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Pest Management Recommendations for Dairy Cattle

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INTRODUCTION

A variety of insect and mite pests affect the dairy industry in the Northeast. House flies, stable flies, face flies, horn flies, horse flies, deer flies, cattle grubs, lice, and mange mites all are common and significant pests of cattle.

Insect and mite pest activity results in lowered milk production levels and reduced feed conversion efficiency. It exposes cattle to pathogenic microorganisms and causes blood loss and hide damage. It can lead to public health–public nuisance concerns.

Moreover, insect and mite pest pressure can add to stresses on young replacement animals, delaying their entry into production and adversely affecting lifelong production performance. As herd sizes increase on modern farms, pest pressures often are aggravated by large quantities of animal waste that must be handled and by crowded conditions that promote the spread of external parasites.

In the past, management of cattle pests often has relied on insecticide use as a single control tactic. But this single-tactic approach can aggravate insecticide resistance problems in pest populations and inadvertently destroy natural enemies of the target species. Modern dairy producers are weaving careful use of pesticides into integrated pest management (IPM) programs.

IPM programs seek to maximize the effectiveness of pest control actions while conserving beneficial insects and minimizing pesticide use. The cornerstone of effective IPM is correct pest identification along with accurate and timely pest monitoring. Other components are various combinations of cultural, biological, and chemical control practices designed to keep pest populations below economically injurious levels. In the sections that follow, information is provided on pest biology, economic importance, identification, monitoring, and management.

FLIES IN AND AROUND LIVESTOCK BARNS

BIOLOGY AND IMPORTANCE

The two principal fly pests of confined livestock are house flies and stable flies. House flies, *Musca domestica*, are nonbiting insects that breed in animal droppings, manure piles, decaying silage, spilled feed, bedding, and other organic matter. They can complete their life cycle from egg to adult in 10 days under ideal conditions in summer months. Each female can produce 150 to 200 eggs, which she lays in batches at 3- to 4-day intervals. Although house flies may be of only minor direct annoyance to animals, their potential for transmitting diseases and parasites is considerable.

Severe house fly infestations may increase bacterial counts in milk, and state inspectors routinely note fly abundance in milk rooms. Flies can also become a serious nuisance both around the production facility and in nearby communities. Demographic changes in the Northeast in recent years have placed many once-isolated dairy producers in closer proximity to their neighbors. These new neighbors often are intolerant of flies, putting greater pressure on producers to keep house fly populations to a minimum.

The stable fly, *Stomoxys calcitrans*, is about the size of a house fly but is dark gray. Its abdomen has seven rounded dark spots on the upper surface. The adult's piercing mouthparts protrude spearlike from under the head. Stable flies breed in wet straw and manure, spilled feeds, silage, grass clippings, and in various other types of decaying vegetation. Each female fly lives about 20 to 30 days and lays 200 to 400 eggs during her lifetime. Under optimum conditions, an egg develops to an adult in about 3 weeks.

Cattle are most irritated by these pests during the warm summer months. Both male and female stable flies feed on blood several times each day, taking one or two drops at each meal. Stomping of feet is a good indication that stable flies are present, since they normally attack legs and bellies. Production performance declines in infested herds because of the flies' painful biting activity and animal fatigue from trying to dislodge flies.

MONITORING

House flies can be monitored using baited traps, sticky ribbons, or spot cards. Baited traps are gallon plastic milk jugs with four 2-inch holes cut in the upper part of the sides. The holes allow entrance of flies that are attracted to 1 ounce of methomyl fly bait placed on the inside bottom of the jug. The traps are suspended from rafters or other building supports with 18- to 24-inch-long wires. Spot cards are 3-by-5-inch white file cards that are attached to obvious fly resting surfaces (areas with large numbers of fly fecal and regurgitation spots).

The number of baited traps, spot cards, or sticky fly ribbons will vary according to facility size, but a minimum of five at equidistant locations throughout each animal housing unit should be used. These monitoring devices are left for 7 days. Then the number of flies collected in the traps or on the sticky ribbons, or the number of fecal and vomit spots on the spot cards, are counted.

Although any of these monitoring devices are effective, spot cards have the additional virtue of providing long-term historical records of fly activity. Old spot cards can be particularly helpful in resolving conflicts with neighbors over claims of increased fly abundance. In general, baited jug trap catches in excess of 250 flies per week, or spot card counts of over 100 spots per card per week, are considered high levels of fly activity. House flies in the Northeast are active from May through October, with peak populations occurring from mid-July though mid-September.

Stable flies are monitored by counting flies on all four legs of about 15 animals in the herd. Treatment is warranted when counts reach an average of 10 flies per animal.

MANAGEMENT

Cultural Control

A variety of cultural control practices can be used effectively to manage house flies and stable flies.

■ *Practice sanitation.* The fly life cycle requires that immature flies (eggs, larvae, pupae) live in manure, moist hay, spilled silage, wet grain, etc., for 10 to 21 days. Removing and spreading fly breeding materials weekly helps to break the cycle. *Waste management is therefore the first line of defense in developing an effective fly management program.* It is much easier and less costly to prevent a heavy fly buildup than to attempt to control large fly populations once they have become established.

