Pest Management Strategic Plan for Beef Cattle in Tennessee and Kentucky

Summary of Workshops held in January 2005 Princeton, KY and Nashville, TN

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Executive Summary

With a combined total of 2,238,000 beef cows, Kentucky and Tennessee are the top two beef cattle production states east of the Mississippi. Cash receipts for cattle and calves sales in 2004 totaled $620,650,000 for Kentucky (15% of all receipts) and $514,338,000 for Tennessee (20% of all receipts). In Tennessee, cattle and calves is the leading agricultural commodity. The significance of this industry underscores the importance of reviewing the status of beef cattle pest management in these states and making recommendations for improvement.

This document presents the conclusions of two one-day meetings involving producers and state Extension personnel. The meetings were held in response to regulatory actions such as the Food Quality Protection Act which may affect availability of pest management products; to the emergence of new technologies; and to ongoing and new threats to the industry such as pesticide resistance and increased pest pressure. The document includes an overview of production practices, pest incidence and importance, and current pest management practices. Arthropods are far and away the most important pest of cattle in these states, therefore, these pests are given the most emphasis.

The priorities developed by meeting participants and published here should serve as a guideline to researchers, Extension personnel, regulators and industry leaders when addressing pest management issues facing beef cattle producers in Kentucky and Tennessee.

Attendees of the Pest Management Strategic Plan Meetings

Princeton, Kentucky, January 18, 2005

Extension Personnel

Roy Burris, Extension Livestock Specialist, P.O. Box 469, UK-REC, Princeton, KY 42445

Doug Johnson, Extension Entomology Specialist and IPM Coordinator, Box 469, UK-REC, Princeton, KY 42445

Kevin Laurent, Extension Associate, Box 469, UK-REC, Princeton, KY 42445

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Patty Scharko, UK Ruminant Ext. DVM, P.O. Box 14125, Lexington, KY 40512-4125

Doug Wilson, County Extension Agent, McCrocken Co., 2705 Olivet Church Rd., Paducah, KY 47001

Producers

Nicky Baker, Fredonia, KY

Paul Beauchamp, Hardinsburg, KY

Greg George, Caldwell, KY

Shelby Hughes, Auburn, KY

Scotty R. Parsons, Dawson Springs, KY

Brock Sargeant, Hopkinsville, KY

Ed Tabor, Utica, KY

Consultant

Larry Reber, Clinton, KY

Industry

Saralyn Hite, Territory Manager, Pfizer Animal Health, Gracey, KY (also a producer)

Nashville, Tennessee, January 25, 2005

Extension Personnel

Ronnie Barron, County Extension Agent, Cheatham Co., 162 Co. Services Dr., Suite 110, Ashland City, TN 37015

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Scott Swoape, County Extension Agent, Van Buren Co., P.O. Box 136, Spencer, TN 38585-0136

James Dennis Taylor, County Extension Agent, Giles Co., P.O. Box 907, Pulaski, TN 38478-0907

Steve Walker, County Extension Agent, 113 E. Macon Co., Locust St., Lafayette, TN 37083

Producers

Bobby Lynn, Kingston Spring, TN

Milton Russell, Rocky Island, TN

Priorities (to-do list) for research, extension and regulatory efforts in the area of beef cattle pest management

Research

1) Update and improve fly (horn and face) management systems: a) proper application of treatments, especially ear tags, including timing of application and rotation of insecticide classes, primarily to reduce development of resistance in flies; b) develop more convenient and reliable face fly controls; c) develop treatments/products with longer residual; and d) determine factors resulting in increased length of active season.
2) Determine association between abundance/species composition of blood feeders and the incidence of anaplasmosis.
3) Because pinkeye has become more prevalent, more research is needed on how the causative agent (*Moraxella bovis*) is spread and on the conditions that predispose animals to develop symptoms. Also, a preventative vaccine for the strain of *Branhamella (Moraxella) ovis* affecting cattle is needed.
4) Develop economic or treatment thresholds for internal parasites (roundworms) based on fecal samples because prophylactic treatments often are not necessary. Seasonal and site-specific effects should be investigated.
5) Develop management strategies for horse flies for which there are currently no good controls.
6) Improve timing of application of avermectins for grub control. Because they kill more slowly they perhaps can be applied later than more traditional grub products, thus, reducing danger to cattle.
7) Increase research in support of organic beef production. A specific request was to evaluate the efficacy of Tasco™ (feed additive derived from dried sea kelp) that supposedly acts as an anti-biotic and enhances insect control.

