Filth Fly Control on Horse Farms

Common Filth Flies in Equine Facilities and Control Options
Most horse owners are probably familiar with this sight: your horse standing in the stall or field, tail swishing, withers twitching, head swinging around to remove a pest fly that is biting, or head shaking to dislodge flies attacking eyes, nose, or lips. Fly pests on equine facilities are common, especially during warmer spring and summer months. While many control options are available, determining the most effective and safe methods isn’t always easy.

Pests found on horse farms are often also problems on livestock and poultry farms. However, equine management practices like bedding choice, turnout, and manure storage, among others, are vastly different from those of other animal facilities. Even among horse farms, management practices and facility structure and layout (like acreage) can vary widely. These differences can change both the risk for pest presence and how effective pest control measures will be.

Unfortunately, there isn’t one silver bullet to fly management. For example, simply spraying insecticides may not work if you are not targeting the right species, and may also kill beneficial insects and contribute to the development of insecticide resistance in many pest flies.

This guide will review basic identification and biology of the major filth fly pests found in horse facilities: house flies, stable flies, face flies, and horn flies. Guidelines on tolerance thresholds and monitoring options, as well as control and evaluation techniques, are included.

Understanding Integrated Pest Management

The most effective and environmentally sensitive approach for controlling pests is through integrated pest management (IPM). IPM focuses on maximizing pest control with appropriate available pest control strategies while minimizing risks to people, animals, and the environment. Establishing an IPM plan for your horse farm involves six basic steps:

1. Identify your pest(s).
2. Learn the basic biology of the pest(s).
3. Monitor pest populations.
4. Determine tolerance thresholds.
5. Implement prevention, management, and control methods.
6. Evaluate the plan.
What Is the Big Deal with Flies?

The obvious answer is, “They are annoying!” and to not just horse owners but their animals as well. However, there are more risks associated with fly populations than just nuisance problems.

Flies can transmit pathogens that cause disease or other conditions in horses; for example:

- Equine infectious anemia can be transmitted by stable flies.
- Equine stomach nematode worms (*Habronema* spp.) can be transmitted by filth flies.
- Arthropod hypersensitivity and pruritus (itching) in horses has been linked to biting flies.
- The bacteria that cause pigeon fever, *Corynebacterium pseudotuberculosis*, can be transmitted by house flies.
- Fecal and other pathogenic bacteria, such as *Escherichia coli* and *Salmonella*, acquired by flies can be transmitted to humans when the flies land on residents or household surfaces.

Flies also have a negative impact on horse condition and physiology. Fly pressure may:

- Cause pain and irritation, and cause pest avoidance responses including tail swishing, head and neck movements, and twitching
- Lead to changes in grazing behavior like reduced grazing time and lower forage intake
- Reduce energy available for growth, reproduction, and body condition maintenance
- Increase blood cortisol concentrations, heart and respiration rates, and rectal temperatures
- Cause eye and skin disorders, including allergic dermatitis

Behaviors like constant stomping and movement and reduced grazing can have serious effects on the performance of pastured and show horses and may cause long- or short-term injury or losses of condition. Clearly, risks associated with high numbers of both biting and non-biting flies are more than just annoyance. Because of these risk factors, it is important to consider developing an IPM plan for fly control.
Steps 1 and 2: Identify the Pest and Learn the Biology

Q: Why should I learn to identify the pests and their life cycles?

A: Identifying the pest of interest and learning its biology is important for establishing a control program. This information can help you understand:
1. The options available for that particular pest
2. How you can interrupt the pest’s life cycle with the respective control options

Four common filth fly pests are discussed in this guide: house flies, stable flies, face flies, and horn flies. These fly pests are similar in size, shape, and color, and develop in similar habitats containing fresh or decomposing organic matter.

All the pest flies discussed here have four distinct life stages: egg, larva, pupa, and adult. Usually, once you start noticing high numbers of adult pests, it is too late to do much to quickly solve the problem. However, targeted control options are available for each of these fly pests and life stages, with the goal being to break (or interrupt) the life cycle at one or more points and reduce pest numbers.
Not every filth fly is a pest!

While some pest flies can be very common on horse farms, other flies that are not necessarily pests can be found and are often confused with fly pests. These flies often develop in trash, carrion, or other decaying matter, but typically do not cause animal or human disturbance. In fact, some of these flies, like the black soldier fly, are actually beneficial in reducing pest fly numbers. If high levels of these flies are present and causing nuisance problems, it is best to locate where these flies are developing and remove the source. Identification: top left, black soldier fly; bottom left, green bottle fly; top right, flesh fly; bottom right, blue bottle fly.

