Tennessee Dairy Cattle Pest Control Profile

Prepared: 2007

Production Facts:

- Tennessee was ranked 33rd of 51 states and/or territories reporting dairy cattle production for 2006. For milk cows that had calved, Tennessee ranked 28 of 50 states.

- Tennessee accounts for less than one percent of the total head of dairy cattle produced within the United States.

- Approximately 67,000 head of milking cows were on Tennessee farms in 2006 and 64,000 head were reported in April-June 2007.

- There were approximately 10 dairy manufacturing facilities located within Tennessee during 2006. These facilities processed products such as cottage cheese, yogurt, ice cream, sherbet, ice cream mix and other dairy based products.

- In 2006, cash receipts from marketing of dairy products in Tennessee were valued at $148,390,000, and the value of milk produced was estimated at $148,958,000 for 2006.

- Value of production less operating costs, ranged from $5.95 in 2005 and dropped to $3.27 per cwt. in 2006. Production cost varies monthly depending on herd size, and market demand.

- The number of livestock slaughtered in Tennessee for May of 2006 was approximately 1,300 and 1,800 in 2007. Slaughter numbers would include all cattle. Value of cattle marketed for consumption averaged approximately $130 per cwt. in 2007.

Production Regions:

Dairy cattle are produced in various counties of Tennessee, however, there are two primary production areas: lower eastern portion and, to a lesser degree, in the northeastern portion. Green and McMinn counties are the two leaders in dairy cattle production, followed by Monroe, Washington, Loudon, Marshall, Robertson, Henry and Bradley counties. Figure 1 lists the number of dairies in Tennessee during 2004.
Cultural Practices:

Generally cattle are moved from low lying marshy areas to other pastures where fly pressure may be less. Sanitation is practiced often to reduce breeding areas such as fresh, undisturbed manure. For many species of flies, manure management practices in and around barn areas is highly effective against house flies and stable flies, but will have no impact on horn fly and face fly populations.

For mosquitoes, removing standing water and/or removing of old tires, cleaning building guttering of debris, allowing areas where water stands for prolonged periods to drain more easily, therefore reducing breeding sites. Mowing weedy areas where cattle congregate near feeding areas also reduces problems. Movement of cattle from mosquito breeding areas is fairly effective means of reducing typical feeding irritation to cattle.

For cattle lice, replacement animals brought into the herd, should be isolated and carefully inspected before they are allowed to mingle with other cattle. Producers should regularly inspect animals so lice may be detected before their populations get out of control. Calves housed in hutches may also reduce spread of any possible infestation.

Weeds can become a problem in pasture areas, and occasional mowing areas may provide some relief by not allowing weeds to reseed.

Worker Exposure Issues

General/applicator/mixer

Permethrin and other pyrethrin coat sprays are principal products applied to dairy cattle. However, coumaphos or dichlorvos (organophosphates) may also be applied with some regularity. Feed additives containing the active ingredient such as s-methoprene (an IGR) or coumaphos are commonly used in dairy cattle production for fly control.

The frequent use of these compounds suggests that when a herd is treated by the producer, such treatment may be conducted on a bi-weekly, or monthly basis when insects are present. The method of spray application, whether by hand or automated sprayers is not reported, nor is the propensity for producers to rotate their choice of insecticides during the season. Although smaller herds are most likely treated by small hand held sprayers, larger operations favor automated systems that trigger sprays as animals enter or exit the milking area. When hand held sprayers are used, some inhalation of aerosol compounds by applicators is inevitable unless a filtered breathing apparatus is used. Contact with the skin of bare arms, hands, face, and neck may occur. It is estimated that of those applying insecticides via spray or aerosol, exposure could occur approximately 14 times during the spring, summer, and fall seasons. The length of each exposure is estimated at 10 minutes per herd application. However, the amount of residual would be minimal, and the amount is currently unknown.
The principal pour-on products used for external parasite control include: eprinomectin, ivermectin, cyfluthrin, and permethrin. Eprinomectin and Ivermectin are commonly used one to two times per year, whereas cyfluthrin and permethrin may be used possibly 6 times per year. The method of application of pour-ons typically involves pouring the insecticide along the back of the cow using a long-handled dipper. Dippers are usually provided by the insecticide manufacturer. Applicators often wear neoprene gloves when applying or handling these products to reduce direct skin contact.

Handlers/ milkers

Workers who milk cows in barns or milking parlors may possibly be exposed to insecticides, via residuals remaining on the animal or from remaining vapors of sprays and/or aerosols used in these areas. Although the amount of time workers have direct contact with the animals is very minute. Greater exposure may occur during the summer when workers are most likely to wear short sleeved shirts. Exposure includes all insecticides applied to the animal or in areas as sprays or aerosols, oiler/scratchers, ear tags, and dust bags. Exposure time varies depending on herd size. Dehorning, castration, and pharmaceutical injections are a few of the other activities that can bring handlers in contact with treated cattle. These activities are typically one-time events during a year and seldom would extend handler exposure to treated animals beyond 8 to 16 hours within a year. These operations also tend to take place during the spring or fall when insect populations are low and insecticide use is minimal and/or remaining residues of products are at extremely low levels.

Environmental exposure issues

There are few environmental issues associated with insecticide applications on dairy cattle. One possible concern might be localized areas of contamination near sites where pour-ons, whole body sprays, or animal dips are used and around dust bags. These sites can be of particular concern if wells are nearby or if the runoff from these sites wash into ponds, creeks, or streams that provide a source of drinking water for livestock and/or humans.

Co-occurrence

There are no detailed records indicating what insecticides are used in combination or in sequential applications. However, the greatest opportunity for sequential uses would be with the aerosols and sprays and the pour-ons which contain pyrethroids for fly control. Pyrethroid products have a quick knock down action. Sequential uses are primarily those occurring with some formulation of a pyrethroid being used followed by other pyrethroid (of the same or different formulation). Although dichlorvos, and/or coumaphos may be used as sprays, the few cattle treated with these insecticides would not indicate insecticide use preceding or following these compounds from a pesticide of another classification since dichlorvos and coumaphos are often used for pyrethroid resistant flies. Another possibility of co-occurrence, would be use of an injectable type products,
possibly followed by pour-ons, sprays on and/or feed additives and/or bolus products that may be administered.

**Treatment Timing**

- **Cattle grubs**: If needed, treatments of cattle grubs are made from mid-May until October 1. Grub control may be made using sprays, pour-ons, and/or injectables.

- **Face fly**: Treatments are made in spring (early April) to early summer (June). Treatments may include ear tags, and pour-ons. The use of aerosols and backrubber applied pesticides may aid in their control.

- **Horn fly**: Treatments are made from May to September when fly populations average around 200 flies per cow.

- **Horse fly**: Treatments are made from early to mid-summer.

- **Mosquitoes**: Treatments usually begin when warm wet weather periods occur. First treatment usually begins in late April to late July.

- **Stable fly**: Treatments are made in early spring around March through May when heavy populations are present.

- **Ticks**: Treatments are made in late winter (February) to early summer.

- **House fly**: Treatments may be made early March through November.

- **Lice**: Treatments are made in the event of an infestation.

**Pests and Pest Control**

The majority of pest management activities for dairy cattle production in Tennessee are devoted to horn fly, face fly, and house fly control. Lice, could develop into an important pest during winter and early spring, however if present, only require one or possibly two treatments annually. Other arthropod pests that are of occasional importance include other biting flies (especially horse flies), ticks, grubs, house fly, stable fly, mites, mosquitoes, and maggots (in wounds). Pests relatively new to Tennessee that may affect cattle are imported fire ants. Gastrointestinal roundworms are usually treated for prophylactically (dewormed) in mid-summer and the products used provide some control of other arthropod pests of dairy cattle. Estimated losses due to external parasites and estimates of methods used for external parasite control are listed in Tables 1 and 2.

Insecticidal control options for external parasites include whole-animal sprays, self-applicating devices, feed-through insecticides and growth regulators, and controlled-release devices, such as ear tags and tapes. Not all products are effective against all
external parasites, and some products labeled for dairy cattle production cannot be used for lactating dairy cattle, and/or have withholding periods.

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/face rubbers covered with an absorbent material treated with an insecticide-oil solution, or dust bags filled with an insecticidal dust. Back rubbers and dustbags are placed in gateways, near water and feed source, and in other areas where animals will make frequent contact with them.

Feed-throughs include insecticidal feed additives, treated mineral blocks, and bolus formulations. Unless the farm was very isolated or participating in an area-wide management program, feed-troughs may not provide satisfactory fly suppression.

Controlled-release ear tags and tapes are generally very effective for horn flies and other flies and provide good control in certain farm areas.

Pour-on treatments involves the application of an insecticide along the backline of the animal at a prescribed dosage of topical products.

The topical products that are currently approved for control and available fit into three major categories: Organophosphates (OP's), pyrethroid and endectocides.