8) Increase evaluation and demonstration of imported fire ant management products in pastures.
9) Improve worker safety during insecticide applications.
10) Develop more alternatives to organophosphate insecticides.

Education/Extension

1) Develop and publish a comprehensive, updated Extension fly control program publication, perhaps as a multi-state effort.
2) Develop and publish an easily understood, efficacy-based rating scale for pesticides so that Extension specialists and agents can provide more detailed, rapid recommendations.
3) Provide on-line database of pesticide product labels that is easily accessible to producers.
4) Extension publications, presentations and recommendations should be revised to emphasize rotation of chemical classes to delay onset of resistance, the use of thresholds in managing horn flies, and the use of fecal sample identification services to determine whether roundworms treatments are necessary.

Regulatory

1) Revise product labels to make chemical class more obvious to users (to facilitate chemical class rotation and to emphasize importance of rotating chemical classes).
2) Revise product labels to make information pertinent to product efficacy (expiration date, proper storage conditions) more conspicuous.
3) Require improved handling and storage procedure information from manufacturers and product sales representatives.
4) Increase the number of available alternatives for organophosphate pesticides.
5) Product labels for avermectins should be revised so that these pesticides can be used later in the season (after late October, the latest time of year recommended for grub control using other larvicides).
6) Increase the number of products registered for use in pastures against imported fire ants.

Production overview

Tennessee. One of the top beef-producing states in the nation, Tennessee ranks ninth in beef cow numbers and is one of the top four states in cow-calf operations. Of the states east of the Mississippi River, only Kentucky has more cattle. As of January 2006, there were 84,000 farms in Tennessee and beef cattle are produced on 42,000 (50%) of these. Most are small operations: 36,500 farms have 1-49 beef cows, 4000 have 50-99, 1470 have 100-499 and 30 have more than 500 beef cows.

In 2005, 2.24 million cattle in Tennessee were valued at $1.67 billion. Approximately one-half of these cattle, or 1.11 million, are beef cows. In addition to the 1.11 million beef cows, other components of beef production in 2005 included 185,000 replacement heifers (500+ pounds) and 125,000 steers (500+ pounds). There were 550,000 calves (< 500 pounds) and 1.06 million calves born (for beef and milk production combined). Sale of cattle and calves is the greatest source of agricultural income in Tennessee, a position the cattle industry has held for a number of years. The cash receipts from the sale of cattle and calves (including beef and veal) during 2004 totaled over $514 million, which was 20% of the state's total agricultural income, the largest of any commodity in agricultural sales.

Cow-calf operations made up 90 percent of the state's beef operations. The remaining operations were backgrounding or stockering operations. More than 750,000 feeder calves are marketed annually to backgrounding operations and feedlots, primarily in the Midwest and High Plains areas of the country. About 375,000 feeder calves are stockered every year in Tennessee. These estimates were published in 2003.