Not every pest is a filth fly!

Several species of fly pests are common on equine facilities that are not discussed in this guide. Black flies, deer and horse flies, biting midges, and mosquitoes are all common biting flies. While these flies are common, they do not develop in the same materials as filth flies, and an IPM plan for filth flies will not affect these populations. If present, a management plan for these specific pests should be developed because they can also transmit pathogens that cause disease in humans and horses. Identification: top left, mosquito; bottom left, deer fly; center, horse fly; right, black fly.
LEARN ABOUT THE HOUSE FLY

General Biology

An adult house fly can lay several clutches of up to 200 eggs at a time. These eggs are laid in organic material with some heat and moisture—such as in manure, soiled bedding, spilled feed, decaying grass clippings or hay, or similar materials. House flies can fly several miles to find suitable areas for development. It is important to identify whether flies are developing on the farm or adults are flying in from neighboring facilities. Total development time from egg to adult depends on environmental conditions, the most important of which is temperature. Under ideal summer conditions, fly development can occur in as few as seven days.

Identification

Adult house flies are non-biting flies with sponging mouthparts. These flies are frequently found on the head near the lips, nostrils, and eyes, or near open wounds. Unlike face flies, house flies can be seen on all parts of the animal body. House flies have mostly gray bodies with yellowish abdomens, four black stripes on the thorax (the area of the fly directly behind the head), and are about ⅜ inch in length. In general, males and females look similar. However, it is important to note that size and color may vary among individuals, depending on development and local population factors. Posture is another way to recognize different species. At rest, house flies hold their body parallel to the surface and have downward-facing mouthparts.

House fly larvae are cream colored to slightly yellowish and have a blunt posterior end that tapers to a point at the head. The larvae go through three stages, getting slightly bigger at each stage. Younger larvae are found slightly deeper in the material in which they are developing, and older larvae move closer to the surface as they find dryer areas in which to become pupae. House fly pupae are oval, red to red-brown, and look like rodent droppings. They can be distinguished from rodent droppings primarily by shape, with fly pupae being rounded and not tapered at the ends. The fly develops in the pupa stage and emerges as an adult in several days.

What You Need to Know about House Flies

- Identifying house fly adults is the key to management.
- Adults have four black stripes behind the head and a yellow abdomen.
- Watch for fly location on the animal body, coloration, and mouthparts. House flies are found near the eyes, nose, or wounds, and have downward-facing mouthparts.
- House flies hold their body parallel to the surface where they are resting.
LEARN ABOUT THE STABLE FLY

General Biology
Stable flies are biting flies with long, pointed mouthparts that can cause pain when biting. Both males and females need to feed on blood daily, and they often feed on the legs. Because stable flies are sensitive to hot summer temperatures, seasonal activity differs by environmental conditions and region of the country.

Stable flies can lay several clutches of 60 to 130 eggs. Stable flies can fly several miles to find sites suitable for laying eggs, and do seem to frequently develop in equine-associated substrates, including manure, waste hay (especially near round hay bales), and other decaying organic matter.

Identification
Adult stable flies are about ¼ to ⅜ inch in body length. They are gray with a tan spot between the black stripes, which are slightly lighter in color than on the house fly. Stable flies also have brownish-gray spots on the abdomen. Stable flies can be distinguished from house flies at rest by body posture. At rest, stable flies hold their body at an angle to the surface with the head higher than the rear and have forward-projecting mouthparts. This is in contrast to house flies, which hold their bodies parallel to the surface and have downward-facing mouthparts.

Stable fly larvae and pupae are nearly identical to house fly larvae and are often found in the same types of development substrate. If identification of immature filth flies is necessary, sample specimens can be collected in isopropyl alcohol and sent to extension educators for identification.

What You Need to Know about Stable Flies
If you see horses constantly stomping, you probably have stable flies.

- Stable flies have a tan spot behind the head and a checkerboard abdomen.
- Watch for fly location on the animal body, coloration, and mouthparts (stable flies are typically on the legs of the animal and have forward-projecting mouthparts).
- Stable flies hold their body at an angle to the surface on which they are resting.
- Immature stable flies are often confused with other filth flies. Recognizing adults is important for deciding on a control method.
LEARN ABOUT THE FACE FLY

General Biology
Preferred material, and likely the only material, for face fly egg-laying is fresh cattle manure, which makes face flies a primary concern in mixed-use facilities (those with horses and cattle) or at horse farms that are near cattle facilities. Development from egg to adult takes about two to three weeks, depending on environmental conditions. Adult flies can travel several miles while searching for new hosts.