The prime fly sources in confinement areas are animal pens, especially those housing calves. The pack of manure and bedding under livestock should be cleaned out at least once a week. In free-stall barns the next most important fly breeding area is the stalls, which should be properly drained and designed to

encourage complete manure removal. In stanchion barns, drops should be cleaned out daily. Wet feed remaining in the ends of the mangers, as well as green chop and other forage and feed accumulations around silos, breed flies and should be cleaned out at least weekly.

■ *Use sticky tapes, paper, ribbons.* Sticky ribbons, especially the giant ones, are very effective for managing small to moderate fly populations. Their only disadvantage is that they need to be changed every 1 to 2 weeks because they dry out, get coated with dust, or get "saturated" with flies.

■ *Maintain a fly-free zone in the milk room.* Sometimes fly location is more important than total fly numbers on the farm. Installing and maintaining tightly closed screen doors and windows to the milk room can greatly reduce fly numbers in this sensitive area. Keeping traffic in and out of the milk room to a minimum will help as well. The occasional flies that still get in can be controlled with sticky tapes, light traps, or careful use of insecticides (discussed below under Chemical Control).

■ *Prevent flies from emigrating from the facility.* Again, fly location can be important, especially if housing and commercial developments have been built near the farm. Certain management practices can reduce fly breeding outdoors.

Spreading manure and bedding as thinly as possible will help ensure that it dries out quickly. If practical, it should be disked under as well to help kill fly larvae and pupae that may be present, especially if cool or overcast weather will slow the drying process. Drainage problems that allow manure to mix with mud and accumulate along fence lines in exercise yards should be eliminated. Gaps under feed bunks where moist feed can accumulate should be sealed.

Biological Control

Female flies lay their eggs on manure, calf bedding, wet feed, or silage. The larvae hatch, and the maggots develop for about a week before they reach the pupal stage. Inside the pupa, which is protected by a hard reddish-brown shell, the developing fly goes through the metamorphosis from maggot to fly.

Flies have "natural enemies" that are commonly present in livestock barns. Beetles and mites devour fly eggs and larvae, adult flies are prone to diseases, and fly pupae are attacked by small parasitic wasps. Unnoticed and unaided by us, these natural biocontrol agents can take a heavy toll on the fly population.

Parasitic wasps are among the most important of these natural biocontrol agents. About a dozen species occur throughout the United States. Some species perform better in different climates, and some prefer different kinds of manure and other fly breeding materials. The species best adapted to dairy farms in the Northeast is *Muscidifurax raptor.* This versatile species attacks fly pupae inside barns as well as outside, and it accounts for most of the naturally occurring wasps on our dairy farms.

Parasitic wasps are like "smart bombs" that live only to find and to kill fly pupae. Although the female wasp has a stinger, she cannot use it for anything except killing flies. When she finds a fly pupa, she first stings and feeds on it. This kills the fly. She then uses her stinger to lay an egg inside the pupa. The egg hatches and the parasite larva feeds on the dead fly. The young adult parasite then chews its way out of the fly's pupal case and resumes the search for new pupae to kill. Development from egg to adult parasite is completed in about 3 weeks.

Evolution has led to a natural balance that allows both the parasite and the fly to coexist. If we think of the fly and the parasite as competitors in a race each summer, the fly has certain advantages that help it to "win" unless we intercede to level the playing field. For example, the fly develops twice as fast from egg to adult, lives longer, and lays more eggs than *Muscidifurax raptor* parasites. As fly populations begin to grow in late May and early June, the parasite populations lag behind. The result is that the parasite population is usually behind that of the fly by several weeks.

The parasite also lags behind the fly in developing resistance to insecticides. Many insecticide treatments for the fly therefore have the undesirable side effect of killing large numbers of parasites. If you use insecticides highly toxic to natural enemies in the early summer, you can get stuck on a "pesticide treadmill." Each subsequent insecticide treatment kills more beneficial insects and creates conditions that require repetitive treatments to keep flies in check. This also aggravates the problem of insecticide resistance in the flies.

Parasite populations can be conserved by using insecticides that are compatible with these important biocontrol agents. Methomyl scatter baits and pyrethrin space sprays are good examples of compatible insecticides. Residual premise sprays such as permethrin, dimethoate, and rabon are highly toxic to

parasites and should be used only as a last resort for dealing with occasional fly outbreaks.

Parasite Releases

Along with conserving natural enemies, it is possible to go one step farther and make releases of parasites to "jump-start" their population growth in the early summer. Releases of parasites can be effective in managing fly populations if certain conditions are met:

■ Waste management is a must; parasite releases complement manure management but cannot replace it.

■ When insecticidal treatment is necessary for supplemental fly control, only those insecticides compatible with parasites (space sprays and baits) should be used.

■ Parasites are sent from suppliers as killed fly pupae containing immature parasites. Local suppliers ship the parasites in cheesecloth bags. If most fly breeding on the farm occurs inside the barn, these bags should be stapled to posts and rafters near areas where fly breeding is a problem. If calves are housed in hutches, the bags should be opened and about 3 heaping teaspoons of pupae placed in each hutch weekly.