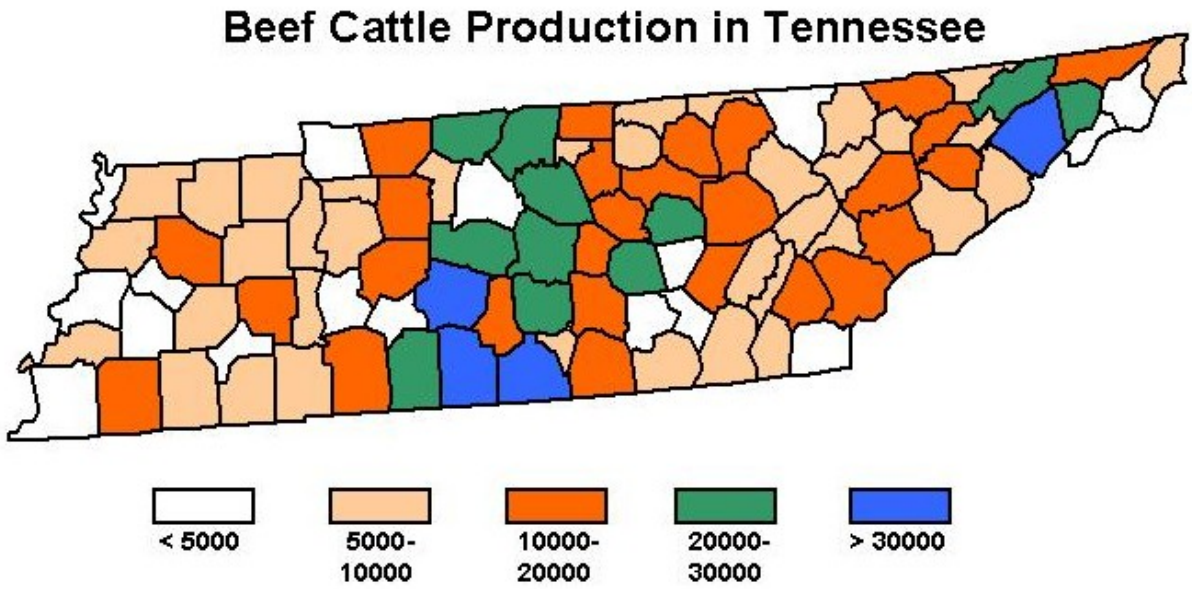
Kentucky. Kentucky is the top beef cattle producing state east of the Mississippi River with approximately 1.13 million beef cows. Nationally, the state ranks eighth in beef cow numbers and is one of the top five states in cow-calf operations. As of January 2006, there were 84,000 farms in Kentucky and beef cattle are produced on 38,000 (45%) of these. Most are small operations: 31,200 farms have 1-49 beef cows, 4500 have 50-99, 2240 have 100-499 and 60 have more than 500 beef cows. Similar to Tennessee, the vast majority of beef operations in Kentucky are cow-calf.

In 2005, 2.4 million cattle in Kentucky were valued at more than $1.8 billion. Forty-seven percent of these cattle, or 1.13 million, are beef cows. In addition to the 1.13 million beef cows, other components of beef production in 2005 included 180,000 replacement heifers (500+ pounds) and 205,000 steers (500+ pounds). There were 560,000 calves (< 500 pounds) and 1.11 million calves born (for beef and milk production combined).

The cash receipts from the sale of cattle and calves (including beef and veal) during 2004 totaled over $621 million, which was 15% of the state's total agricultural income. For comparison, sale of horses and stud fees totaled $950 million; sales of all poultry totaled $817 million. A 2002 estimate on annual production costs (per bred cow) for cow-calf production (including dairy) was approximately $1150 for western Kentucky and $890 for eastern Kentucky. Greatest operating costs were for harvested forages. Cost of “veterinary and medicine” which includes pesticides was $38.49 for western Kentucky and $16.25 for eastern Kentucky. [Note: estimates were developed for national regions (rather than individual states) based on results of a 1996 national survey.]