Identification
Face flies resemble house flies, and distinguishing between the two can be difficult. Adults are ¼ to ⅓ inch long and, like the house fly, have a gray thorax and four black stripes. Female flies have a gray abdomen with yellowish-orange sections toward the front of the abdomen.

Like the house fly, the face fly has downward-facing sponging mouthparts. The feeding behavior of the face fly can help distinguish it from other flies. Female face flies preferentially feed on the mucosa associated with the eyes and nose, so they are often found on the face. However, they can also be found on open wounds or in large groups resting on fence lines. Males feed on nectar and dung. Unlike house flies, face flies are rarely found in barns or other buildings, but they can enter buildings during the fall as they seek shelter in which to overwinter.

Both the larvae and the pupae of the face fly resemble house flies. However, the pupae are calcified (hardened), which makes using biological control with parasitoids inadequate for control of this species as the parasitoids cannot penetrate the calcified pupal case.

What You Need to Know about Face Flies
Location! Location! Location!
• Watch for fly location on the animal body; face flies are often found in large numbers on the head of the animal.
• Adults look similar to adult house flies but have orangish sections on the sides of the abdomen.
• Face fly larvae develop in cattle manure, so larvae will not develop on equine farms unless cattle are also present. Adults will fly from local cattle farms; thus, adult control is necessary.
LEARN ABOUT THE HORN FLY

General Biology
Cattle manure is the requisite habitat for horn fly larval development, and adults feed principally on cattle. However, horn flies typically diapause (similar to hibernation) as pupae over the winter in most subtropical and temperate areas. Horn fly populations are a year-round nuisance to cattle in the southeastern United States, with lower populations in the winter.

Identification
Adult horn flies have blackish or brownish-gray bodies with wings that slightly overlap and are held flat over the abdomen. These flies are smaller, ranging from about 1/6 to 1/5 inch in length, and slightly narrower than the other filth flies. Instead of four stripes, the thorax has two stripes just behind the head and no patterns on the abdomen. Horn flies are blood feeders with mouthparts that are similar to but shorter than those of stable flies.

Horn flies differ from stable flies in development substrate as well as other body features. Horn flies develop exclusively in fresh cattle manure, whereas stable flies prefer decaying organic matter that is slightly older and from various sources. Horn flies are accidental pests of horses in that they can feed from horses but cannot complete their development in horse manure or horse-associated substrates.

A female horn fly can lay up to 100 to 200 eggs during her life of approximately six to seven days. The time required for the horn fly to complete its life cycle is between 10 and 20 days, depending on the temperature and time of year. They are typically found on horse facilities that are near cattle facilities. Horn flies are found on the withers and the back of the animal, and will move to the belly during hot parts of the day. The larvae are off-white or cream in color, have a tapered appearance on one end, and are rounded on the other end. They are slightly more elongated than other filth fly larvae. Pupae are similar to those of other filth flies.

Horn flies are obligate blood feeders with forward-facing mouthparts similar to those of stable flies. However, horn flies are smaller, have shorter mouthparts, and are typically found on the body of the animal, whereas stable flies are often found on the legs.

What You Need to Know about Horn Flies
Horses are accidental hosts; horn flies may be found as adults, but they are not developing on your farm unless you also have cattle.
- Horn flies resemble stable flies but are smaller, narrower, and have shorter mouthparts.
- Their wings overlap and are held over the abdomen.
- They are found primarily on the back and belly, not just the legs like stable flies.
- Immature development occurs exclusively in cattle manure, so they will not develop on farms that have only horses. Adult management is required.
A Note on Lesser House Flies (*Fannia* spp.)

Lesser house flies are generally associated with poultry facilities, where they can be a significant nuisance due to their flight habits. Males spend much of their time in flight and have a characteristic hovering and circling pattern. Larvae of the lesser house fly have a “hairy” appearance compared to the smooth larvae of other filth flies. Adult lesser house flies are similar in appearance to the common house fly but smaller and with three stripes on the thorax that are less pronounced. The base of the abdomen also has a distinct yellow patch on either side. Development from egg to adult is about two weeks in warmer weather. Lesser house flies may be found in equine stables in areas near poultry facilities or in mixed-use farms; however, they do not commonly develop in equine-associated materials. Many of the methods used for controlling house flies can be used for lesser house fly if they become a nuisance.
Step 3: Monitor Pest Populations

Q: Why should I monitor pest numbers? I can see that there are flies!