Weeds can be a serious problem in pastures, but they are generally managed by practices that will maintain a dense stand of grass. These practices include maintaining soil fertility through proper fertilization and liming. Weeds of importance in Tennessee pastures include hairy buttercup, musk thistle, plantains, horsenettle, pigweed, cocklebur and wild brambles. Spiny amaranth, ironweed and Perilla mint are also problems in Tennessee cattle production areas. Broadcast sprays or spot treatments of broad-leaf herbicides (e.g., those containing 2, 4-D or other phenoxy herbicides) are used to manage most pasture weeds.

**External Parasites and Cattle Grubs**

House flies, stable flies, face flies, horse flies, deer flies, cattle grubs, lice and mange mites all are common and can become significant pests of livestock, if not managed. Several of the common pests observed in dairy production in Tennessee are listed below. At the beef cattle strategic plan meetings held in 2005, attendees ranked beef cattle arthropod pests in order of importance. A pest ranking for Tennessee beef cattle production was previously listed as: 1) face flies, 2) horn flies, 3) lice, 4) ticks, 5) other biting flies, 6) house flies, 7) mites and scabies, 8) grubs, 9) bots, 10) maggots in wounds, 11) stable flies, and 12) other pests. These rankings would be similar in dairy cattle production. Table 1, lists estimated losses due to external parasites in dairy cattle.
production. It is recommended that producers rotate control products annually to provide the best means of control.

**Horn flies (Haematobia irritans)**

Both male and females feed on blood, using an extremely painful bite which tears through the skin and blood vessels. Unlike most other flies, horn flies remain on the animal almost constantly, leaving only for a brief period. After the fly has completed its meal, the wound continues to bleed, attracting face flies. Horn fly larvae develop only in fresh cow dung. In hot weather horn flies develop rapidly, completing a generation every 2 to 3 weeks or so at 30°C, or monthly at 25°C. The young larvae, which cannot survive desiccation, live at the moist surface of the dung; older larvae live within tunnels made in drier dung by beetle larvae. Pupation takes place in the soil under the dung or nearby.

**Chemical Controls:**

Organophosphate insecticides:
- **Coumaphos** (CoRal) applied as a dust, spot treatment, eartag and/or backrubber. Non-lactating cattle.
- **Diazinon** (various) applied as an eartag for non-lactating animals.
- **Dichlorvos** (Vapona) applied as a 1% spray.
- **Ethion** (Commando) applied as an ear tag.
- **Tetrachlorvinphos** (Rabon) applied as a dust, eartag, and/or feed additive.
- **Malathion** is no longer available for use in dairy production. However a 2% spray solution may be used near mosquito breeding areas and may provide some control for horn flies. Would provide fair control as a premise treatment.

Pyrethroid insecticides
- **Cyfluthrin** (Cylence) applied as an eartag. Two tags may be needed per animal.
- **Fenvalerate** (Ectrin) applied as an eartag.
- **Permethrin** (various) applied as a spray, backrubber, pour-on, or breeding areas spray.
- **Pyrethrin** and synergist (various) applied as a premise spray, backrubber, or to breeding areas.

Other insecticide classifications:
- **Spinosyn** (Elector) Applied as a spray or pour-on.
- **Diflubenzuron** (Vigilante) applied as a bolus, kills larvae up to 5 months.
- **S-Methoprene** (Altosid) applied as a feed additive.
- **Doramectin** (Dectomax 1%) applied as a pour-on and may be applied to heifers upto 20 months of age. Cattle treated with product should not be used for human consumption until 35 days after treatment.
- **Eprinomectin** (Eprinex 0.5%) applied as a pour-on.
- **Moxidectin** (Cydectin 0.5%) applied as a pour-on, no pre-slaughter or milk discard interval.
NOTES: products used to control horn flies are used in different formulations which include; premise sprays, pour-ons, direct sprays, ear tags and/or injectables.

Cultural Control Practices:
- Manure management practices in and around barn areas that are highly effective against house flies and stable flies and may have no impact on horn fly and face fly populations.
- Walk-through horn fly trap.
- Annual rotation between pyrethroids and phosphate products.

Biological Controls:
- A wasp (*Polybia scutellaris*) has been reported to provide some control of horn flies. If these could be purchased, may be too cost prohibitive. Unknown if control would be effective.
- High populations of dung beetles may reduce breeding sites of horn flies.

Other Issues:
- Possible pyrethroid resistance is a major concern, so products with other pesticide chemistries should remain available to aid in control of all fly infestations.

**Face flies (Musca autumnalis)**
Face flies are non-biting flies which feed on animal secretions, and dung liquids. Adult female face flies typically cluster around the animals’ mouth, muzzle and eyes. This causes extreme annoyance to the animal. They also gather around wounds created by other pests or mishaps to feed on blood and/or other exudates. Face flies generally do not enter darkened barns or stables during summer months. Face flies reproduce rapidly, which makes them difficult to control. The flies’ activities around the eyes allows them to serve as vectors of eye disease and parasites such as pinkeye and *Thelazia* eyeworms. Market reports have indicated that calves with pinkeye are marketed for $10 to $12 less per hundred pounds due to pinkeye infection.

Chemical Controls:

**Organophosphate Insecticide Controls:**
- **Coumaphos** (CoRal): applied as a dust, spray, and/or backrubber.
- **Tetrachlorvinphos** (Rabon): Applied as a dust, feed additive and/or eartag.
- **Ethion** (Commando): applied as an eartag.

**Pyrethroid Insecticide Controls:**
- **Fenvalerate** (Ectrin) applied as an eartag.
- **Permethrin** (various): various formulations applied as sprays, dusts, backrubbers/facerubbers.
- **Permethrin with a synergist** (various) applied premise spray or back/face rubber.
- **Cypermethrin** (Python Magnum): applied as an eartag.

**Insect Growth Regulators:**
- **Diflubenzuron** (Vigilante): applied as a bolus.
- **S-Methoprene** (Altosid): applied as a feed additive.
Cultural Control Practices:
- 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. Fly breeding areas include fresh, undisturbed manure.
- Annual rotation of active ingredients, aids in reducing resistance.

Biological Controls:
- Three fly parasites may be of some benefit include: *Muscidifurax raptorellas*, *M. zaraptor*, and *Spalangia cameroni*, however no state data is available.

**House flies (Musca domestica)**

House flies often create severe problems for livestock operations. They are non-biting insects that breed in animal droppings, manure piles, decaying silages, spilled feed, bedding, and other organic matter. Although they may be of only minor direct annoyance to animals, they are carriers of a number of important bacterial pathogens, such as *Salmonella* spp. and *Escherichia coli* strains. Severe house fly infestations may increase bacterial counts in milk. House flies are active from April to October, however may be active until December, if extreme cold conditions do not occur in latter months. Peak populations occur from mid-June until mid-September. High populations may cause problems for producers, when local residents complain about livestock odors and pest problems. They generally complete their lifecycle from egg to adult, within 10-days.

Chemical controls:

**Organophosphate Insecticide Controls:**
- **Coumaphos** (CoRal) in spray and/or dust formulations
- **Dichlorvos** (Vapona) applied as a light mist spray to animal or premise insect strip.
- **Tetrachlorvinphos** (Rabon) added to feed or fed through mineral mixtures.
- **Tetrachlorvinphos** and **Dichlorvos** (Ravap) a mixture of two products applied directly to animals

**Pyrethroid Insecticide Controls:**
- **Fenvalerate** (Ectrin) applied as an eartag.
- **Permethrin** (various) applied as a pour-on and/or in back/face rubber.
- **Pyrethrin** with piperonyl butoxide (various) applied directly to animal as a spray or added to oil and applied to animal. May be added to automatic sprayers.
- **Cypermethrin** (Pythion Magnum) applied as an eartag.

**Insect Growth Regulators:**
- **Difulbenzuron** (Vigilante) bolus applied. Provides long lasting control.

**Cultural Controls:**
- Monitoring may be conducted by using baited traps, sticky ribbons, or spot cards.
- Control may be achieved using pesticides and sanitation. The fly life cycle requires that immature flies (eggs, larvae, pupae) live in moist areas until they are
fully developed. Therefore, waste management and sanitation are the first lines of defense. Breeding areas usually include fecal material and/or moist decaying organic matter or spilled feed.

- Screening provides good control in milking areas
- UV light and electrocution devices provide fair control in milking areas which don’t have direct sunlight.
- Annual rotation of active ingredients, aids in reducing resistance.

Biocontrols:
- Beetles and mites devour fly eggs and larvae, adult flies are prone to diseases and fly pupae are attacked by small parasitic wasps. Releases of *Muscidifurax raptorellus* and *Spalangia cameroni* may provide some control but have not been proven to provide superior control.
- Z-9-Tricosene (Muscalure) is added to sugary baits to aid in attracting flies in sticky type traps.

### Stable flies (*Stomoxys calcitrans*)

Adult stable flies have piercing mouthparts that protrude in a spear fashion from under the head. They breed in wet straw and manure, spilled feeds, silage, grass clippings, and various other types of decaying vegetation. Both male and female flies may take blood meals several times each day. They are usually observed on legs and bellies of cattle. Production performance declines in infested herds because of the flies’ painful biting activity and animal fatigue from tying to dislodge flies. They generally complete their lifecycle from egg to adult, within 21 days in optimum conditions. Breeding areas include fecal material and or decaying organic matter.