■ Many companies who sell parasites advertise their products in farm magazines, but not all of them sell the right species or provide parasites adapted for our northeastern climate. Moreover, parasites from some commercial insectaries suffer from a debilitating disease that greatly reduces their effectiveness. Dairy farmers should look for *Muscidifurax raptor* and stay away from *Nasonia vitripennis*. *Nasonia* parasites are inexpensive but are inappropriate for use on our dairy farms. IPM Laboratories in Locke, NY (315-497-3129) is currently the only commercial insectary that produces and sells disease-free *Muscidifurax* parasites.

■ Releases should be started early, preferably in middle to late May, and continued weekly until the middle of August.

■ How many parasites should be released? Weekly releases of either 200 parasites per milking cow *or* 1,000 parasites per calf have proven effective in research trials. But every farm is different, and release rates and schedules may require adjustment to achieve a level both effective and affordable for an individual farm.

■ How cost-effective are parasite releases? Prices vary, but they run at about $13.00 per batch of 10,000 parasites plus shipping charges. At a release rate of 200 per cow (= 26 cents) per week, this means that total costs for the summer are between $2.60 and $4.70 per cow, depending on how long the releases are sustained.

In research trials, parasite release costs have been more than offset by reductions in insecticide treatments. On average, dairy farmers who use biocontrol in fly IPM programs make 80 percent fewer insecticide treatments than farmers who rely on insecticides for fly control. In addition, fly populations on IPM farms are about 50 percent lower than on conventionally managed farms.

■ We are still at an early stage in understanding how to use biocontrol to full advantage in fly management programs. Please share your observations, successes, and disappointments so that we can all learn together. Call us (Don Rutz at 607-255-3251 or Charlie Pitts at 814-863-7789); or contact your local Cooperative Extension agent or regional specialist.

Chemical Control

Insecticides can play an important role in integrated fly management programs. Chemical control options include space sprays, baits, larvicides, residual premise sprays, and whole-animal sprays. Insecticides registered for fly control are listed in Table 1, enclosed in the pouch on the back cover.

Space sprays with synergized pyrethrins or a combination of dichlorvos and synergized pyrethrins provide a quick knockdown of adult flies in an enclosed air space. Because space sprays have very little residual activity, resistance to these insecticides is still relatively low in fly populations in the Northeast. Scatter baits containing the insecticide methomyl are also very useful for managing moderate fly populations. As indicated previously, space sprays and baits are compatible with fly parasites.

A number of insecticides are labeled for use as larvicides, either for direct treatment of manure or in controlled-release formulations. Direct application of insecticides to manure and bedding should be avoided in general, because of harmful effects on beneficial insects. The only exception is occasional spot treatment of breeding sites that are heavily infested with fly larvae but that cannot be cleaned out. Controlled-release larviciding options include boluses and feed additives that result in the insecticide's being excreted with animal feces.

Treatment of building surfaces with residual sprays such as permethrin, dimethoate, naled, and rabon has been one of the most popular fly control strategies over

the years. High levels of resistance to these insecticides are now very common. These materials should be used sparingly and only as a last resort to control fly outbreaks that cannot be managed with other techniques.

Whole-animal sprays can be made directly on the animals to manage stable fly problems. Although this approach can provide needed relief from biting fly pressure, the control is rather short-lived.

Fly Control in Milk Rooms

Milk rooms represent a special case. Because sanitary codes restrict insecticide use in milk rooms, the only chemical treatments recommended are space sprays with synergized pyrethrins (read label carefully regarding protection of milk and milk handling equipment) and placement of Vapona strips. *Use of sticky ribbons and cultural practices that restrict fly entry into the milk room can greatly reduce the need for insecticidal treatment in the milk room.*

Warning. Always read product labels carefully before applying any insecticide; mix and apply as directed, do not overdose, do not treat too often, and follow all precautions exactly. Remember that improper practices can lead to illegal residues even when correct materials are used. It is illegal to use an insecticide in any manner inconsistent with the label.

FLIES ON PASTURED CATTLE (EXCLUDING CATTLE GRUBS)

BIOLOGY AND IMPORTANCE

Several fly pests attack cattle on pasture. These pests include horn flies, face flies, horse flies and deer flies, black flies, mosquitoes, and biting midges. Each has distinctive habits, life histories, and economic importance.

Horn Flies

The adult horn fly, *Haematobia irritans,* is about half the size of a house fly or stable fly. Both sexes have piercing mouthparts which they use to penetrate animal skin to obtain blood meals. Horn flies are intermittent feeders that take 20 or more small blood meals each day. The flies normally congregate on the shoulders, backs, and sides of the animals. During very hot or rainy weather the flies move to the underside of the belly.

Unlike most other flies, horn flies remain on the animals almost constantly, leaving only for very brief periods to lay eggs on very fresh (less than 10-minute-old) droppings. Development from egg to adult is completed in 10 to 20 days. The flies overwinter as pupae in or under dung pats. Horn flies can be a serious pest of pastured cattle by causing reduced milk production, poor weight gain, blood loss, and animal annoyance and fatigue.

Face Flies

The face fly, *Musca autumnalis,* is a robust fly that superficially resembles the house fly. It is a nonbiting fly that feeds on animal secretions, nectar, and dung liquids. Adult female face flies typically cluster around the animals' eyes, mouth, and muzzle, causing extreme annoyance. Their activity around the animals' eyes allows face flies to serve as vectors of eye diseases and parasites such as pinkeye and *Thelazia* eyeworms. They are also facultative blood feeders, meaning that they gather around wounds caused by mechanical damage or biting fly activity to feed on blood and other exudates.