A: You need to monitor pest numbers to establish whether pest numbers are increasing or your control methods are working in an objective way. In some cases, monitoring can help you determine where pests are coming from.

Keys to successful monitoring:
1. Count pests consistently at the same time intervals. When counting pests that are on hosts, do so at relatively the same time of the day.
2. Keep good records.

Monitoring should be established before pests become a problem, but it can be started at any point. Filth fly problems generally occur from spring through fall, with peak populations occurring in July and August, depending on local climate and weather patterns. Because fly behavior is very different among species, monitoring methods need to be adapted to the pests that are present.

MONITORING HOUSE FLIES

House flies are probably the easiest of the filth fly species to monitor. Adults can be monitored using baited traps, sticky ribbons, or spot cards.

Baited traps can be purchased commercially or made at home. Commercial traps use attractive bait or pheromones to attract adult flies. These same attractants can also be used in homemade traps. An easy way to build a homemade trap is to cut four 2-inch holes in the upper part of the sides of a plastic milk jug. Place the bait or the pheromone and water on the inside and bottom of the jug. Hang the jug in the barn in the eves where flies generally rest or on fence lines. These traps can also serve as control methods, if left long enough.

Like jug traps, sticky ribbons can be purchased commercially and hung in areas where flies congregate. Also like jug traps, sticky ribbons have the added benefit of capturing small numbers of flies. However, they can be unsightly depending on where they are hung, and can collect dust and other particulate debris that make the stickiness less effective.

Spot cards are 3-to-5-inch white index cards that are placed on rafters, eves, or building supports where flies like to rest. As flies rest on these surfaces, they leave fecal and/or regurgitation spots that can be counted. Spot cards can be stored for long-term historical records.

Facility size and structure will determine how many fly ribbons, jug traps, or spot cards are needed. A minimum of five placed at relatively equal distances throughout the facility is recommended for indoor barns or spread around fence lines for pasture situations. They key is complete coverage of areas where pests have been observed. In general, jug traps catching over 250 flies per week or spot card counts over 100 are indicative of high levels of fly activity.

Word of caution: Pheromone traps can have unattractive scents, and traps need to be replaced frequently—at least every seven days, if not sooner—in the summer months since dead flies will serve as a suitable place for new flies to develop. For monitoring purposes, leave traps out for a day and then count the captured flies.
MONITORING STABLE FLIES

Monitoring of stable flies is typically conducted in one of three ways: (1) counting individual flies on horse legs, (2) counting fly-avoidance behaviors, or (3) using stable fly traps.

On-animal and fly-avoidance behavior counts should be conducted at regular intervals during the same time of day. Counting the number of flies on the legs or the number of stomps is typically the most reliable since stable flies tend to bite below the elbow and stifle on horses.

While stable fly traps are somewhat more difficult to use, they are more reliable because they allow you to accurately identify the species of fly. Sticky traps, such as the Starbar Bite-Free Trap or the BugJammer Knight Stick, can be used to both monitor and control stable flies.

MONITORING FACE FLIES AND HORN FLIES

Both face flies and horn flies are best monitored on the animal by either fly counts or evasive behaviors, as previously mentioned for stable flies.

For horn flies, count the number of flies on the head, shoulders, and back of several horses. If horses are moving around due to fly pressure, a single count along the side, back, or another specific body location can be made. Keep in mind that if it is warm, flies may be on the underside of the abdomen. The key is to take counts consistently—at the same time of day, on the same animal, in the same location on the farm, and in frequent (e.g., weekly) intervals.

WHERE TO LOOK FOR FLY DEVELOPMENT

House flies and stable flies can find habitat suitable for development on equine farms. While adults are easiest to monitor, you need to identify whether they are developing on the property before control plans are put in place. If not, some control options (such as using parasitoid wasps) will not be effective. At the very least, determine whether suitable habitats for development exist.

**What You Need to Know About Monitoring**

Different flies will be monitored and controlled in different ways. House flies can be monitored with traps and spot cards, while stable flies, face flies, and horn flies can be monitored with on-horse counts. Remember the keys: consistency and recordkeeping.
Dirty stalls or barn areas, especially around the edges or under floor mats in stalls and trailers, are protected and moist areas that are suitable for fly development. Manure left in a manure pile or sitting in a wheel barrow or manure bucket can support fly development. Flies can hatch in less than 12 hours after eggs are laid in the right conditions.