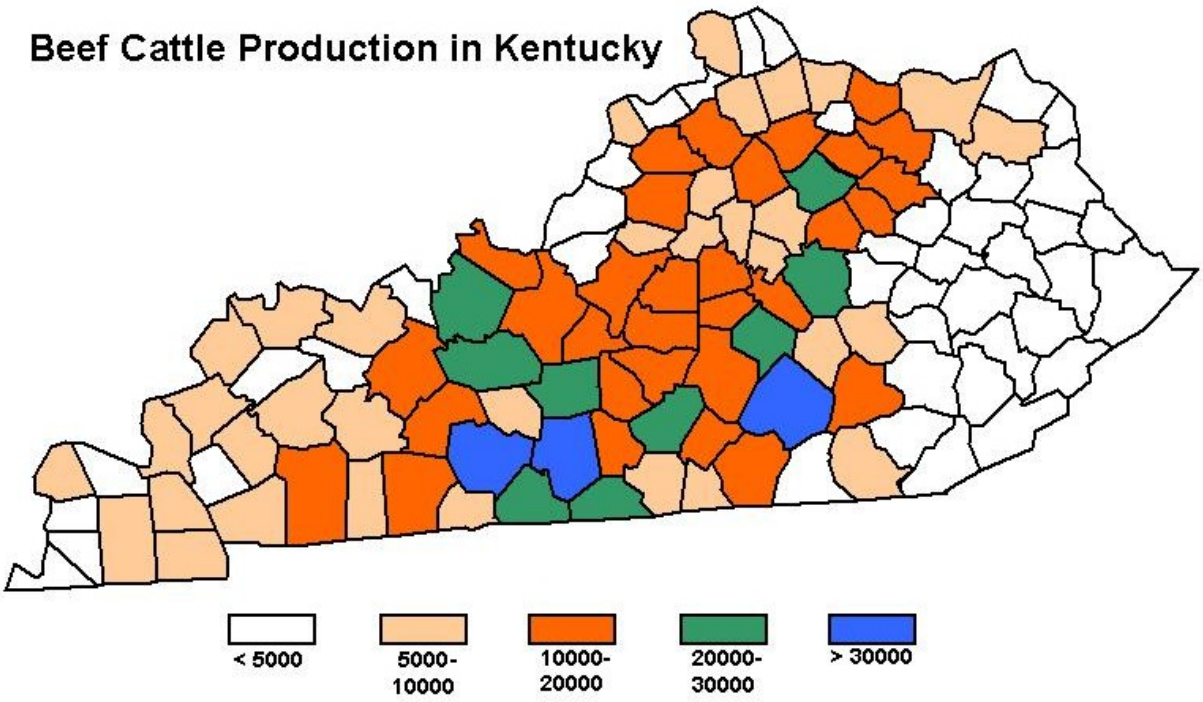
Production regions

Tennessee. Beef cattle are produced in every county of Tennessee, however, there are two primary production areas: in the center of the state and, to a lesser degree, in the northeast corner. The map below provides production, based on beef cow inventory, by county.



Beef cattle production in Tennessee based on inventory of beef cows, 2005 (National Agricultural Statistics Service; Tennessee Agricultural Statistics Service). Leading production counties are Lincoln (38,000 head), Giles (33,000 head) and Maury (32,500 head) and in south-central Tennessee and Greene (35,000 head) in the northeast.

Kentucky. Beef cattle are produced in every county of Kentucky, however, the primary production area is in the center of the state. The map below provides production, based on beef cow inventory, by county.



Beef cattle production in Kentucky based on inventory of beef cows, 2005 (National Agricultural Statistics Service; Kentucky Agricultural Statistics Service). Leading production counties are Barren (35,000 head), Pulaski (31,300) and Warren (30,700 head) in south-central Kentucky.

Cultural Practices

Most beef production operations in Kentucky and Tennessee are cow-calf, with most calves remaining with cows (dams) until weaned. A recommended production practice is to have at least 90% of calves running with dams until weaned. Backgrounding or stockering (retaining or purchasing weaned calves to grow for sale later or to use as replacement heifers) comprises the remainder of the industry. Approximately 250 to 350 pounds are added to stockered calves prior to marketing.

Winter calving is considered best for profitability when high quality spring forages increase milk production resulting in greater gain and weaning weights for calves. But severe weather may make calving difficult and possibly dangerous. Calving may be more successful in fall; and calves born in fall are ready for sale in mid- to late spring when market prices for calves are usually greater.