By contrast, male face flies feed only on nectar and dung. They spend much of their time resting on branches and fences and attempting to catch and copulate with female flies as they move about. Females lay their eggs on very fresh droppings on pasture, and development from egg to adult is completed in about 2 to 3 weeks, depending on temperature.

Face flies are strong fliers that can travel several miles. Unlike house flies, face flies do not enter darkened barns or stables during the summer months. In the fall, however, they enter buildings and overwinter indoors in a state of diapause, or hibernation.

Horse Flies and Deer Flies

Horse flies and deer flies belong to the fly family Tabanidae. They represent a complex of at least 300 species, some of which are very pain-inflicting and annoying pests. Dairy cattle on pasture occasionally are severely attacked by these flies, particularly on pastures that border woodlands or wet, marshy areas. Female horse flies and deer flies cut through the skin of the animal with knifelike mouthparts. They then feed on the blood that pools around the wound. The wound continues to bleed after the fly leaves and often attracts face flies.

Large numbers of these flies can cause extreme annoyance and fatigue, blood loss, reduced milk production, and reduced weight gain. Some species have also been implicated in the transmission of tularemia, anthrax, anaplasposis, and leukosis. Female flies typi-

cally lay their eggs in distinctively shaped egg masses on vegetation near marshes, ponds, or streams. Development from egg to adult requires 70 days to 2 years, depending on the species.

Other Biting Flies (black flies, mosquitoes, biting midges)

Black flies belong to the family Simuliidae, which includes at least 700 different species. Most are generalist feeders that attack cattle as well as humans, deer, and other animals. Black fly larvae live in clean, fast-moving water such as streams and dam outfalls.

Mosquitoes also belong to a large family, the Culicidae, which includes numerous species that attack cattle and other animals. Mosquito larvae live in permanent and transitory standing water, including ponds, tree holes, drainage ditches, and stockpiled tires. Although dairy cattle are sometimes attacked by large numbers of these pests, such problems tend to be very local and short lived.

Biting midges, also called "no-see-ums" or punkies, are tiny biting flies in the family Ceratopogonidae. Adult flies feed on blood, and larvae feed on decaying organic matter in moist soil habitats. Ideal breeding grounds are sometimes created where manure mixes with mud around cattle watering areas and manure lagoons. In some regions of the country, biting midges also transmit the virus that causes bluetongue disease.

MONITORING

Horn flies are monitored by counting flies on the heads, shoulders, backs, and sides of at least 15 animals; counts in excess of 50 flies per side warrant insecticidal treatment. Face flies are monitored by counting flies on the faces of 15 pastured animals; average counts in excess of 10 flies per face are considered economically injurious. No action thresholds are known for tabanids, mosquitoes, black flies, or biting midges.

MANAGEMENT

Horn Flies and Face Flies

Horn flies and face flies breed exclusively in very fresh droppings on pasture. As a result, cultural controls such as manure management practices in and around barn areas that are highly effective against house flies and stable flies will have no impact on horn fly and face fly populations.

Biological control against these pests at present is limited to beneficial organisms that occur naturally in the field. Face flies are attacked by parasitic nematodes, and immature stages of both horn flies and face flies are attacked by predaceous mites, predaceous beetles, and parasitic wasps. Manure competitors such as dung beetles also limit fly populations by removing and burying cattle dung before immature flies can complete their development. Adult flies are attacked by predaceous yellow dung flies, and face flies are occasionally attacked by pathogenic fungi.

In spite of the diversity and importance of natural enemies of face flies and horn flies, methods are not known for exploiting these biological control agents in pest management programs. Parasite releases for house fly and stable fly control are not effective against these pasture pests.

Insecticidal control options for horn flies and face flies include whole-animal sprays, self-applicating devices, feed-through insecticides and growth regulators, and controlled-release devices, such as ear tags and tapes. Table 2 lists examples of insecticides that are registered for control of pests of pastured cattle. Read product labels carefully for target pest information and for precautions to avoid contaminating milk and meat; not all products are effective against face flies, and some products cannot be used on lactating dairy cattle.

Whole-animal sprays provide rapid relief from fly pressure. Animal sprays are applied either as a dilute coarse spray, often applied under high pressure to soak the skin, or as a fine low-volume, more concentrated mist.

Self-applicating devices include back rubbers covered with an absorbent material treated with an insecticide-oil solution, or dust bags filled with an insecticidal dust. Back rubbers and dustbags should be placed in gateways, near water and feed sources, and in other areas where animals will make frequent contact with them.

Feed-throughs include insecticidal feed additives, treated mineral blocks, and bolus formulations. These treatments are generally less effective for face flies than for horn flies. In either case, feed additives have no effect on adult flies that are already present or that may immigrate from neighboring farms. Unless your farm is very isolated or you are participating in an area-wide management program, feed-throughs may not provide satisfactory fly suppression.