**Chemical Controls:**

**Organophosphate Insecticide Controls:**
- *Dichlorvos* (Vapona) applied as a light mist spray to animal
- *Tetrachlorvinphos* (Rabon) applied as a 3% dust or an oral feed additive
- *Tetrachlorvinphos* and *Dichlorvos* (Ravap) applied as a premise spray.

**Pyrethroid Insecticide Controls:**
- *Fenvalerate* (Ectrin) applied as an eartag.
- *Permethrin* (various) applied as a ready-to-use product, or diluted and applied directly to the animal or applied in back/face rubbers.
- *Pyrethrin* and *piperonyl butoxide* (various) applied as a mist to the animal or as wetting spray.
- *Cypermethrin* (Python Magnum) applied as an eartag.

**Cultural Controls:**
- Removal of breeding sites such as manure decay grass, hay or straw.
- Screening provides good control in milking areas
- UV light and electrocution devices provide fair control in milking areas which don’t have direct sunlight.
- Sticky traps have been used, however only provide marginal control.
- Annual rotation of active ingredients aids in reducing resistance.

Biological Controls:
- *Spalangia nigra*, *Spalangia cameroni*, and *Spalangia endius* may provide some parasitism of stable flies. Parasitoids that kill immature stable flies are commercially available. These non-chemical practices are of little relevance, to pastured dairy cattle operations.

*Horse flies and deer flies (Tabanidae family)*
Horse flies and deer flies belong to the fly family *Tabanidae*. Large numbers of these flies may 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, anaplasmosis and leukosis. Development from egg to adult is usually 70-days to 2-years. Both horse and deer flies are difficult to control and can move great distances between breeding areas and hosts. Since 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 presence.

Chemical controls:
Organophosphate Insecticide Controls:
- **Dichlorvos** (Vapona) applied as a mist to animal. Should not be applied to animals younger than 6 months of age.

Pyrethroid Insecticide Controls:
- **Permethrin** (various) applied as a 0.01 to 1% solution. Applied to the animal as spray or applied in a back/face rubber. Applied every two weeks as needed.
- **Pyrethrin** and piperonyl butoxide (various) applied as a mist with an automatic mist system or applied as a spray wetting the animals coat.

Cultural controls:
- Generally, cattle are moved from low lying marshy areas to other pastures where fly pressure may be less.
- Clean up fresh, undisturbed manure, to reduce breeding areas.

Biological Controls:
- A wasp species that may serve as a type of biological control of horse flies and deer flies is the Horse Guard Wasp, *Stictia carolina*, which is adept at catching tabanids on the wing, paralyzing them with their sting, and stuffing them in their underground burrow to provide food for their next generation. No information for use of this species in Tennessee as a possible biocontrol agent has been reported.

*Mosquitoes (Culicidae family)*
Mosquitoes are one of the best known blood-sucking insects that belong to the family *Culicidae*. Only females take blood meals. Currently, no known disease is spread in dairy cattle production in Tennessee by mosquitoes and the primary effect of mosquitoes is irritation. Infestations of mosquitoes tend to be very local and short lived. Breeding areas include standing or stagnant water.
Chemical Controls:
Organophosphate Insecticide Controls:
- Malathion (various 5E): very effective and economical. Applied in grassy/weedy areas where adult mosquitoes congregate during dry conditions. Not applied to the animal.
- Dichlorvos (Vapona) applied as a light mist to the animal’s coat. Applied as a spray, pour-on or in back/face rubber.
- Tetrachlorvinphos and dichlorvos (Ravap) applied as a spray to animal’s coat, premise spray or applied to animal in a back/face rubber. May be used on lactating cattle.

Pyrethroid Insecticide Controls:
- Permethrin (various) applied as a pour-on or spray of 0.01 to 1.0 % concentration or as a 0.25% dust.

Cultural Controls:
- Removal of old tires, clean any building guttering of debris, allow areas where water stands for prolonged periods to drain more easily. Clean any building guttering to keep water from standing. Flush water troughs.
- Mow weedy areas where cattle congregate near feeding areas.
- Movement of cattle from any mosquito breeding areas.

Biocontrols:
- Agents (Bacillus thuringiensis israelensis) applied in areas where water ponds.

Ticks (various)
Lonestar tick (Amblyomma americanum) are referred to as three-host ticks because they utilize different hosts for each feeding stage. Females occur in late spring and early summer. After feeding, they drop from the host and lay clusters of thousands of eggs in ground litter. Males die soon after mating with one or more females and females die soon after laying eggs. There may be overlapping generations, with peak adult and nympha! activity occurring from March through May and again from July through August. Larvae occur in mid-June or July. It often takes up to 3 years for a tick like the lone star tick to complete its life cycle. Lone star ticks live in wooded areas with underbrush, along creeks and rivers near animal resting places.

American dog tick (Dermacentor variabilis) the engorged female drops off the host and seeks a sheltered place to lay her eggs. Over 14-32 days she lays egg masses totaling 4,000-6,500 yellowish-brown eggs, and then dies. Egg hatch usually occurs in 36-57 days. Unfed larvae actively crawl about seeking a host. They can survive for up to 540 days unfed. Adults crawl up on grass or other low vegetation and wait for a host to pass. After both sexes have fed, females are completely engorged in about 10.5 days (range 5-27 days), mating occurs on the host. Males continue to feed but females drop off to lay their eggs. Unfed adults can survive for about 2-3 years (up to 1,053 days). The entire life cycle (egg to egg) requires from 3 months to more than one year, and both larvae and nymphs can overwinter.
Blacklegged / deer tick (Ixodes scapularis) live for two years and have three blood meals. The life cycle begins when the female lays eggs. As the eggs mature, they develop into larvae, then nymphs, and finally adults. Larvae usually feed on white-footed mice or other small mammals from April till September. In the spring and summer of the tick’s second year (the nymph stage), they primarily feed from April through August. Breeding areas include various vertebrates. The adult female ticks feed and mate on large animals in the fall or early spring. The female lays her eggs, then dies.

Chemical Controls:
Organophosphate Insecticide Controls:
- Coumaphos (CoRal) applied as a ready to use product as a dust formulation or as a back/face rubber.
- Coumaphos with Diazinon (Co-Ral Plus) applied as an eartag.
Pyrethroid Insecticide Controls:
- Permethrin (various) applied as a 1.0% solution or 0.05% spray. Applied thoroughly to animal’s coat.

- NOTES: Perimeter sprays, pour-ons and ear tags serve as excellent tools to control ticks.

Cultural Controls:
- Cattle are kept away from areas highly populated with wildlife, since many ticks could migrate to cattle.
- Keep fields mowed early season to reduce wildlife (mice, deer) contact.

Biological Controls:
- Possible biocontrols for the lonestar tick included the entomopathogenic fungi *Beauveria bassiana* and *Metarhizium anisopliae*. No information has been obtained for effectiveness of control in Tennessee.
- Entomopathogenic nematodes may be a potential control method for both lonestar and American dog ticks, however no field data is available.

**Cattle grubs / Heel fly (Hypoderma lineatum)**
Cattle grubs are the larval stage of heel flies. They are large flies which often resemble bees, do not feed on cattle and only survive for 3 to 8 days. Adult female flies lay eggs on lower body regions of cattle, between early May to late August. Newly hatched larvae burrow into the skin, causing infested animals considerable irritation.

Economic losses include gadding behavior in response to adult flying activity which decreases the animal’s ability to graze efficiently. Gadding also makes cattle difficult to hand and increases the risk of self-inflicted injuries. Tunneling due to infestation causes tissue degradation and heavy infestations may cause poor weight gain, delayed time to first lactation and long term production losses. Holes created in the skin by grubs, substantially decreases value of the hide. Carcass value is further reduced due to discoloration of infested tissue areas. This pest only has one generation per year and is fairly susceptible to most insecticides. Products often used for internal parasite control are often effective against grubs at very low dosages.
Chemical Controls:
Insect Growth Regulators:
- **Doramectin** (Dectomax 0.5%) applied as a pour-on. Not for use in female dairy cattle 20 months of age or older. Provides control of mites, lice and horn flies.
- **Eprinomectrin** (Eprinex) applied as a pour-on. Provides about 7 days of control for horn flies. Provides control of mange mites.
- **Ivermectin** (Ivomec 0.5%) applied as a pour-on. Provides control of mites, lice and horn flies.
- **Moxidectin** (Cydectin 0.5%) applied as a pour-on. No pre-slaughter or milk discard interval. Provides control of mites, lice and horn flies.

Cultural Controls:
- Placement of cattle in sunny areas in spring may help to kill off grubs.
- Since heel flies and bomb flies lay eggs only in the daytime and do not enter stables, a practical control solution is to provide darkened sheds or shelters into which cows can retreat as the flies approach.