General production goals for a cow-calf operation include: 1) calves produced at 12-month intervals (per cow); 2) restricting the calving season to 60 days; 3) pre-weaning death loss of < 2%; and 4) average weaning weight that is about 50% of dam's normal weight. Ideally, heifers should be bred to begin calving about 3 to 4 weeks before cows. Because heifers are not fully grown, the early calving provides extra time to gain weight prior to breeding season.

Of primary importance to cattle production is availability and quality of forage. In Tennessee and Kentucky, most pastures and hayfields consist of tall fescue, orchardgrass or timothy. Bluegrass is also popular in Kentucky. Forage quality can be improved with addition of clovers. Warm-season forages such as millet, sudangrass or bermudagrass are often used in both

states to supplement the cool-season grasses (e.g., tall fescue) which decline in hot weather. Big bluestem is a warm-season grass used in Kentucky. Hay, usually consisting of alfalfa, fescue, timothy or orchardgrass, is the primary winter feed (mature cows need 25-30 lbs per day during a season that usually lasts from 120 to 150 days).

Grains, usually corn, are used if hay is not available. Protein supplements (plant-based, such as corn gluten, cottonseed meal or soybean meal and pellets) may be needed if hay is of average to poor quality. Mineral supplements are recommended and can be fed at any time of year.

The majority of pest management activities for beef cattle in Kentucky and Tennessee are devoted to horn fly and face fly control. Lice, the most important pests during winter and early spring, are also common and usually require treatment yearly. Other arthropod pests that are of occasional importance include other biting flies (especially horse flies), ticks, grubs, house fly, stable fly, mites 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.

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 Kentucky and Tennessee pastures include hairy buttercup, musk thistle, plantains, horsenettle, pigweed, cocklebur and brambles. Spiny amaranth, ironweed and Perilla mint are also problems in Tennessee. Broadcast sprays or spot treatments of broad-leaf herbicides (e.g., those containing 2,4-D) are used to manage most pasture weeds.

Worker activities

Pest management activities are usually conducted on an as-needed basis; and most activities pertain to managing horn and face flies and lice. Formulations used for these, and other, pests include slow-release ear tags, back rubbers and dust bags and topical pour-ons and sprays. Some ingredients are added to feeds to inhibit fly larval development in cattle manure; and some are injested in boluses. Injectable products are also used to some extent. Less used are residual premise sprays and knockdown aerosols. Insecticides applied directly to cattle by workers, such as ear tags or pour-ons are usually applied to animals confined in chutes or access-ways. Protective wear, rubber gloves, aprons and eye protection is usually worn when applying a pour-on.

Arthropod Pests of Beef Cattle

The majority of pest management activities for beef cattle in Kentucky and Tennessee are devoted to horn fly and face fly control. Lice, the most important pests during winter and early spring, are also common and usually require treatment yearly. Other arthropod pests that are of occasional importance include other biting flies (especially horse flies), ticks, grubs, house fly, stable fly, mites and maggots (in wounds). Pests relatively new to Tennessee that may affect cattle are imported fire ants. See the appendix for times of pest activity.

At the strategic plan meetings, attendees ranked beef cattle arthropod pests in order of importance. As expected, pest ranking was similar for the two states. For Kentucky, the pest ranking was: 1) Face flies, 2) horn flies, 3) lice, 4) ticks, grubs, 5) other biting flies, 6) stable

flies, 7) mites and scabies, 8) maggots in wounds, house flies, 9) bots. For Tennessee the ranking was: 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.

Horn fly, *Haemotobia irritans*

Description and Importance. Adults are about ½ the size of house flies and are found almost exclusively on hosts from which they may take 20 to 30 blood meals per day. Larvae develop in isolated manure pats, not in accumulated debris. Usually found on the shoulders, back and neck of cattle, the flies interfere with the animal's normal activities and in large numbers can make cattle anemic. The irritation they cause, and resulting reduced grazing, and the loss of blood can substantially reduce weight gain. Heavy infestations of horn flies and face flies may reduce weight gain by 0.5 pound per day. As few as 50 flies per animal may be of economic importance, but thousands may occur, especially on bulls. Normal populations usually average several hundred per animal. In Kentucky and Tennessee, horn flies are active from mid- to late-spring until early fall. Horn flies can transmit the causative agent of anaplasmosis, a rickettsial organism. Anaplasmosis can result in fever, anemia, jaundice, weight loss, reduced performance and possibly death.