Controlled-release ear tags and tapes are generally very effective for horn fly control in the Northeast, and they often reduce face fly pressure as well. Because

these products have not been used extensively in the Northeast, insecticide resistance is not a major concern at present. But in other parts of the country, high levels of resistance have developed in horn flies to pyrethroids such as permethrin, fenvalerate, resmethrin, and flucythrinate. You can prevent horn fly resistance from becoming a serious problem by following guidelines developed by a panel of experts in the field. These guidelines include the following:

- Do not treat unless flies exceed threshold levels.
- Use organophosphate insecticides, such as rabon or coumaphos, for early-season horn fly control, and reserve ear tags for late summer use.
- Remove ear tags in the fall to reduce development of resistance to low levels of pyrethroids.

Although ear tags and boluses are controlled-release application methods, the amount of active ingredient they release decreases over time. Because of this, timing of ear tag and bolus placement is important. If at all possible, delay using these application methods until July so there will still be enough active ingredient left in mid-August, when horn fly populations reach their peak. Early tagging or bolusing of heifers at the time they are placed on spring pasture in April or May will greatly reduce the effectiveness of these treatments later in the summer when it is needed the most.

Other Pasture Flies

Horse flies and deer flies are notoriously difficult to control. They are strong fliers that move large distances between breeding areas and hosts. Because they land on host animals to feed for only a very short time, it is difficult to deliver a lethal dose of insecticide to them during their episodic host attacks.

Moreover, because livestock represent only one of many host animals these pests feed on, treating the cattle will have a negligible impact on total fly populations. Severe horse fly and deer fly pressure is generally temporary because of the seasonality of fly activity. In some cases, cattle can be moved from low-lying pastures near marshy areas to other pastures where fly pressure is less during these periods of peak activity.

Mosquitoes, black flies, and biting midges are also difficult to control. Strategies such as boluses and feed additives that are aimed at fly larvae have no effect on any of these pests because the immature stages do not occur in animal droppings. Whole-animal sprays and pour-ons can provide temporary relief in some cases from horse flies, deer flies, mosquitoes, etc.; read product labels carefully to see which ones claim to control or "aid in the control of" these pests.

CATTLE GRUBS

BIOLOGY AND IMPORTANCE

Cattle grubs are the larval stage of heel flies. Two species of these flies occur in the Northeast: the common cattle grub (*Hypoderma lineatum*) and the northern cattle grub (*Hypoderma bovis)*. Both have similar life cycles. Adult flies emerge during the spring and summer. They are large, hairy flies that resemble bees. After mating, the females locate cattle on which to lay their eggs. Egg laying occurs between late May and August. Cattle often panic in the presence of the fast-moving flies and may run wildly with their tails high in the air in an effort to escape. In spite of this gadding response by cattle, the flies neither bite nor sting the animals. In fact, the adults do not feed at all and survive only 3 to 8 days.

Female flies attach their eggs to the hairs of the cow's legs and lower body regions (hence the term "heel fly"). Each can lay up to 600 eggs, which hatch in 4 to 7 days. Newly hatched larvae burrow into the skin, causing the animal considerable irritation. The young larvae then migrate through the animal's connective tissue. By November 1 most larvae of the common cattle grub have migrated to the submucosa of the esophagus, whereas those of the northern cattle grub migrate to the epidural tissues of the spinal canal.

During the winter months, the larvae of both species migrate again, this time into the animal's back. By February most larvae have reached the back and have cut a breathing hole through the hide. There the larva forms a warble (swelling) between the layers of the hide. Within the warbles, the grubs grow rapidly for about two months, reaching a final size of about an inch in length.

Young animals are more heavily infested with grubs than mature milking cows are, because older animals develop a degree of immunity to the grub larvae. When mature the grubs emerge through the breathing holes, drop to the ground, and pupate in pasture litter and soil. During this stage the grub's skin hardens and turns black. The metamorphosis from grub to adult fly takes from 2 to 8 weeks. Adult heel flies emerge from the pupae and are active from late May through August. Most activity occurs during June and July.

Economic losses to cattle grubs take several forms. First, gadding behavior in response to adult fly activity decreases the animal's ability to graze efficiently. Gadding also makes cattle difficult to handle and increases

the risk of self-inflicted injuries. Second, tunneling by cattle grub larvae through the animal's tissues causes great damage. Heavy infestations in replacement animals can result in poor weight gain, delayed time to first lactation, and long-term production losses.

Third, the breathing holes cut by the grubs damage the most valuable portion of the hide, substantially decreasing its value at slaughter. Moreover, the meat surrounding the warbles is discolored and must be trimmed at the slaughter house, further reducing the carcass's value.

MONITORING

Backs of cattle should be examined during March and April for the presence of warbles. Warbles are detected by rubbing the cow's backline and feeling for the cystlike bumps. When the hair around a warble is parted, the breathing hole may be visible. Because animals develop some immunity to infestation by grubs, the most important animals to examine are those under 5 years of age. Calves born after the fly season and animals kept indoors during the summer will not have cattle grubs and need not be monitored.

Gadding behavior during late spring and summer indicates that female heel flies are laying eggs. Pastured animals may also be examined for the presence of eggs on the hairs of the animal's legs, udder, escutcheon, thighs, and rump.

MANAGEMENT

Cattle confined in barns from May to August are protected from cattle grubs, because heel flies do not enter barns to lay their eggs. But individual production and management practices often rule out this method of cultural control. The most effective method of actually reducing fly populations is to organize a community-based, area-wide program for treating all nonlactating cattle with systemically active insecticides. Such an area-wide treatment can substantially reduce heel fly activity the following year.