Biological Controls
- None

**Cattle lice (Bovicola bovis, Solenoptes capillatus, Lignonathus vituli)**
Cattle lice are relatively small and inconspicuous. There are several species of cattle lice which have been observed in Tennessee cattle production areas, however rarely become a serious problem in dairy cattle production. These include the cattle-chewing louse, cattle-biting louse (**Bovicola bovis**) which may be found on the base of tail, shoulders, and top line. These species are not blood feeders, but uses their mouthparts to rasp away at animal skin and hair. Other lice species feed on blood of cattle and have specialized mouth-parts for penetrating animal skin. These include the little blue cattle louse (**Solenoptes capillatus**) generally found on the muzzle, dewlap and neck and the long-nosed cattle louse (**Lignonathus vituli**) generally found on the dewlap and shoulders of cattle. Cattle 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. Individuals working with infested animals may be at greater risk of injury. Lice are most common on mature cows in December through March, with peak populations found in the spring. Direct sunlight in the spring aids by naturally killing larvae from heat.

Chemical Controls:
Organophosphate Insecticide Controls:
- **Coumaphos** (CoRal) Applied as a spray, dust and/or back/face rubber.
- **Tetrachlorvinphos** (Rabon) applied as a 3% dust to animal coat with self applicator.

Pyrethroid Insecticide Controls:
- **Permethrin** (various) applied as a pour-on, back/face rubber, 0.001% spray-on and/or 0.25% dust.
- **Pyrethrin** and piperonyl butoxide (various) applied as a 0.025% to 1% spray on materials.
Other Insecticide Classification Controls:

- **Doramectin** (Dectomax 0.5%) applied as a pour-on.
- **Eprinomectin** (Eprinex 0.5%) applied as a pour-on.
- **Ivermectin** (Ivomec 0.5%) applied as a pour-on.
- **Moxidectin** (Cydectin 0.5%) applied as a pour-on.
- **Spinosyn** (Elector) applied as a pour-on or spray on animal coat. No milk discard or withholding. May be used on lactating cattle.

**Notes:** In previous years, products containing Ciodrin (crotoxyphos) an organophosphate, rotenone a botanical, and/or pyrethrum were used for lice control. Products were either in wettable powder or emulsifiable spray on formulation. Products containing crotoxyphos are no longer available for use.

**Biological Control:**
- None currently available.

**Cultural Control:**
- Newly obtained animals should be isolated and carefully inspected for lice before being allowed to mingle with the herd.
- It has been reported that housing calves in hutches will reduce infestations by 90% without any pesticide treatments.
- Regularly inspect animals for infestations.

### Mites (Chorioptic)

Parasitic mites affecting cattle are small arachnids (less than 0.5 mm in length as adults), living in the skin feeding on skin and on tissue fluids oozing from the excavations. There are three species of mites that may cause scabies, a serious, debilitating mange condition: **Psoroptes ovis**, **Sarcoptes scabei** and **Chorioptes bovis**. **Psoroptes ovis**, which causes the condition psoroptic scabies, is the most important. Infestations of this pest require reporting and quarantine. Like lice, mites live their entire lives on their hosts, may be spread from animal to animal by contact and are most abundant in cold weather. They prefer areas of the body thickly covered with hair; their feeding causes itching and severe skin irritation. Animals rub and scrape the affected areas, producing lesions in which the mites thrive. Lesions most commonly occur on the withers, along the back and around the tail. Weight loss may occur and heavily infested animals exposed to harsh weather may die. Fortunately, psoroptic scabies is rare in the eastern United States. Psoroptic scabies (**Psoroptes ovis**) causes common scabies in cattle. Lesions due to infestations become enhanced in the fall and winter and abate during the spring and summer. They have rarely been a problem in Tennessee within the past 15 years.

**Chemical Controls:**

**Insect Growth Regulators:**
- **Doramectin** (Dectomax 0.5%) applied as a pour-on. Cattle must not be slaughtered for human consumption within 45 days of treatment. Not for use in female dairy cattle 20 months of age or older.
- **Eprinomectrin** (Eprinex 0.5%) applied as a pour-on
- **Ivermectin** (Ivomec 0.5%) applied as a pour-on
• Moxidectin (Cydectin 0.5%) applied as a pour-on

Cultural Control:
• Control and spread of this pest has been accomplished due to early detection, successful quarantines and treatment of infested animals.

Biological
• None

Other pests occasionally found in dairy cattle production
Cattle follicle mite (*Demodex bovis*) found on withers, neck, back, and/or flanks. Cattle itch mite (*Psorobia bos, P. bovis*) found on the neck, brisket, ventral abdomen, and/or body. Sarcoptic mange mite / itch mite (*Sarcoptes scabei var. bovis*) found on the head, neck, shoulders, and entire body.

Cultural Control:
• Quarantine infested animals, when feasible move animals off farm only for slaughter.
• Segregate all newly purchased animals from the rest of the herd for several weeks and keep animals under observation.
• Avoid any animals that show visible skin lesions or that appear to be abnormally itchy or agitated.

No-See-Ums (*Culicoides spp.*)
Black flies (belong to the family *Simuliidae*) are mostly generalist feeders, feeding on various vertebrates. They live in clean, fast-moving water such as streams and dam outfalls. These have occasionally been observed in Eastern Tennessee near stream areas. They are rarely a problem.

Rattailed maggots / Drone flys (*Eristalis tenax, and Eristalinus aenus*)
Rattailed maggots are very rarely pests in Tennessee. Occasionally larvae appear in alarming numbers in dung pits or animal waste lagoons. Even so, they pose little threat to man or animals.
Chemical Control:
• Treatment is rarely necessary.

Fireants (*Solenopsis richteri, S. invicta, and hybrids*)
Fire ants are not ectoparasites of cattle, although are omnivorous and stings from these pests can irritate cattle and cause additional damage to the skin. Damage to the skin may cause loss of blood and possible secondary infection. The most effective method of control is obtained by utilizing insect growth regulating compounds.
Chemical Controls:
Organophosphate Insect Controls:
• **Chlorpyrifos** (Lorsban 4E): This active ingredient is toxic to bees. Cattle are not allowed to graze treated areas and the active ingredient is **not allowed** for use in pasture areas.

**Insect Growth Regulators:**

- **Abamectin** (Clinch 0.011%): Caution as the signal word. Product is extremely safe in bait formulation.
- **S-Methoprene** (Extinguish 0.5%): extremely safe bait formulation, Caution as the signal word. For use in **non-grazed** pastures.
- **Pyriproxyfen** (Distance, Esteem 0.5%): extremely safe bait formulation, Caution as the signal word. For use in **non-grazed** pastures. Extremely safe bait formulation.

**NOTES:** Baits are one of the most effective methods of control.

**Cultural Controls:**

- Mow infested areas regularly may provide little control.

**Biological Controls:**

- *Pseudacteon tricuspis* and *Pseudacteon curvatus* are parasitoid phorid flies from South America which parasitize fire ants. Phorid flies have been introduced in many counties in Tennessee, and are slowly reproducing and spreading.
- In the laboratory, the virus, SINV-1 has proven to be both self-sustaining and transmissible. Currently, no field data available for control in Tennessee.
- The microsporidian protozoan *Thelohania solenopsae* and the fungus *Beauveria bassiana* are promising pathogens. *Solenopsis daguerrei*, a parasitic ant, invades colonies to replace the queen in hopes of gaining control of the colony.

**Pest Control Products**

There are various materials and methods used for pest control in dairy cattle production systems. Materials may be used directly on cattle (spot sprays, ear tags, pour-ons), applied as a premise or residual surface sprays, space sprays, manure sprays, baits, or injected or applied in feed, as a feed additive. When materials are applied as premise sprays, they are allowed to dry prior to allowing cattle to re-enter treated areas. Insecticide-impregnated ear tabs have been one of the most popular methods of controlling flies since they became available. Since most ear tags are effective for only about five months, it is recommended for producers to wait until early May to place them on cattle. This application is later than normally recommended for fly control to begin with more conventional methods of fly control. Generally control begins when 100 flies are observed per head. A combination of practices may be needed periodically during the fly season. This would be true for lice control, since they may become a serious problem. If heavy infestations are observed a second treatment within 10-14 days is recommended, to kill lice hatching from eggs. The following list includes various products available for pest control in dairy operations.
Premise sprays, pour-ons, injectables, and bolus applications

**Organophosphates:**

Coumaphos (Co-Ral 4.2, 1.0, 0.25): the formulations containing 4.2 and 1.0 lbs ai have a signal word of Danger on the label, where the 0.25 lb product has Warning as the signal word. The product formulated with 1 lb ai per gallon is used as spray treatments at 2-12 quarts per 100 gallons of water depending on target pest. For lactating dairy cattle, 1 to 4 quarts formulation (1E) per 100 gallons of water. All formulations are labeled for use on non-lactating dairy cattle to control horn flies, face flies, lice, ticks, screwworms and grubs. Back rubbers usually receive one gallon of 0.25lb ai in 13 gallons of carrier (oil). Should not be used within 14 days of freshening. No more than one quart 0.0625 lbs ai per 50 gallons of water for lactating dairy cattle and no more than 1 lb ai per 50 gallon water for non-lactating dairy cattle. The 0.25 lb ai formulation cost is approximately $400 per gallon.