Chemical management. Chemical insecticides for horn fly are available in a variety of formulations including pour-ons, ear tags, spray-ons, liquids delivered in back rubbers, dusts, oral larvacides and boluses. Products with a pyrethroid as the active ingredient have been the most numerous and popular, however resistance to this chemical class, caused mainly by overuse of ear tags, has reduced effectiveness. Rotation among classes is highly recommended. See appendix for relative popularity of application methods.

Pour-ons. The endectocides known as avermectins and moxidectin are becoming more popular because they are also used to control internal parasites and other arthropod pests such as lice and scabies mites. (Endectocides are systemic compounds that have activity against endoparasites and ectoparasites.) The pyrethroids permethrin (including formulations containing a synergist, piperonyl butoxide), cyfluthrin and lambda-cyhalothrin are active ingredients in pour-on products. A new product containing spinosad as the active ingredient provides an alternative chemical class for producers to use.

Ear tags. Use of ear tags has declined as resistance to pyrethroids and, more recently, organophosphates has increased; however, they remain popular. More than fifteen ear tag products are available. Pyrethroids, organophosphates or a combination of the two are the active ingredients. Rotation among ear tags with different chemical classes is emphasized by Extension personnel.

Liquids administered in back rubbers. Most products contain organophosphates: coumaphos, phosmet, tetrachlorvinphos and dichlorvos. Several products contain the pyrethroid permethrin as the active ingredient.

Oral larvicides in feed additives. Feed additives have been gaining in popularity. Active ingredients pass through animals to kill fly larvae in dung pats. Products containing the insect growth regulator methoprene are most numerous and popular. Products containing the organophosphate tetrachlorvinphos are also available.

Spray-ons. The vast majority of products applied as sprays contain either organophosphates (coumaphos, dichlorvos, tetrachlorvinphos, phosmet) or the pyrethroid permethrin. A spinosad product is now available as a spray-on.

Dusts. Available dusts, usually applied in dust bags, contain either organophosphates (coumaphos, malathion, tetrachlorvinphos) and pyrethroids (permethrin, zeta-cypermethrin). Dusts have become less popular in recent years.

Bolus. Fly larvicides containing the growth regulators methoprene or diflubenzuron are administered orally as a bolus. The active ingredient passes through the animal to kill immature flies in dung pats.

Non-chemical management. Monitoring cattle to determine fly populations is recommended. Recommended treatment thresholds vary from 50 to 100 flies per animal side. Pastures can be dragged to open and desiccate manure pats, but this must be done on a regular basis. And it affects only local fly populations. Horn fly adults can fly great distances in search of a meal. "Walk-through" fly traps using "inverted cone technology" have been shown to be effective (up to 70% reduction), but they must be properly placed, animals may need to be trained to walk through the traps and they should walk through the traps several times a day. The number of Kentucky and Tennessee beef cattle producers using alternative, non-chemical methods is unknown. None of the producers attending the strategic plan meeting indicated they were using either of these methods.

Face fly, *Musca autumnalis*

Description and Importance. Face flies resemble house flies except they are slightly larger and darker. Female face flies sit on the face and feed on secretions from the eyes, nose, and mouth of cattle. They may carry the causative agent of pinkeye (the bacterium *Moraxella bovis*), although pinkeye, due to other vectors, can occur in the absence of face flies. Therefore, controlling face flies does not guarantee an absence of pinkeye. Because they transmit the bacterium causing pinkeye, face flies may be more important for cow-calf operations than horn flies. Calves with pinkeye will be sold for substantially less ($10-12/cwt in 2002). The pests' persistent feeding is an irritant and annoyance. There are no estimates of how many face flies cause a reduction in the rates of production or growth. These flies are present in spring through autumn months. Larvae develop in isolated manure pats.