In the absence of regional control programs, individual producers may minimize damage to their own animals by using systemically active insecticides on their young, nonlactating heifers. Several systemic insecticides are available as pour-ons, spot-ons, and injectables. It is essential, however, that systemic insecticides not be used on lactating animals because of the danger that insecticide residues will appear in the milk. **At present no cattle grub treatment is available for lactating animals.**

Proper timing is critical for the safe, effective use of systemic insecticides. Treatment must be made after adult heel fly activity ceases, but before the migrating grub larvae reach the esophagus or spinal cord. This means that systemics should be used in September, and never after November 1. Treatments made after November 1 may cause severe allergic reactions in the animals, resulting in bloat, paralysis, and death. A list of systemic insecticides for grub control is presented in Table 3.

CATTLE LICE

BIOLOGY AND IMPORTANCE

In contrast to the fly pests, lice are relatively small and inconspicuous. Four species of lice attack dairy cattle in the Northeast. By far the most common is the cattle chewing louse, *Bovicola bovis*. This species is about 1/8 inch long when fully grown, has a yellow-brown appearance, and is most commonly found on the animal's neck, back, hips, and tailhead. *B. bovis* are not blood feeders, but they use their mouthparts to rasp away at animal skin and hair.

In addition to chewing lice, three species of sucking lice feed on the blood of dairy cattle: the long-nosed cattle louse (*Linognathus vituli*), the short-nosed cattle louse (*Haematopinus eurysternus*), and the little blue louse (*Solenopotes capillatus*). Sucking lice have mouthparts specialized for penetrating animal skin. They spend most of their time with their heads firmly attached to the skin. Sucking lice often take on a darker appearance than chewing lice as they become engorged with blood.

Female lice lay their eggs by attaching them to hairs with a strong glue to prevent them from falling off. The eggs, known as nits, hatch in 10 to 14 days, and the young lice (nymphs) complete their development within several weeks. Lice, in contrast to some other livestock pests, are permanent parasites that spend their entire lives on the host animal.

All four types of lice cause extreme annoyance to the host animals. Milk production declines in heavily infested cattle, and the animals' preoccupation with rubbing leads to hair loss, reduced feed conversion efficiency, and general unthriftiness. Infested animals become irritable and difficult to work with, especially during milking. People working around lousy animals are exposed to greater risk of injury and are also annoyed by stray lice they pick up from infested ani-

mals during handling.

Although louse problems are generally perceived as being most severe during the fall and winter months, animals of different age groups show distinct differences in the seasonality of infestation. Lice are most common on mature cows in December through March, with peak populations found in March. In contrast, calves housed inside barns show high levels of infestation throughout the year, with peak populations in June. This difference may be due to the fact that cows are placed on pastures in the spring, where exposure to direct sunlight heats the skin to levels lethal for most lice. Calves kept in the cool environment of the barn are not able to take advantage of sunlight's natural curative properties.

Other animal housing conditions also affect louse populations. Cows in stanchion barns are twice as likely to be infested as cows in free stalls, owing to the greater opportunities of unrestrained animals to groom themselves. Calves housed in communal pens inside barns are 10 times as likely to be infested as calves in individual hutches. The effectiveness of hutches results from a combination of the animals' isolation from one another and the opportunity for calves in hutches to spend time in direct sunshine.

MONITORING

Because lice often are inconspicuous, many producers do not detect them until their cattle begin to show hair loss from the animals' grooming activities. But by the time the infestation has progressed to this stage, populations of lice are already well above economic injury levels, and treatment becomes very difficult owing to the large numbers of lice involved. Effective management of cattle lice below economic injury levels requires sampling of apparently healthy as well as noticeably lousy animals for the presence and relative numbers of lice. Such surveillance should be conducted every 2 to 3 weeks throughout the fall, winter, and spring months.

Lice can be monitored easily with a flashlight and a little practice. Sampling involves carefully inspecting sections of skin on a representative sample of animals in the herd, either 10 percent or 15 animals in each group: mature cows, heifers, and calves. The best regions to inspect are the head, neck, shoulders, back, hips, and tail. If sampling indicates that *B. bovis* is the dominant species present, assessment of the neck and tailhead alone is sufficient to detect most infestations. Treatment is recommended when counts average over 10 lice per square inch.

MANAGEMENT

Cultural Control

Producers can save on the cost of insecticide treatments for lice by adopting cultural control practices. First, replacement animals brought into the herd should be isolated and carefully inspected for lice before they are allowed to mingle with the rest of the herd. Second, careful and regular monitoring for lice can detect problems before an infestation gets out of control. Third, housing calves in hutches will reduce infestations on these valuable replacement animals by 90 percent without any insecticide applications.

Chemical Control

Many insecticides and application procedures are effective for managing lice. Insecticides registered for control of lice are listed in Table 4. As with any insecticide application, it is essential to consult the label to ensure the insecticide is registered for use on dairy cattle, and if so, whether it may be used on *lactating* animals. Before selecting an insecticide, consider how it can be applied to meet individual needs and production practices. There are several categories of application methods: self-application devices, whole-animal sprays, pour-ons, and dusts.