Deltamethrin (Annihilator 0.02%) has Warning listed as the signal word. Product is in a ready to use mixture and applied thoroughly to surfaces until wet. Insects coming to rest on treated surfaces will be killed or repelled. Repeated treatments maybe necessary but not more than once per week is allowed. Animals are not sprayed, or applications are not made to animal feed or watering equipment. Product cost approximately $20.00 per gallon of ready to use solution.

Diazinon (Dryzon): as a premise spray was applied at the rate of 2 – 4 lbs 50% WP and mixed in 25 gallons of water and applied as a residual spray, however, is no longer allowed in dairy cattle production. One gallon of mixture would cover 350 to 750 square feet of ceilings, and/or walls. If applied as a bait, 1 lb of sugar or 2 cups of syrup or molasses is added to the spray mixture and applied to areas out of reach of animals. Animals were removed from buildings and corrals prior to treatment and allowed to return after the spray had dried. This product may not be applied as a space spray. EPA cancelled use of this product as a premise spray in Nov. 2001 and in Dec. 2002, the product was cancelled for use in various production areas, however, remaining stocks could be used until depleted. Use in Tennessee during 2007 would have been negligible. Cost was not available for this product.

Dichlorvos (Vapona 3.88 EC, 1%, no-pest strip): the 3.88 and 1% formulations have Danger listed as the signal word. The 3.88EC formulation is applied at the rate of 1 gallon per 100 gallons of water to give a final solution of 0.5%. Applied as a space spray mist to open air space at the rate of 1 quart (32 oz.) of diluted solution per 8,000 cubic feet or as a coarse wet spray to indoor surfaces at the rate of 1 quart of diluted solution per 1,000 sq. ft. The 1% formulation is applied at the rate of 1 pint formulation per 8,000 cubic feet. The 1% formulation may be applied to animal at 1 to 2 fl oz of product to wet hair of animal in morning and evening. No more than 2 fl oz of 1% product per animal daily may be applied. Labeled for use in dairy barns, feed lots, and animal facilities. For control of horn flies stable flies, face flies, and mosquitoes. The 1% formulation cost approximately $15.99 per gallon. Cost would be estimated at $0.13 per application per
head of cattle. This product was extremely difficult to obtain in 2007. In the previous years, this product was very much available in fly strips for use in milking areas. The strips are composed of 18.6% dichlorvos and 1.4% related materials. Strips cost approximately $6.25 and treat a 12’ x 12’ x 8’ room.

**Malathion (malathion 5EC):** has Warning as the signal word. This product has a 12 hour REI. This product is no longer labeled for the use in dairy cattle production. No indoor use allowed, however may be used outdoor for fly and mosquito control. A 2% spray solution (1 part malathion 5EC with 28 parts water) may be used for adult mosquito control. For outdoor fly control, 2 gallons malathion 5EC is mixed with 100 gallons of water. One gallon of dilution covers approximately 1,000 sq.ft. area. Rate of product would range from 2.56 fl.oz. EC for fly control to 4.57 fl.oz. per gallon of water for mosquito control. An approximate cost of this product would be around $0.62 to $1.11 per gallon of dilution to treat 1,000 sq. ft.

**Tetrachlorvinphos / stirofos (Rabon 0.463%):** Has Caution listed as the signal word and is a feed additive. This product is available to cattle in block form. Fed at the rate of 0.07grams active ingredient in 0.5 ounces of the feed which is consumed per 100 lbs body weight. Approximately one block would be needed per 5 head of cattle for 4 weeks. Cost would be approximately $13.50 per block or $2.70 per cow per 4 weeks. Controls face flies, horn flies and stable flies.

**Tetrachlorvinphos -Rabon / dichlorvos -Vapona (Ravap):** has Danger listed as the signal word. This product is a mixture of two active ingredients; tetrachlorvinphos 23% and dichlorvos 5.3%. Product may be applied as a diluted spray to cattle and as a premise spray. As a livestock spray, 2-5 oz. formulation is mixed in 3 gallons of water and sprayed on animal. Animals should not be treated more often than every 10 days. May also be used with back rubbers and applied at 5 fl.oz. per one gallon carrier (oil). Controls lice, flies and lone star ticks on lactating dairy cattle. There is no withholding period from last application to slaughter. Cost is approximately $29.00 per quart of product or an estimated $0.30 per head for treatment when used as an animal spray.

**Phosmet (Prolate / Lintox –HD / Delphos 11.6%):** Has Danger listed as the signal word and is formulated at a 1 lb ai per gallon. Used as a spray-on and in back/face rubbers. As a spray-on it may be mixed at the rate of 1 gallon formulation to 100 to 240 gallons of water and sprayed on the animal. When used in a back rubber, it may be applied at the rate of 1 gallon formulation per 50 gallons of diluent. Labeled to control horn flies, lice, sarcoptic mange, and ticks on cattle. Non-lactating cattle should not be treated within 28 days of freshening. Cattle may be slaughtered 3 days after treatment. Cost is approximately $15.80 per quart of formulation. Cost may range depending on rate used from $0.26 to $0.64 per head as an animal spray.

**Famphur (Warbex 13.2%):** is a general use product. It was designed to be applied topically to treat insect infestations. The product is approved by the FDA for use on beef cattle, dry cows, and replacement heifers to treat grubs and reduce lice infestation. Applied at the rate of approximately 30 milligrams active ingredient per kilogram of
body weight and not to exceed 120 milligrams ai per animal. Not to be applied to lactating dairy cows or dry dairy cows within 21 days of freshening. Has a 35-day waiting period until slaughter. Product has been cancelled by EPA but is labeled by the FDA. Product was difficult to obtain by operators in 2007.

Fenthion (Tiguvon): has Warning listed as the signal word and is applied as a spot-on treatment once per season when lice become evident. However, further treatment later in the season may be necessary if lice re-appear. This product is a Restricted Use material. Tiguvon in the Spot-on formulation is a ready to use product. It is supplied in a backpack and must be applied only with the special Spot-on-Gun or Dial-a-Dose cup. It may be applied to the rump or loins of a non-lactating animal in one spot according to the label. It may be used on pregnant cows, and at the same time as drenching, castrating, dehorning and vaccinating. The product has a 45 day pre-slaughter interval. Do not treat dairy cattle of breeding age; calves less than 3 months old; sick, convalescent, or severely stressed livestock. Do not treat cattle for 10 days before or after shipping, weaning, dehorning, or after exposure to contagious or infectious diseases. Use of this product is regulated through the FDA. Product was difficult to obtain in 2007.

Carbamates:

Methomyl (Apache, Golden Malrin 1.0%): Product has Caution listed as the signal word and is applied as a dry bait and scattered on floors, walkways, throughout the operation but away from animals. Applied at the rate of 0.25 lbs formulation per 500 to 1,000 sq ft depending on pest pressure which is 0.0025 lbs ai per 500 to 1,000 sq,ft. Used to control house flies and stable flies. Cost is approximately $8.50 per lb of formulation or $2.13 per 500 to 1,000 sq ft.

Pyrethroids:

Cyfluthrin (Countdown, Tempo Ultra SC, Cylence): has Caution listed as the signal word. Animals are removed prior to application and allowed to return after applications have dried. This product is available in EC and WP formulations. Product is not applied as a space spray. Product is not applied directly to animals. Cylence pour-on is applied at the rate of 4mls to 400 lb body weight, and 8mls from 400 to 800 lb wt and from 800 lbs or greater body weight 12 mls would be used. Cost would be approximately $0.04 per ml of product or $0.31 per 800 lb animal. For perimeter treatment 8-16ml Tempo is added to one gallon of water which is then applied to 1,000 sq. ft. Cost would range from $1.43 to $2.86 per treatment.

Permethrin (Atroban, Ectiban, Gardstar, Overtime, Permaban, Permethrin, ProZap, PO 0.25%, 1EC): some product labels (0.25%, 0.125% formulations) have Caution listed as the signal word, where others (10% formulation) have Warning listed as the signal word. One quart formulation (1EC or 10%EC) added to 200 gallons of water for a spray mixture and applied to the animal to cover entire animal. When used in a back rubber
applied at the rate of 1 quart 1EC formulation to 20 gallons carrier (oil). Permethrin is used to control face flies, horn flies, stable flies, mosquitoes, lice mites, ticks, including deer tick. Cost of approximately $14.82 per 150,000 sq ft surface spray or per charge of a backrubber. Lactating cows may be treated after milking.

**Permethrin and diflubenzuron** (Cleanup) has the signal word Caution on the label. This product is a mixture of two active ingredients which contains a mixture of 5% permethrin and 5% diflubenzuron and is applied as a pour-on. Diflubenzuron is an insect growth regulator, where permethrin is a pyrethroid. Cleanup is labeled for flies and lice control at the rate of 3 mls formulation per 100 lbs body weight not to exceed 30 mls per animal. A half gallon of formulation will treat approximately 63 head of cattle. Cost is approximately $50 per 63 head of cattle treated. Has a 0-day pre-slaughter interval and milk discard time.