Chemical management. Because they do not spend much time on the animal, management of face flies is usually more difficult than for other pests. Many of the products and application methods used for horn flies are recommended for face flies, however, efficacy may not be as good as that for horn flies.

Pour-ons. A few of the products applied as pour-ons for horn flies are recommended for face flies. The pyrethroids permethrin (including formulations containing a synergist, piperonyl butoxide) and cyfluthrin are active ingredients in these products.

Ear tags. Ear tags used for horn flies will provide control of face flies, although 2 tags must be used per animal. Only 70% reduction may be achieved. But this is considered just as good or better than results achieved with other measures.

Liquids administered in back rubbers. Products used in back rubbers for horn fly control will provide suppression of face flies providing the rubber has been modified to deliver product

to the animal's face. Long strips of cloth (ca. 18" in length) should be hung at 4- to 6-inch intervals along the length of the rubber.

Oral larvicides in feed additives. The feed additives used for horn flies also have activity against face flies.

Spray-ons. Many of the products applied as sprays for horn flies are also recommended for face flies. Products contain either organophosphates (dichlorvos, tetrachlorvinphos, phosmet), the pyrethroid permethrin, or pyrethrin (+ a synergist).

Dusts. Dusts used for horn flies (containing coumaphos, permethrin or tetrachlorvinphos) and delivered in dust bags may provide some control of face flies.

Bolus. Fly larvicides containing the growth regulators methoprene or diflubenzuron are administered orally as a bolus. The active ingredient passes through the animal to kill immatures.

Non-chemical management. Dragging pastures to break apart manure pats may aid in the management of face flies.

Lice

Description and Importance. There are four species of lice which can be found on cattle in Kentucky and Tennessee. The longnosed cattle louse (*Lignognathus vituli*), shortnosed cattle louse (*Haematopinus eurysternis*) and little blue cattle louse (*Solenopotes capillatus*) are referred to as "sucking lice" because they feed on blood with their piercing-sucking mouthparts. The cattle biting louse (*Bovicola bovis*) has chewing mouthparts and feeds on the outer layer of skin. All life stages occur on the hosts. Lice become more numerous in cold weather when hair is longer and cattle are in close proximity (because they are spread from one animal to another through contact). Thousands may occur per animal. Sucking lice, in dense clusters, can appear as dark, quarter-sized blotches. Although economic effects have been difficult to assess, a rough estimate of 10 lice per square inch of body surface are required to negatively affect an animal. Heavy infestations can result in anemia, poor weight gain or weight loss, lowered resistance to disease and an unthrifty appearance. Control should be accomplished in early winter before infestations build up.

Chemical management. Lice can be eliminated from a herd if the herd is isolated from other cattle. All animals in the herd must be treated to kill all life stages except the egg. Re-treatment 14 to 21 days later (except with products requiring a longer interval between treatments) kills lice that hatched from eggs since the first treatment.

Pour-ons. Pour-ons containing endectocides (the avermectins ivermectin, eprinomectin and doramectin; and the milbemycin moxidectin) are the most popular formulations for lice control. Other products contain the triazapentadiene amitraz; pyrethroids (permethrin, including formulations containing a synergist; cyfluthrin); organophosphates (fenthion, lambda-cyhalothrin) or spinosad.

Liquids administered in back rubbers. Most products contain organophosphates: coumaphos, phosmet, tetrachlorvinphos, dichlorvos or malathion. Several products contain the pyrethroid permethrin as the active ingredient.

Spray-ons. The vast majority of products applied as sprays contain either organophosphates (coumaphos, dichlorvos, tetrachlorvinphos, phosmet, malathion) or the

pyrethroid permethrin. Other active ingredients include amitraz, pyrethrin (+ a synergist), and spinosad.