Waste hay surrounding round bales or left on the ground after feeding is ideal habitat for filth fly development, stable flies in particular.
Flies can develop quickly in waste hay and manure. The edges of rubber mats in stalls and horse trailers are good places to check for fly development. Shaded manure piles can produce excellent habitat for fly development as it keeps the temperature too low to compost and moisture high.
Step 4: Determine Tolerance Thresholds

Q: What is a tolerance level?

A: A tolerance level is the number, density, location, or other factor(s) of pests that can be tolerated at a facility. Control plans should be in place to manage pests before they reach this level.

Farms can be spotless, perfectly managed, and still have pest problems. At times, this is due to proximity to other farms that are producing adult pest flies. Therefore, it is unrealistic to have a tolerance threshold of zero. In some cases, a certain number of pests can be tolerated. Conversely, there is a point where control must be implemented. In typical farming situations, this is the economic threshold—the point where the cost of damage created by the pest(s) exceeds the cost of control.

On equine farms, tolerance to certain pests may also vary by whether they are a human or animal health hazard (low tolerance) or merely a nuisance (high tolerance). These may be levels implemented by the farm owner or clients that worry about animal health. It is important to establish some baseline of tolerance, usually by monitoring fly numbers.
Step 5: Implement Prevention, Management, and Control Methods

Q: What does “integrated pest management” mean?
A: Integrated pest management (IPM) is the use of multiple methods to maximize pest control while minimizing cost and risks to humans, animals, and the environment.

The four methods of IPM are:
1. Cultural control
2. Mechanical/physical control
3. Biological control
4. Chemical control

Integrated pest management may, but doesn’t necessarily have to, involve multiple strategies to control flies. If fly development is identified in an area that can be easily managed (e.g., a manure pile), a single strategy to eliminate or move the manure pile or exclude flies from the pile may be enough. In other cases (e.g., when multiple species are present or the farm is mixed use or neighbors other livestock), multiple strategies may need to be employed.

The IPM pyramid is a simple way to view different control strategies. Cultural control (or sanitation control) is more preventive, and the options get more reactionary as you move up the pyramid. Options at the bottom of the pyramid are also more environmentally benign, whereas methods at the top of the pyramid have greater potential to impact the environment. It is important to consider all options from a pest management, time, and resources standpoint when selecting control options.

A Note on Chemical Control
It is a misconception that IPM does not include chemical control. Synthetic or natural chemicals can be used judiciously as part of an overall IPM strategy.
CULTURAL CONTROL METHODS

Moisture Management

The keys to cultural control, or sanitation, are moisture and manure management. Moisture may come from natural water sources, like rain, or artificial ones, like leaky hoses and waterers. Moisture is naturally present in animal waste as well, which allows it to be a suitable site of development for many filth flies. Basic water management can reduce many natural sources of water. Proper farm and facility drainage should be established, and leaky waterers, hoses, or other water sources should be repaired quickly. In addition, proper ventilation, like the addition of outdoor-rated fans, can aid in quick drying of bedding and stored manure.

Manure Management

Manure management eliminates sites that are suitable for fly development. Many fly eggs can hatch in as little as 12 hours, so proper removal and storage can limit pest problems. Ideally, manure should be removed from horse stabling and congregation areas daily. There are many ways to deal with waste manure, but the most common methods on equine facilities are manure accumulation areas and spreading manure over paddocks or other land. It is important to understand and follow the regulations concerning manure and nutrient management in your state.

Bedding Choices

Along with frequent cleaning, bedding choices can influence fly development in both stalls and manure piles. Sawdust tends to support fewer developing flies than other bedding choices like shavings and straw. Adding a drying agent can keep stall floors unsuitable for mass fly production, although flies will often find small protected places, such as between rubber stall mats or at the edges of stall walls, to develop. Applied daily at 1.1 kilograms per stall, sodium bisulfate is safe for stalled horses and has been found to lower the pH of soiled bedding enough to reduce fly development.

Other Practices

Other sanitation practices can reduce the likelihood of fly development or limit nutritional resources for adult flies. Keeping feed storage areas clean, removing spilled feed quickly, and covering feed in bins will eliminate many sugar resources. Round bale management can reduce fly development, particularly stable flies. Moving round bale sites or protecting round bales with metal rings or other exclusion devices not only will prevent waste from being trampled and becoming fly habitat but can also save money due to waste reduction.