**Permethrin and piperonyl butoxide** (Synergized Lice-No-More 1%, Aerosol 0.5%, Synergized): has Caution listed as the Signal Word. Applied to lactating and non-lactating cattle. Labeled to control lice, horn flies, face flies, and aids in control of horse flies, stable flies, house flies, mosquitoes, and black flies. Applied at the rate of 15 cc per 100 lbs body weight up to a maximum of 5 fl. oz. for any one animal. May also be applied in a back rubber at the rate of one pint 1% formulation per gallon of carrier (oil). Used undiluted as a premise spray at the rate of one gallon per 7,300 square feet. The 7.4% with 7.4% PBO is applied at the rate of 2 mls/cwt body weight at a cost of approximately $0.58 per 800 lb cow per treatment. No milk withholding or slaughter withdrawal times.

**Others:**

**Spinosyn** (Elector): This product has Caution listed as the Signal Word and is considered an antibiotic. It is a 2.46% formulation of Spinosad and mixed to have a final concentration of 0.08% ai. (20 oz. per 5 gallons of water). May be applied as a premise spray one gallon final solution per 500-1,000 sq ft. Spinosad is a natural product produced by a soil actinomycete (bacterium) *Saccharopolyspora spinosa*. Spinosad is absorbed by contact, affects insect nervous system and results in rapid (within minutes) paralysis and death. Elector is non-irritating to people and animals and no protective equipment is required. This product is also effective against horn flies resistant to other classes of insecticides. Used for horn fly and lice control and approximate cost of $3.07 per head of cattle as a pour-on application.

**Imidacloprid with Z-9-Tricosene** (MaxForce, QuickBayt strips or granular): is a neonicotinoid insecticide which is formulated as a 0.50% bait with 0.10% Muscalure. It has Caution listed as the signal word. It may be scattered on floors or walkways but away from animals. The granular formulation MaxForce, is applied at the rate of 1.6 oz per bait station per 250 sq. ft. The liquid formulation is applied at a rate of 1.5 oz. 0.5% formulation with one fl. oz. water. The mixture creates a paste which is applied to surfaces where flies rest. Baits are placed in inaccessible to food producing animals, pets
or children. Depending on square footage of facility application rate may range from one ounce finished product per 250 sq ft. Cost for a treatment using 2 strips would be approximately $18.00 per 500 sq.ft area. Cost per 250 sq ft using the granular formulation is approximately $0.90.

**Nithiazine (QuikStrike):** is a nitronmethylene insecticide formulated as a 1% fly abatement strip. One strip per 100 sq feet to 300 sq ft depending on fly population in enclosed areas that are protected from rain. Cost of approximately $13.50 per trap.

**Amitraz (Taktic 12.5%)** has Danger listed as the signal word. Rate ranges from 25.7 fl.oz. to 51.4 fl.oz. formulation added to 100 gallons of water. Up to two gallons of solution may be applied to an animal. It is important to wet the animal thoroughly and that the spray penetrates to the skin until run-off. Labeled for the control of ticks, mange mites and lice. It can be used on lactating dairy animals, with no withholding period for milk following application. Also, there is no post-treatment slaughter interval on dairy cattle. It is priced approximately $55.60 per quart of formulation. Cost may range from $ 0.89 to $1.78 per head per treatment.

**Diflubenzuron and permethrin (Cleanup)** has the signal word Caution on the label. This product is a mixture of two active ingredients which contains a mixture of 5% permethrin and 5% diflubenzuron and is applied as a pour-on. Diflubenzuron is an insect growth regulator, where permethrin is a pyrethroid. Cleanup is labeled for flies and lice control at the rate of 3 mls formulation per 100 lbs body weight not to exceed 30mls per animal. A half gallon of formulation will treat approximately 63 head of cattle one time per season. Zero day pre-slaughter interval and milk discard time. Approximate cost of $0.95 per head per treatment.

**Macrocyclic Lactones**

The macrocyclic lactones (avermectins and milbemycins) are products, or chemical derivatives of soil microorganisms belonging to the genus *Streptomyces*. The avermectins in commercial use are ivermectin, abamectin, doramectin, eprinomectin, and selamectin. Commercially available milbemycins are milbemycin oxime and moxidectin. The macrocyclic lactones have a potent, broad antiparasitic spectrum at low dose levels. They are active against many internal parasites and arthropods of dairy cattle.

The macrocyclic lactones are well absorbed when administered PO, parenterally, or as pour-on formulations. Regardless of the route of administration, macrocyclic lactones are extensively distributed throughout the body and concentrate particularly in adipose tissue. However, the route of administration and formulation may affect disposition. Effective levels are reached in the GI system, lungs, and skin regardless of the route of administration.

**Eprinomectin** (Eprinex / CooperMEC): has Warning as the signal word and is an avermectin compound which is a member of the macrocyclic lactone class of
endectocides. It contains 5 mg eprinomectin per ml and is applied as a pour-on for control of grubs, sucking lice, biting lice, chorioptic and sacroptic mange mites and horn flies. Applied at the rate of 1 ml per 22 lbs body weight or 500mcg /kg body weight. May be applied to lactating and non-lactating dairy cattle. This product also provides control of other internal parasites such as round worms and lungworms. An approximate cost of $0.58 per cwt.

Ivermectin (Ivomec Pour-On) has Warning as the signal word. It is a topically applied dewormer for the control of internal and external parasites in cattle. It's labeled for the control of gastrointestinal roundworms, lungworms, grubs, horn flies, sucking and biting lice, and sacroptic mange mites. Ivomec Pour-On controls horn flies for up to 28 days after dosing. Cattle must not be treated within 48 days of slaughter. Female dairy cattle of breeding age should not be treated. Applied along the topline in a narrow strip from withers to tailhead. Dosage: 1 ml formulation per 22 lbs of body weight. One mL contains 5 mg of active ingredient. Cost is approximately $600.00 per 10 liters of formulation or $0.06 per ml formulation or approximately $0.28 per cwt.

Doramectin (Dectomax 1% and 0.5%) may be applied as a pour-on or as an injectable solution. Applied at the rate of 1 ml per 110 lbs body weight of an animal. The pour-on formulation is formulated to deliver the recommended dosage of 500 µg/kg (227 µg/lb) body weight when applied topically at the rate of 1 mL/22 lb body weight. Should not slaughter cattle for human consumption within 45 days of treatment. A withdrawal period has not been established for this product in pre-ruminating calves. Do not use in calves to be processed for veal. Not for use in female dairy cattle 20 months or older. Used to control harmful species of gastrointestinal roundworms, lungworms, eyeworms, grubs, sucking lice and mange mites. If administered to a 800 lb animal the cost would range from $3.19 for the pour-on formulation to $3.49 per animal for the injectable product.

Ear Tag Applications
Producers are encouraged to rotate active ingredients of ear tags from year to year to reduce possible resistance within the pest population.

Organophosphate ear tags

Beta-cyfluthrin (CyLence Ultra): has a signal word of Caution on the label. Labeled for control of face flies, horn flies and ear ticks. Formulated with 8% cyfluthrin and 20% piperonyl butoxide. Cost approximately $1.95 per tag.

Coumaphos, diazinon (Co-Ral Plus): has a signal word of Caution on the label. Formulated with a mixture of 20% coumaphos and 20% diazinon. Used on non-lactating dairy cattle to control horn flies, ticks, and face flies. Cost approximately $2.00 per tag.

Diazinon (Optimizer, Terminator): have a signal word of Warning on the labels. Both are formulated at 21.4% ai and contain approximately 15g ai per tag. They are used on non-
lactating dairy cattle to control horn flies, ticks and aids in face fly control. Optimizer has a cost of approximately $0.92 per tag.

**Diazinon (Patriot)** is a 40% formulation of diazinon. For use on non-lactating dairy cattle. Cost approximately $1.50 per tag.

**Diazinon, Chlorpyrifos (Warrior):** has Warning listed as the signal word. Has 15 grams ai per tag and composed of a mixture of 30% diazinon and 10% chlorpyrifos. For use on non-lactating dairy cattle for control of horn flies, biting and sucking lice, ear ticks, and aids in control of face flies, stable flies and house flies. Cost approximately $1.60 per tag.

**Fenthion / piperonyl butoxide (Cutter Blue)** has a signal word of Warning on the label. Product contains 20% fenthion and 15% piperonyl butoxide, a synergist. Use on lactating and non-lactating dairy cattle. Used for control of horn flies, and aids in control of face flies. This product was not available through the retail market in 2007. Any use of this product would have been from stocks remaining on the farm. Pirimiphos Methyl (Dominator) has Caution listed as the signal word. This product is labeled to control horn flies, also aids in control of face flies. It is formulated with 20% active ingredient per tag. Cost approximately $1.20 per tag.

**Pirimiphos methyl and lambdacyhalothrin (Double Barrel VP):** has Caution listed as the signal word. This product contains 6.8% Lambdacyhalothrin a pyrethroid and 14% pirimiphos methyl an organophosphate. Labeled for control of face flies and horn flies. Labeled for use with non-lactating dairy cattle. Cost approximately $1.69 per tag.

