that will not sting people. Some of these parasitoid species are native to Texas, and many are available commercially for purchase and release.

The female parasitoid wasp seeks out house fly pupae. Using her *ovipositor*, she probes the pupa and feeds on it, then deposits one or more eggs inside the pupal shell. (An *ovipositor* is a stinger-like appendage used to lay eggs.) The female wasp's probing kills the fly pupa, then a wasp larva emerges from the eggs laid in the pupal shell and feeds on the dead fly inside. When fully developed, an adult wasp emerges from the pupal shell to mate and search for new fly pupae.

The most important parasitoids for biological control of house flies include several species of

*Muscidifurax*, *Nasonia*, and *Spalangia*. These parasitoid species have slight but important differences in biology and host preferences, described as follows:

- ***Muscidifurax raptor*** is the most commonly used parasitoid for biological control of house flies. Found naturally throughout the year in Texas and the rest of the United States, it also parasitizes blow flies and flesh flies. Female *M. raptor* most actively search for pupae located in the top two inches of a fly-breeding substrate; typically they do not attack fly pupae below this level. Females deposit one egg per pupa; each female can lay up to 100 eggs in a lifetime. Adults are strong fliers and may disperse from CAFs after release.
- ***Muscidifurax zaraptor*** is biologically similar to *M. raptor*. It primarily searches for host pupae located on surfaces of house fly-breeding habitats, down to approximately one-inch deep into substrates. Adults may disperse 30 to 70 feet from a release point.
- ***Muscidifurax raptorellus***, considered a warm-weather wasp, actually may be the species most commonly produced for sale in the United States. Female *M. raptorellus* may deposit more than one egg per house fly pupa, laying as many as 150 eggs during a lifetime. The ability to produce more than one individual per host pupa accounts for rapid population growth. This species also does not disperse far from its release point, so it is more likely to remain within CAFs after initial release.
- ***Nasonia vitripennis***, distributed throughout North America, is easily raised in the laboratory. It parasitizes several fly species and can search for pupae located deeper into the fly-breeding substrate. A single adult female may produce up to 140 to 200 eggs during her lifetime and may deposit several eggs into a single house fly pupa. However, *Nasonia vitripennis* is considered generally ineffective at suppressing house fly populations because it cannot locate hosts under field conditions. Consequently, this species is not recommended for release into CAFs such as dairies.
- ***Spalangia cameroni*** is distributed throughout North America; in southern states like North Carolina, it is active primarily from late summer through fall. It attacks house flies and other fly species. Females can discriminate between hosts and prefer un-parasitized hosts to previously parasitized ones. Generally, this species confines its searching to the top two inches of fly-breeding substrate, but it may attack hosts located as deep as five inches into the substrate. Each adult female may produce up to 25 viable offspring during her lifetime. Little is known about its dispersal from a release point.
- ***Spalangia endius*** also is distributed throughout the United States; it is one of the parasitoids preferred for biological control of house flies in North Carolina, where it is active from summer through fall. It attacks house flies and other fly species. Searching extends to hosts located up to five inches below the surface of the soil or fly-breeding substrate. Females deposit one egg per house fly pupa, and each female lays an average of 34 eggs during its lifetime. Little is known about its dispersal from a release point.
- ***Other species***. There are several other house fly parasitoid species in Texas, including *Muscidifurax uniraptor, Pachycrepoideus vindemiae and Spalangia chontalensis, S. drosophilae, S. nigra, S. masi* and *S. nigroaenea*. However, these species have not received much attention as biological control agents.

## Using Parasitoids for Biological Control

Many species of house fly parasitoids occur naturally in Texas but not in sufficient numbers or at the right times to provide desired control levels. Native parasitoid populations can be conserved by using compatible insecticides, such as bait products containing methomyl and space-treatment products containing pyrethrin. Purchasing and releasing natural enemies is called "augmentation biological control"; its intent is suppression of pest populations by increasing pest mortality due to these agents. Effective biological control through augmentation requires:

- Selecting parasitoid species adapted to local conditions
- Purchasing high-quality natural enemies
- Releasing parasitoids at the correct rate, frequency and time
- Using release methods that ensure parasitoid survival and dispersal

Before purchasing and releasing parasitoids, make sure you have answers to these important questions:

1. **What species do I have already in my facilities? Are my natural populations effective at suppressing house flies?**

   Native populations already may be present in your facilities, so inoculation with purchased material might not be necessary. During the summer, collect samples of 10 to 15 house fly pupae from various fly-breeding sites around

your CAF to assess natural control by native parasitoids. Collect only old (mature) pupae (dark brown or black), because they are more likely to be parasitized then are young pupae (tan or light brown). Place samples in a closed container and store them at room temperature. Assess parasitism approximately 2 weeks after sample collection by observing house fly and parasitoid emergence. Adult house flies break off one end of the pupal shell upon emergence; adult parasitoids emerge through pinholes. Contact your local county Extension agent for help identifying parasitoid species.

2. **What parasitoid species should I purchase and release?**

   Consider time of year, house fly-breeding substrate and infestation levels. Some parasitoids will attack only those house fly pupae located on substrate surfaces. *Muscidifurax raptor* and *M. zoraptor* are more effective at killing house flies than other species. Avoid purchasing *N. vitripennis* because it is not considered a good biological control agent.

3. **How many parasitoids should I release?**

   Research in other states has indicated effective weekly release rates of either 200 parasitoids per milking cow or 1,000 parasitoids per calf. However, every situation is different; release rates should be adjusted to achieve cost-effectiveness.

4. **What is the quality of the parasitoid product sold?**

   Parasitoid wasps are sold in the form of parasitized house fly pupae. High-quality products will produce high ratios of adult wasps to released pupae. Assess product quality frequently by taking a sample of 50 to 100 pupae from each shipment and placing it a closed container kept at room temperature. Percent emergence can be estimated by counting the number of pupae with wasp emergence holes relative to the total number of pupae in your sample. Insect diseases may contaminate insectaries and reduce product quality; it is important to obtain only high-quality, disease-free parasitoids.

5. **Are parasitoid releases cost-effective?**

   Sampling methods described above can be used to monitor parasitization rates and house fly suppression. Compare numbers of flies observed in suppression areas to those observed in areas without released parasitoids or with previous infestation records. Monitoring programs also help to identify the best release methods to achieve house fly suppression in particular production systems. Prices of parasitoids vary, averaging about $13.00 per 10,000, plus shipping and handling costs. Release rates are suggested at 200 per cow, which translates into $2.40 to $4.70 per cow per season.

6. **Where can I purchase parasitoids?**

   A complete list of suppliers is posted at *http://www.cdpr.ca.gov/docs/impinov/ben_supp/filthpar.htm*.

7. **How does the company-of-interest compare with other insectaries?**

   Always check the competition and compare effectiveness, product quality and per-unit prices. Check for consistency between shipments, and be aware of unsupported claims of effectiveness.

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