MECHANICAL/PHYSICAL CONTROL METHODS

Mechanical and physical control are methods that modify environmental factors, use mechanical force or manual labor, or prevent pest presence to minimize pest problems.

Exclusion

Some of the easiest ways to incorporate mechanical control into an integrated pest management plan for equine farms is by exclusion. Fly screens on windows in barn areas can reduce fly presence in the stable areas. On-animal fly problems can be reduced by using physical exclusion methods such as fly sheets, masks, and boots. Fans in the stable area can interrupt flight and prevent some flies from landing.

Manure Management

Mechanical methods can be used to modify manure management. Rather than being stocked in a designated pit area, manure can be spread on the field after it is removed from stalls. This spreading allows the manure to dry fast enough to support little or no fly development. Manure can also be actively composted. This requires frequent turning and covering to maintain a high internal temperature that will kill developing flies.

Sawdust has been shown to support fewer developing flies in some studies.

Fly sheets, masks, and boots can be used to keep fly pests from accessing the face, legs, or body of horses.
flies. Simply covering manure (with a secured tarp or similar material) can exclude adult flies and keep them from laying eggs. Tarping can be used without turning if exclusion alone is desired. The most important areas to cover are material being added to the pile and material that is up to seven days old.

NRCS and some state conservation districts can help provide recommendations that will improve manure storage and handling practices on a farm. While these manure management methods will not prevent horn fly or face fly development if cattle are present on site, frequent dragging of paddocks to spread manure pats can eliminate suitable development sites.

**BIOLOGICAL CONTROL METHODS**

Two methods for biological control of filth flies on equine farms are parasitoid wasps and entomopathogenic fungi. Both of these methods have pros and cons and require some background information to be effective.

**Parasitoid Wasps**

Parasitoid wasps are likely the most common biological control for filth flies. These tiny, stingless wasps can be purchased commercially. The wasps attack and kill the pupal stage of developing filth flies, primarily house flies and stable flies. Parasitoid wasps are almost unnoticeable because they are extremely small (1/16 to 1/8 inch), but they appear naturally on most farms with developing flies. Female parasitoid wasps lay eggs in the fly pupae. The eggs hatch and the tiny larvae consume the developing flies, effectively killing them. The larval wasps develop within the pupae and then emerge as adult wasps to repeat the cycle.

Major species of parasitoid wasps found naturally on equine farms are primarily *Spalangia endius* and *Spalangia cameroni*. Though sold by several companies in the United States, companies vary in their knowledge and colony quality. Please note that this is not a suitable control method for horn flies or face flies that develop exclusively in cattle manure.

Using these wasps is fairly straightforward. If you are considering parasitoid releases, see “Use of Pupal Parasitoids as Biological Control Agents of Filth Flies on Equine Facilities,” published in the *Journal of Integrated Pest Management* and available at [https://academic.oup.com/jipm/article/6/1/16/2936983](https://academic.oup.com/jipm/article/6/1/16/2936983). This open-access article highlights the use of parasitoids on equine facilities.

Covering manure piles with a black tarp can increase the temperature of the waste so that it is not suitable for fly development. This can also prevent adult flies from laying eggs.

Parasitic wasps are very small biological control agents of house and stable flies.

Spreading manure in thin layers helps the manure dry out and reduces filth flies’ ability to develop.

The fly and parasitoid life cycle. An adult fly will lay eggs that emerge and develop into the larval stage. Once the larvae pupate, adult female wasps will lay an egg that develops within the fly pupae, killing the fly. The fully developed adult parasitoid emerges to start the cycle over.
Fungal Control

Another potential biological control approach is the use of entomopathogenic fungi such as *Metarhizium brunneum* var. *anisopliae* and *Beauveria bassiana*. These fungi are naturally occurring and found in soil. When isolated and used as a fly control, 75 to 100 percent fly control can be achieved in about two weeks or less, depending on strain. While no current products are labeled for fly control on equine facilities, research is exploring the development of new products using these safe and beneficial-insect-friendly fungi as traps or biopesticides.

CHEMICAL CONTROL METHODS

Two problems exist with relying on chemical insecticides for filth fly control. First, since fly resistance to active ingredients has been increasing, it is becoming more difficult to find products that work. Second, while insecticides may reduce adult flies that come into contact with the compound, they do not address the source of fly development. However, chemical control methods may be required in some cases, such as when immediate control of large populations is required, if flies are produced from neighboring properties and not developing on site, or to reduce fly pressure on individual horses in the short term.