**Pyrethroid ear tags**

**Fenvalerate (Ectrin 8.6%):** Product has Caution listed as the signal word. It is formulated in an ear tag, with 10 grams ai per ear tag. Labeled to control horn flies, face flies, stable flies, house flies, Gulf coast ticks, spinose ear ticks and lice. For optimum pest control, attach one tag to each ear when pests first appear. Cost is approximately $1.99 per ear tag.

**Permethrin, chlorpyrifos, piperonyl butoxide (Ear Force Ranger):** has a signal word of Caution on the label. This product is a mixture of two classes of insecticides and a synergist. It is formulated at 10% permethrin, 6.67% chlorpyrifos, and 4% piperonyl butoxide. Labeled to control horn flies, face flies, ticks and aids in control of lice, stable flies, and house flies. Price not available.
Permethrin, piperonyl butoxide (Atroban Extra): has Caution listed as the signal word. For use on lactating and non-lactating dairy cattle. This product contains a pyrethroid insecticide and a synergist. One ear tag is used for horn fly control. Two ear tags are used for horn flies, face flies, stable flies, house flies, ear ticks and aid in control of lice.

Permethrin (Ear Force, GardStar) has Caution listed as the signal word on the label. Is a 10% impregnated plastic tag. For use on dry or lactating dairy cattle and calves. One tag is used for horn fly control. Two tags are used for control of face flies, ticks and can aid in the control of lice, stable flies and house flies. Cost approximately $0.68 per tag.

Cyfluthrin (Cutter Gold): has a signal word of Caution on the label. Product is formulated with 10% active ingredient. Pricing was not available.

Lambdacyhalothrin and pirimiphos methyl (Double Barrel VP): has Caution listed as the signal word. This product contains 6.8% lambdacyhalothrin, a pyrethroid, and 14% pirimiphos methyl, an organophosphate. Labeled for control of face flies and horn flies. Labeled for use with non-lactating dairy cattle. Cost approximately $1.68 per tag.

Lambdacyhalothrin and piperonyl butoxide (Saber Extra) has Caution listed as the signal word. It is formulated with 10% lambdacyhalothrin and 13% piperonyl butoxide a synergist. Labeled to control face flies and horn flies. For use with non-lactating dairy cattle. Cost approximately $1.84 per tag.

Zetacypermethrin and piperonyl butoxide (Python Magnum): Product has Caution listed as the signal word. The Python Magnum tag contains 10% zetacypermethrin s-isomer and 20% piperonyl butoxide, as synergist, for a total of 15.4 grams ai per tag. Labeled for control of horn flies, face flies, stable flies, and lice. Labeled for use on lactating and non-lactating diary cattle. Cost is approximately $1.65 per tag.

Zetacypermethrin and piperonyl butoxide (Python, ZetaGard) has Caution listed as the signal word and contains 9.5 grams ai per tag. The formulation consists of 10% S-Cyano cypermethrin and 20% piperonyl butoxide. One tag is labeled for control of horn flies, face flies, lice and ear ticks. With two tags, it controls of stable flies, black flies, house flies, and small horse flies. Cost is approximately $1.45 per tag.

Other Insecticide Classifications Ear Tags

Endosulfan (Avenger) has Warning listed as the signal word. This a 30% formulation of endosulfan, which is a cyclodiene organochlorines class insecticide. Has an approximate cost of $1.85 per tag.
Possible Pest Control Alternatives

**Bomyl** (various) an organophosphate insecticide (1,3-di(methoxycarbonyl)prop-l -en-2-yl dimethyl phosphate) is no longer available for use. It was previously used as a fly bait and was formulated as a granular material. This product is no longer available for use.

**Dimethoate** (Dimethoate Residual Fly Spray 2 EC): is a organophosphate which has Warning listed as the signal word. One gallon of 2lb active ingredient /gallon product is added to 25gallons of water to produce a 1% spray solution. One gallon of solution covers 350 to 750 square feet of surface. Product was **not labeled** for application to milking rooms. This product was **cancelled** for use in dairy cattle production in 2002.

**Flumethrin** (Bayticol) is a pyrethroid insecticide and is currently **not labeled** within the US. It has Caution listed as the signal word and contains 10g/L flumethrin and is used to control ticks on cattle and used in some countries for export. It is applied at 50 mL per 50 kg body weight.

**Crotoxyphos** (Ciodrin) is an organophosphate and is **no longer registered** for use. Depending on formulation, the previously used labels contained signal words ranging from Caution to Danger.

**Lindane** (various): this product was **voluntarily cancelled**. Product would provide control of ticks, and grubs. Lindane is an organochlorine insecticide usage has been cancelled in the USA. All agricultural uses of lindane have been discontinued by EPA. However, lindane use continues to be allowed for treatment of lice and scabies in pharmaceutical products regulated by the Food and Drug Administration (FDA).

Other Forms of Pest Control

- Sanitation is the key to any successful fly control program. Sanitation aids, by removing fly breeding sites. This method can be labor intensive.

- Screening and/or other mechanical control methods are invaluable in preventing flies from entering milking areas. Air curtains are also useful in keeping flies from entering these areas. Generally used with larger dairy herds.

- Black light/UV electrocution traps attract flies to light source and when they come in contact with the trap, electricity kills the fly. Con: Only useful in areas without direct sunlight. Not useful during summer months for face fly control. These products provide good fly control in enclosed indoor environments or confined situations. Generally, this type of product aids in control of house flies. However, the device must be placed in areas away from sun light, since flies will be attracted to sunlight rather than the device.
Biological Controls

Several species of parasitic wasps are commercially available, however the efficacy of these have not been studied in Tennessee. Various species may be identified by their scientific names in advertisements or brochures. The small amount of research data available from the midwest indicates that *Spalangia nigroaenea* is a commercially available parasite that is most likely to attack both house fly and stable fly pupae in feedlots. *Muscidifurax raptor* and *Muscidifurax zaraptor* may provide some parasitism of house flies. *Spalangia nigra, Spalangia cameroni,* and *Spalangia endius* may provide some parasitism of stable flies. It is recommended that livestock operations not buy unspecified "blends" of species or shipments of *Nasonia vitripennis* for control of pests. Field trials have shown that *N. vitripennis* has not been effective in midwest feed lots and no data has been available for Tennessee.

Vertebrates

**Rodents** Norway Rat (*Rattus norwegicus*), House Mouse (*Mus musculus*)

Rodents are a year-round problem in livestock facilities. They cause sanitation problems and food contamination or loss. Rats eat 1-2 oz. food per day while mice consume much less. In large numbers, rodents can cost producers much loss. Rats and mice also cause structural damage to buildings by chewing on wood and cinderblock, removing insulation from the walls for their nests, and stripping wiring, which can lead to fires. Rodents are also disease/parasite vectors, and their bites can lead to injury or infections. Their reproductive potential is very high; rodents produce four to eight generations per year. Rats and mice need three things to survive: food, water, and a nesting site. Rats need a water source more than mice, which can extract enough moisture from their food. Rats typically live in underground burrows near foundations, feed bins, or secluded areas near livestock facilities. Mice can live nearly anywhere.

**Monitoring:** Look for signs of infestation, including droppings, structural damage, burrows, tracks, or rodents themselves. Treat if pests are present.

**Chemical Control:** Anticoagulants are used most commonly in livestock facilities. Different formulations such as tracking powders, bait pellets, chunks, and concentrates are available. Follow label directions explicitly; otherwise, rodenticides are ineffective and dangerous. Rats do not take baits as readily as mice, unless the baits are left in their path and better food is unavailable. Place baits in locations where rodents travel or congregate such as along walls, in corners, or in concealed places.

**Biological Control:** Cats and predatory birds can help control small rodent populations. Poisoned rodents should be removed quickly to prevent secondary poisoning.

**Cultural/Mechanical Control:** Keep facilities clean and free of debris, remove spilled grain, mow around buildings and waste lagoons, install gravel barriers around buildings,
and use rodent-proof food storage bins. Snap traps, glue boards, and live traps are useful only in areas where rodent infestations are low.

**Birds**

Birds that nest in, or near, dairy facilities may cause damage or carry various pests and diseases. Dairy cattle that are exposed to avian tuberculosis may test positive for bovine tuberculosis and be slaughtered unnecessarily. Bird droppings corrode farm equipment, and nests plug drains/gutters. Birds will also destroy insulation. Avian pests include pigeons, European starlings, house finches, and house sparrows.

**Chemical Control: Aminopyridine** (Avitrol) is a RESTRICTED USE pesticide that may be used to control birds. Use would be limited to 1% of the production facilities.

**Biological Control:** Natural enemies of pest birds include predatory birds and cats.

**Cultural/Mechanical Control:** Clean up spilled grain, store grain in pest-proof containers, use covered feeding troughs that exclude birds, and keep water at a level deep enough that birds cannot stand in it, but shallow enough that they cannot drink it by perching on the lip. To keep birds out of buildings, hang plastic strips in doorways, use wire and mesh to seal openings, and cover rafters with netting. To keep birds from nesting or roosting, change the roosting ledge angle to at least 45°, install porcupine wires, use electronic bird-control devices, install catwalks, or use chemical perch repellents. Other methods to control birds include destroying nests, puncturing eggs, and trapping.