Self-application devices such as dust bags must be placed in areas where animals will contact them frequently and treat themselves with repeated, small doses. Whole-animal sprays have the advantage of ensuring good coverage over the entire animal's body. But severe louse problems on mature animals are most common in winter, and it generally is wise to avoid soaking animals in periods of cold weather. Applications with foggers and mist blowers can overcome these problems. With these types of applications, a small quantity of concentrated pesticide is propelled as an aerosol made up of very small spray particles. The concentrated aerosol can then be applied evenly over the animal's body, greatly reducing the amount of liquid used.

Another method of application is the use of pour-on insecticides, in which a small quantity of pesticide is poured down the backline of the animal. The most popular application method for lice is dusting by hand. Dusts are easy to apply, require no mixing, and can be used year-round.

Insecticides must be used properly to achieve satisfactory control of lice. Many louse-control products require two treatments, 10 to 14 days apart. ***The second treatment is essential to kill newly hatched lice that***

were present as eggs at the time of the first treatment and were therefore not killed. Failure to make the second treatment in a timely manner will create problems requiring many more subsequent treatments.

MANGE MITES

BIOLOGY AND IMPORTANCE

CHORIOPTIC MANGE

Two economically important species of mites infest dairy cattle in the Northeast. One species, *Chorioptes bovis,* lives on the animals' skin and hair. Infestation by these mites results in a condition known as chorioptic mange, or barn itch. Chorioptic mange is generally characterized by dermatitis, hair loss, and scabbiness in small areas around the feet, legs, and tail head. The skin underneath the affected areas becomes swollen and inflamed. Infestations by this mite are usually localized, although in some cases the lesions can spread to cause a more generalized dermatitis resembling sarcoptic mange.

Chorioptic mange mites live on the surface of the host animal's skin and feed on lymph as well as dead cells and other debris. Development from egg to adult mite is completed in about 2 weeks. Mite populations usually are very low in the summer months, and symptoms of infestation typically disappear during this time. Populations increase again in the fall, with the most severe problems occurring in winter. High levels of chorioptic mange in dairy herds can reduce milk production.

SARCOPTIC MANGE

Sarcoptic mange is a condition caused by another, smaller species of mite, *Sarcoptes scabiei.* The skin lesions arising from infestation by these mites are so severe that sarcoptic mange is handled as a quarantinable disease.

Unlike lice and *Chorioptes* mites, the microscopic sarcoptic mange mites burrow deeply into the skin, laying eggs inside the burrows. The eggs hatch into the larval stage. The larval mites then leave the burrows, move up to the skin surface, and begin forming new burrows in healthy skin tissue. Development from egg to adult is completed in about 2 weeks. The lesions resulting from infestations by these mites are a consequence of the reaction of the animals' immune system to the mites' presence. Because of the intensity of the animals' immunological response, it takes only a small number of mites to produce widespread lesions and generalized dermatitis. Animals show remarkable variation in the extent to which they react to the infestation, however. It is not uncommon to have healthy-looking animals in stanchions next to animals with lesions over much of their bodies.

MONITORING

Mange lesions often first appear around the tail, anus, thighs, udder, legs, and feet. The first sign of infestation usually is hair loss from the animals' rubbing as they try to relieve the itching. As the infestation progresses, the lesions become larger and bloody or moist, followed by the formation of thick, crusty scabs. If left untreated, the lesions may eventually cover the animal's body. When this happens, the entire hide may take on a thick, wrinkled appearance.

Sarcoptic mange mites are nearly invisible to the naked eye. In addition, mange is only one of several conditions resulting in somewhat similar symptoms. The only way to diagnose mange accurately is by having skin scrapings taken by a veterinarian or other trained professional. Scrapings are made with a scalpel by abrading rather deeply into the skin. The scrapings are then brought back to the laboratory and examined under a microscope for the presence of mites and for species determination.

MANAGEMENT

PREVENTION

Mange mites, like lice, are permanent external parasites that do not survive away from the host for very long. The best way to minimize the risk of introducing the mites into a herd is to be cautious when buying or boarding new animals. Avoid any animals that show visible skin lesions or that appear to be abnormally itchy or agitated. As an extra precaution, it is wise to segregate all newly purchased animals from the rest of the herd for several weeks and keep them under observation. A veterinarian should be called in if any of the animals show signs of unusual itchiness.

CHEMICAL CONTROL

Several pesticides used for controlling cattle lice also are effective against chorioptic mange mites. These are shown in Table 4. Because of the severity of sarcoptic mange, it is regarded from a regulatory standpoint as a reportable disease. Therefore, the threshold for placing a herd under quarantine is the discovery of a single mite on one animal.

Once a herd has been placed under quarantine, animals may not be moved off the farm except for slaughter. Every animal in the herd must then be treated with high-pressure hydraulic spray equipment by certified pesticide applicators under the supervision of a state veterinarian. Either two or three treatments must be made, depending on the choice of insecticide used, with treatments spaced 7 to 10 days apart. Quarantine is lifted when post-treatment skin scrapings demonstrate the infestation has been eradicated. Because high-pressure spray equipment is necessary to ensure penetration by the spray into the skin, "home remedies" applied with low to moderate pressure gear of the type owned by many dairy producers are never successful.

INFORMATION ON SYMPTOMS AND TREATMENT OF TOXIC CHEMICAL EXPOSURE

You can obtain prompt and up-to-date information about the symptoms and treatment of cases resulting from exposure to toxic agricultural chemicals by telephoning any of the centers listed below and asking for "Poison Control Center."