Types of Chemical Control Products

Several types of chemical control exist. But with the overwhelming number of products available, how can you determine which one to use? First, decide on the type and application method: residual insecticides, fly baits, larvicides, on-animal fly sprays/roll-ons/wipes, or feed-through growth regulators.

Residual insecticides and premise sprays are applied to walls, ceilings, and other places where flies rest. These are typically sprayed and allowed to dry. Also included in this group are automatic fly sprayer systems. Caution must be taken to protect animals and water sources during application. Failures can be minimized by rotating active ingredients to prevent localized resistance. However, with indiscriminate use—such as with automatic sprayers—localized resistance will likely occur quickly while repeatedly exposing humans and animals to insecticide vapor and droplets.

Fly baits can be placed in bait stations. These can be effective when competing food sources are limited. It is important to note that baits will attract and kill house flies but not other blood-feeding flies. Since baits are toxic, it will be necessary to prevent other animals and children from being exposed to them.

Larvicides are specific insecticides that are applied to fly development sites where large numbers of flies are predicted. These can be used when the area cannot be cleaned as frequently as necessary to break the fly life cycle. This is not a suitable control method for horn flies or face flies that develop exclusively in cattle manure.

On-animal fly sprays/roll-ons/wipes are available with a variety of active ingredients, percentages, and trade names.
These may or may not be effective depending on local resistance and application. Many formulations degrade quickly in UV light during turnout, wash off with sweat, or can be hidden under layers of dirt after rolling. In these cases, reapplication is necessary. It is important to follow label application rates to ensure sufficient application amounts and full coverage.

Feed-through growth regulators are administered as supplements that are fed to the horse, pass through the digestive system, and are excreted in fecal matter. These compounds interact with the physiology of the developing flies and prohibit them from emerging as adults. Every horse at a property must be fed these feed-throughs to prevent flies from developing in all other suitable manure. This is not a suitable control method for horn flies or face flies that develop exclusively in cattle manure.

Types of Active Ingredients

Selection and percent of active ingredient is another consideration for chemical control of filth flies. This information can be found below the brand or trade name as the active ingredient and the percent concentration. Pyrethrins and pyrethroids are most common for fly control on horses. Pyrethrins are compounds that have natural insecticide properties extracted from the flowers of some chrysanthemum species. These typically provide knockdown benefits (i.e., they knock the pest off the animal). However, they may not kill the insect pests, just repel them. These tend to be more sensitive to UV light and will break down quickly. Piperonyl butoxide is another compound often found with pyrethrins. This acts as a synergist to make the products more effective. Cypermethrin, permethrin, and resmethrin are synthetic forms of pyrethrin called pyrethroids; they are more stable than the pyrethrins and have longer-lasting effectiveness. Current research has suggested that more natural products containing the fatty acids octonoic, nonanoic, and decanoic acid are as effective as synthetic compounds in repelling house flies and have a longer duration of effectiveness in the laboratory.

For applications to be most effective, horses should be clean, free of dust, and dry. Following label directions for application rates, the products should be applied to target areas and then brushed lightly in the direction of the hair. Pay particular attention to the legs, belly, neck, face, and shoulders. Note any human and animal precautions that should be taken as directed by the label.

A Note on Chemical Resistance

Insecticide resistance is a frequent and legitimate concern when using chemical insecticides, especially with filth flies. Resistance is an inherited physiological or behavioral change that allows some individuals in a population of pests to continue to survive and reproduce in the presence of a toxin. Cross-resistance is when developed resistance to one toxin leads to resistance of a similar toxin because of how these toxins act on the pest, or the mode of action. Resistance can develop when pests are repeatedly exposed to a toxin. After initial exposure, most pests may die but a few naturally resistant individuals survive and produce offspring that are resistant. The fly life cycle is short in optimal conditions and may offspring are produced so populations can quickly develop resistance.

To reduce the risk of resistance it is important to not expose multiple generations of a pest population to the same insecticide mode of action. This is important whether you are using fly sprays, wipes, feed-throughs, baits, or other methods of application. To reduce risk of resistance the best option is to create an IPM plan as proposed by this guide and, if using chemical control methods, by rotating chemical classes. When you decide on an insecticide, look at the active ingredients and compare to the Insecticide Resistance Action Committee (IRAC) chart. Rotate that choice with another that is in a different IRAC group which may have a different mode of action. For more information on mode of action and IRAC please visit www.irac-online.org/modes-of-action.
**Step 6: Evaluate the Plan**

**Q:** What type of evaluation do I need to perform?

**A:** Basically, evaluation is a form of monitoring. Review your monitoring records and see if there is a downward trend. Supporting evidence like horse comfort and fly presence can help determine the effectiveness of the plan.