**Chemical Vertebrate Pest Control**

The list below contains many of the products available to producers for vertebrate pest control in cattle production along with the recommended application rates. REIs are not listed here because the Worker Protection Standard (WPS) only covers pesticides that are used in the production of agricultural plants, not animals. Products would be placed in and around barns and milking parlors depending on specific label directions. Approximately 5% of the dairy operations would use one or more of the listed products for control of mice and rats.

- **Aluminum Phosphide** (*Weevil-Cide Pellets, Phostoxin*) – Inorganic which has Danger listed as the signal word and is formulated with 55% active ingredient.  
  o For control of rodents on agricultural premises, follow label directions.  
  This product is a **Restricted Use Pesticide**.
- **Aminopyridine** (*Avitrol*) - Inorganic aromatic heterocyclic and a 0.5% formulation. It contains the signal word of Caution and is a **Restricted Use Pesticide**.  
  o Used for bird control. Commonly mixed with various seeds that are attractive to the targeted avian species.
• **Brodifacoum** (*D-Con Bait Pellets II, Talon, Havoc, Final*) – A single-dose Anticoagulant Rodenticide – Formulated at 0.005%. Most formulation contain Bitrex, a non-target deterrent and most formulations are weather resistant. This product has a signal word of Caution.
  o For **bait control** of rats on agricultural premises, place 4-16 baits per placement at 15-30 ft. intervals. For control of mice, place 1-2 baits per placement at 8-12 ft. intervals. Maintain bait supply for 10-15 days, or until rodent activity ceases.

• **Bromadiolone** (*ROC-622 Rat & Mouse Bait Packs, Contrac, Maki*) – A single-dose Anticoagulant Rodenticide. Formulated at 0.005%.
  o For **bait control** of rats on agricultural premises, place 3-10 packs per placement. For control of mice, place one pack per placement. Maintain bait supply for 10-15 days, or until rodent activity ceases.

• **Bromethalin** (*Clout All Weather Bait, Fastrac, Vengeance, Assault, CyKill*) – Benzenamine, have a 0.01% active ingredient formulation with Caution listed as the signal word.
  o For **bait control** of rats on agricultural premises, place 2-12 baits at 20-30 ft. intervals. For control of mice, place 1-2 baits at 8-12 ft. intervals. Maintain bait supply for at least one week, or until rodent activity ceases.

• **Cholecalciferol** (Quintox) has Caution listed as the signal word and is a 0.075% formulation. This is a multiple-dose product.
  o For **mice** apply 0.25 to 0.5 oz per bait station, for **rats** apply 2 to 8 ounces per bait placement.

• **Difethialone** (*D-Con Rat & Mouse Bait Blocks, BlueMax*) – Benzothiopyranone, is formulated at 0.0025% and has Caution listed as the signal word. This product is a single-dose anticoagulant.
  - For **bait control** of rats on agricultural premises, place 6 to 23 blocks per placement, spaced at 15 to 30 ft. intervals. For control of mice, apply one or two blocks per placement, spaced at 8 to 12 ft. intervals. Provide an uninterrupted supply of bait for 10 to 15 days, or until rodent activity ceases.

• **Diphacin or Diphacinone** (*Ramik Green Mini Bait Packs, Ditrac, Tomcat*) - anticoagulant rodenticide formulated at 0.106% and has Warning listed as the signal word. This product is a multiple-dose poison.
  o For **bait control** of rats on agricultural premises, place 3-10 packs per placement. For control of mice, place 1-2 packs per placement, spaced at 8-12 ft. intervals. Maintain bait supply for 10-15 days, or until rodent activity ceases.

• **Warfarin** (*Ra-Mo-Cide WF*) – A multiple-feed anticoagulant rodenticide formulated at 0.025%.
  o For **bait control** of rats, place 2-5 packs per placement, providing a supply of bait for at least 10 days. For mice control, open the pack and apply 0.25-0.5 oz. of bait at 8-12 ft. intervals.
• **Zinc Phosphide** (*Eraze Rodent Pellets, ProZap*) – Inorganic is a 2% formulation with Caution listed as the signal word.
  - For *bait control* of rodents on agricultural premises, follow label directions.

### Diseases

**Pinkeye,** (*Moraxella bovis*)

Pinkeye is a contagious disease of the eye caused in part by a bacterium that is vectored by face flies. Other eye irritants include bright sunlight and weeds. Pinkeye is painful and can lead to blindness if left untreated. Pinkeye is more common in the summer but can occur at any time. It is more prevalent in young animals because they lack resistance. Infectious bovine rhinotracheitis, or IBR, has similar symptoms except for ulcerations (usually). Fevers, nasal discharge and coughing are present instead. Cattle with dark pigmentation around the eyes are less likely to contract the infection.

**Monitoring:** Symptoms include watery, cloudy eyes, squinting, and ulcerations on the cornea.

**Chemical Control:** Injectable or topical antibiotics, such as oxytetracycline (LA200) are helpful. Insecticides can be used to control the flies that vector the infection, and vaccines are used to prevent pinkeye. Early treatment nearly guarantees success.

**Biological Control:** There are no biological control agents available.

**Cultural Control:** Use eye patches or shade as treatment options. Clip weeds to reduce eye irritation, and provide good nutrition to boost the immune system. Use gloves when examining infected livestock, disinfect equipment, and isolate infected cattle to avoid contaminating other animals. Pink eye has been reported more often in cattle with white pigmentation surrounding the eyes than in breeds with darker pigmentation.

**Bluetongue** (*a virus - BTV*)

Bluetongue virus is spread via biting midges between late summer and early fall. Sheep are more commonly affected, although cattle can contract the virus. Less than 5% of cattle usually become symptomatic. Bluetongue virus may cause infertility, abortions, stillbirths, or congenital defects in calves.

**Monitoring:** Inspect flocks for suspicious symptoms including panting; high fever; hemorrhaging or open sores on the tongue, mouth, or nostrils; redness of the skin, face, neck, or body; a swollen, reddish blue tongue; lameness with a swollen, reddish blue area at the base of the horns and coronary bands of the feet; foot lesions; weakness; and hair loss.
**Chemical Control:** Ear tags or spray/pour-ons may aid in control, however no data is available to support this.

**Biological Control:** No biological controls are available.

**Cultural Control:** To prevent bluetongue virus, keep animals in during the night and at dawn, keep cattle away from sites with biting insects, take the herd to higher altitudes, and eliminate biting gnat breeding areas.

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- Fred Hopkins – Professor, Veterinary Science, Extension Service. fhopkins@utk.edu, 865-974-3471

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Milk Production, Disposition and Income 2006 Summary

US Milk Cows and Production

Tennessee Dairy Production 2004

Diazinon Premise Spray Cancellation Order
Table 1. Estimated Losses Due to External Parasites in Dairy Cattle Production

<table>
<thead>
<tr>
<th>Pest - Common Name</th>
<th>Potential loss due to presence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horn flies</td>
<td>15%</td>
</tr>
<tr>
<td>Face flies</td>
<td>15%</td>
</tr>
<tr>
<td>House flies</td>
<td>8%*</td>
</tr>
<tr>
<td>Stable flies</td>
<td>2%</td>
</tr>
<tr>
<td>Mosquitoes</td>
<td>&lt;0.01%</td>
</tr>
<tr>
<td>Ticks</td>
<td>&lt;0.10%</td>
</tr>
<tr>
<td>Black flies (noseeums)</td>
<td>&lt;0.01%</td>
</tr>
<tr>
<td>Blow flies</td>
<td>2%</td>
</tr>
<tr>
<td>Cattle lice</td>
<td>&lt;0.10%</td>
</tr>
<tr>
<td>Cattle grubs</td>
<td>1%</td>
</tr>
<tr>
<td>Mites</td>
<td>&lt; 0.01%</td>
</tr>
<tr>
<td>Fire ants</td>
<td>&lt; 0.01%</td>
</tr>
<tr>
<td>Others</td>
<td>&lt; 0.01%</td>
</tr>
</tbody>
</table>

* cause the greatest concern in milking areas, due to possible milk contamination.

Table 2. Estimated Method of Pesticide Application for External Parasite Control

<table>
<thead>
<tr>
<th>Method</th>
<th>% head treated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ear-tags</td>
<td>50</td>
</tr>
<tr>
<td>Pour-ons</td>
<td>50</td>
</tr>
<tr>
<td>Spray-ons</td>
<td>15</td>
</tr>
<tr>
<td>Automated mists</td>
<td>2</td>
</tr>
<tr>
<td>Back / Face Rubbers (oilers)</td>
<td>5</td>
</tr>
<tr>
<td>Back / Face Rubbers (dusts)</td>
<td>2</td>
</tr>
<tr>
<td>Feed Additive (mineral block, bolus)</td>
<td>8</td>
</tr>
<tr>
<td>Baits</td>
<td>1</td>
</tr>
<tr>
<td>No-pest strips</td>
<td>12</td>
</tr>
</tbody>
</table>

Products containing pyrethroids are most commonly used for fly control.