When you are unable to reach a Poison Control Center or obtain the information your doctor needs, the office of the NYS Pesticide Coordinator at Cornell University (607) 255-1866 or the Pesticide Education Program at Penn State (814) 863-0263 may be able to assist you in obtaining such information.

PESTICIDE EMERGENCY NUMBERS

Pesticide Spills and Accidents
CHEMTREC
1-800-424-9300

Pesticide/Information Emergencies
National Pesticide Telecommunications Network
1-800-858-7378

Report Oil and Hazardous Material Spills
NYS Department of Environmental Conservation
1-800-457-7362
1-518-457-7362

PENNSYLVANIA POISON CONTROL CENTERS

TOWN	CENTER	PHONE
Allentown	Lehigh Valley Poison Center Allentown Hospital 17th & Chew Sts., 18102	215- 433-2311
Altoona	The Milton S. Hershey Medical Center	717- 531-6111 OR 1-800-521-6110
Chester	Sacred Heart Medical Center 9th & Wilson Sts., 19013	215- 494-0700
Danville	Susquehanna Poison Center Geisinger Medical Center Box 273A, 17822	717- 275-6116 OR 1-800-352-7001
Easton	Easton Hospital 250 S. 21st St., 18042	215- 250-4000
East Stroudsburg	Lehigh Valley Poison Center Allentown Hospital	215- 433-2311
Erie	Northwest Regional Poison Center Saint Vincent Health Center 232 W. 25 St., 16544	814-452-3232
Gettysburg	The Milton S. Hershey Medical Center	717- 531-6111 OR 1-800-521-6110
Harrisburg	The Milton S. Hershey Medical Center	717- 531-6111 OR 1-800-521-6110
Hershey	The Central Pa. Poison Center The Milton S. Hershey Medical Center P.O. Box 850 500 University Drive, 17033	717- 531-6111 OR 1-800-521-6110
Johnstown	Pittsburgh Poison Center	412-681-6669
Lancaster	St. Joseph's Hospital 250 College Ave., 17604	717-299-4546
Latrobe	Pittsburgh Poison Center	412-681-6669
Lewistown	Susquehanna Poison Center Geisinger Medical Center	717- 275-6116 OR 1-800-352-7001
Philadelphia (Bucks, Chester, Delaware, Montgomery, Philadelphia counties)	Delaware Valley Regional Poison Control Center 1 Children's Center, 19104	215- 386-2066 OR 386-2100 (emergency line)
Pittsburgh	Pittsburgh Poison Center Children's Hospital 1 Children's Place 3705 5th Ave. at Desoto St., 15213	412- 681-6669
Scranton	Community Medical Center 1822 Mulberry St., 18510	717- 343-5566
Sharon	Pittsburgh Poison Center	412-681-6669
Wilkes-Barre	Wilkes-Barre Gen. Hospital N. River & Auburn Sts., 18764	717- 829-2200 OR 829-8111 Ext. 2916
York	The Milton S. Hershey Medical Center	717- 531-6111 OR 1-800-521-6110

NEW YORK POISON CONTROL CENTERS

Western New York	1-800-888-7655
Rochester	1-800-333-0542
Central and Southern Tier New York	1-800-252-5655
Eastern and Northern New York	1-800-366-6997
New York City	1-212-340-4494
Long Island	1-516-542-2323

TIPS FOR LAUNDERING PESTICIDE-CONTAMINATED CLOTHING

■ Air
Hang garments **outdoors** to air.

■ Prerinse
Use one of **three methods:**
1. Hose off garments outdoors.
2. Rinse in separate tub or pail.
3. Agitate in automatic washer.

■ Pretreat (heavily soiled garments)
Use heavy-duty liquid.

■ Washer Load
Wash garments **separately** from family wash.
Wash garments contaminated with the same pesticide together.

■ Load Size
Wash only **a few** garments at once.

■ Water Level
Use **full** water level.

■ Water Temperature
Use **hot** water, 140°F or higher.

■ Wash Cycle
Use **normal** 12-minute wash cycle.

■ Laundry Detergent
Use a **heavy-duty detergent.**
Use amount recommended on package, or more for heavy soil/hard water.

■ Rinse
Use **two full warm** water rinses.

■ Dry
Line dry to avoid contaminating dryer.

■ Clean Washer
Run complete, but empty, cycle.
Use **hot water and detergent.**

OTHER TIPS

■ Wear a disposable coverall **over** work clothes.

■ Remove contaminated clothing **before** entering enclosed tractor cabs.

■ Remove contaminated clothing **outdoors** or in an entry. If a granular pesticide was used, shake clothing outdoors. **Empty pockets and cuffs.**

■ Save clothing worn while handling pesticides for that use only. Keep separate from other clothing **before, during, and after** laundering.

■ Wear **chemical-resistant gloves** when handling highly contaminated clothing. **Replace** gloves periodically.

■ Wash contaminated clothing after **each** use. When applying pesticides daily, wash clothing **daily.**

■ Rewash contaminated garments **two or three times** before reuse for more complete pesticide removal.

Tips prepared by Charlotte Coffman, Department of Textiles and Apparel, Cornell University.

Hang this information in the laundry room.

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PENNSTATE

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