Evaluating the IPM plan means simply to continue monitoring. The purpose of evaluation is to determine if:

- The control actions decreased pest numbers
- There were unintended side effects
- There are ways to optimize the plan or perhaps improve, reduce, or refine implemented control methods

The key to both monitoring and evaluation is recordkeeping. If records are kept over time, they can aid in timing control options. Types of records to keep are the pest(s) of interest; where the pests occurred; dates, timing, and type of control methods, including name of products and application rates; and results.

IPM is cyclical. If your evaluation suggests your control methods aren’t working, it may mean that you need to reevaluate one of the previous steps. Perhaps you misidentified your pest or maybe your monitoring method isn’t sufficient. Regardless, at this point the plan can be revised as necessary.

**Summary of Chemical Control Options for Filth Flies**

The table on the following page is not a comprehensive list, nor does it suggest a recommendation. Each situation is going to require evaluation to select the best products for the most effective control. Always refer to the insecticide labels for current and specific instructions for use and application. Before applying any product (including on-horse fly sprays), read the label and note application rates. In addition, only apply products that are labeled for use in the state of application. Check with local county or state regulations before using any product.
<table>
<thead>
<tr>
<th>Control Method</th>
<th>Active Ingredient Name</th>
<th>Brand Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baits</td>
<td>Imidacloprid</td>
<td>Quick Bayt</td>
</tr>
<tr>
<td></td>
<td>Methomyl</td>
<td>Apache, Blue Streak Fly Bait, Fatal Attraction, Golden Malrin, Tailspin</td>
</tr>
<tr>
<td></td>
<td>Trichlorfon</td>
<td>Dipterex</td>
</tr>
<tr>
<td>Feed-through</td>
<td>Cyromazine</td>
<td>Serene, Solitude IGR</td>
</tr>
<tr>
<td></td>
<td>Diflubenzuron</td>
<td>Equitrol II Feed-Thru Fly Control, SimpliFly with LarvaStop Feed-Thru Fly Control</td>
</tr>
<tr>
<td></td>
<td>Stirofos</td>
<td>Equitrol Feed-Thru Fly Control</td>
</tr>
<tr>
<td>Larvicide</td>
<td>Stirofos</td>
<td>Rabon</td>
</tr>
<tr>
<td>Residual</td>
<td>Cyfluthrin</td>
<td>Countdown</td>
</tr>
<tr>
<td></td>
<td>I-Cyhalothrin</td>
<td>Grenade, Cyonara</td>
</tr>
<tr>
<td></td>
<td>Permethrin</td>
<td>Atroban EC, Gardstar, Permethrin II, Prozap Insectrin</td>
</tr>
<tr>
<td></td>
<td>Spinosad</td>
<td>Elector</td>
</tr>
<tr>
<td>Topical—roll-ons/wipes</td>
<td>Cypermethrin</td>
<td>Endure Roll-on</td>
</tr>
<tr>
<td></td>
<td>Permethrin</td>
<td>Bug Block Easy Wipe, Ultra Shield Towelettes, Solitude Wipe-On Fly Repellent</td>
</tr>
<tr>
<td></td>
<td>Pyrethrins</td>
<td>Flysect Roll-On, Roll-On Fly Repellent</td>
</tr>
<tr>
<td>Topical—sprays</td>
<td>Cypermethrin</td>
<td>Bite Free Biting Fly Repellent, Endure Sweat-Resistant Fly Spray for Horses, Repel-X Lotion, Tri-Tec 14 Spray, Tri-Tec Concentrate Fly Spray for Horses</td>
</tr>
<tr>
<td></td>
<td>Natural products (various active ingredients)</td>
<td>Smartpak OutSmart, Ecovet, Nature’s Force, Equiderma, Espree Aloe Herbal, Zero-bite Natural, UltraShield Green</td>
</tr>
<tr>
<td></td>
<td>Resmethrin</td>
<td>Absorbine Concentrated Fly Repellent</td>
</tr>
</tbody>
</table>

**Caution:** Pesticides are poisonous.

Be sure to fully read and understand pesticide labels and Safety Data Sheets before applying any pest control product on the farm. Handle pesticides carefully and store them in their original labeled containers out of the reach of children, pets, and other animals. Dispose of empty containers right away, in a safe manner and place. Do not contaminate forage, streams, or ponds.