Dusts. Available dusts, usually applied in dust bags, contain either organophosphates (coumaphos, malathion, tetrachlorvinphos) and pyrethroids (permethrin, zeta-cypermethrin). Dusts have become less popular in recent years.

Injections. Ivermectin and moxidectin are available as injectable solutions for suppression of lice. *Psoroptes* (scabies) mites, gastrointestinal roundworms and lungworms may also be controlled with these products.

Non-chemical management. None.

Other biting flies

Description and Importance. Several species of horse flies, *Tabanus* spp., occur in Kentucky and Tennessee. These large, robust flies inflict a painful bite when taking a blood meal. They feed only during daylight, and are primarily a nuisance, disrupting grazing, causing cattle to expend energy to avoid the pests, and possibly reducing weight gain. Also, they can transmit the causative agent of anaplasmosis. The feeding wound can serve as a secondary feeding site for other nuisance insects. Because they don't feed regularly on one animal and are strong fliers, control is often difficult. Larvae develop in wet or moist areas, such as wetlands. Smaller than horse flies, deer flies (*Chrysops* spp.) feed upon and affect cattle similarly; and as with horse flies, they are difficult to control. Deer flies may also transmit the causative agent of anaplasmosis. In large numbers, mosquitoes may cause cattle to bunch and reduce grazing, but they are rarely considered a pest. Near suitable larval habitat (flowing water), black flies may also be pests of cattle.

Chemical management. Some of the insecticidal sprays, pour-ons and dusts recommended for horn fly management may provide short-term control of horse, deer and black flies and mosquitoes. But because they do not spend much time on hosts and s, there are no long-term, practical controls for these pests on pastured cattle in Kentucky and Tennessee. Products that may provide control include the synergized pyrethrin spray, dichlorvos (Vapona) spray, and the permethrin EC sprays, dusts, and pour-ons.

Non-chemical management. Source management (alteration or destruction of larval habitat) may reduce pest numbers, but this is usually impractical.

Ticks

Description and Importance. The two ticks most likely to be found on cattle in Kentucky and Tennessee are the Lone Star Tick (*Amblyomma americanum*) and the American Dog Tick (*Dermacentor variablis*). They rarely occur in enough numbers to result in significant blood loss, but they can transmit anaplasmosis. Adult female Lone Star Ticks have a single white spot on their back. Female and male American Dog Ticks are dark brown with wavy lines or reticulations on its back. Larvae (seed ticks) and nymphs of both species are an indistinctive brown. Both pests are "three-host ticks": eggs are laid on the ground; newly-hatched larvae climb vegetation and attach to and feed on small mammals, then drop from the host and molt to

the nymph stage. Nymphs attach to small to mid-sized mammals to feed. They drop off and molt to adults. Adults usually attach to large mammals on which they mate and feed (only adult females feed). Ticks are most likely to be encountered where vegetation is tall and conditions are humid; therefore, cattle are not likely to pick up ticks on closely grazed or mowed pastures.

Chemical management. Many of the products recommended for other pests, especially horn flies and lice, will suppress tick populations. Spray-on formulations are considered most efficacious. Treatments are usually not applied for ticks only because their populations rarely reach levels to justify action.

Pour-ons. Pour-on formulations containing permethrin or permethrin plus a synergist are recommended.

Ear tags. Ear tags used for horn fly control will also provide some measure of control of ticks, though not as good as that achieved with products applied as sprays.

Liquids administered in back rubbers. Products administered through back rubbers for horn fly and lice control aid in the suppression of ticks on cattle.

Spray-ons. Most of the sprays applied for horn flies are recommended for tick control. The product containing amitraz (used for lice control), however, is a better choice for ticks.

Dusts. Dust formulations containing an organophosphate (malathion or phosmet) are recommended.

Non-chemical management. None.

Cattle grubs

Description and Importance. The common cattle grub (*Hypoderma lineatum*) and the northern cattle grub (*Hypoderma bovis*) are the larvae of heel flies. Heel flies lay their eggs on the hairs of the legs, sometimes causing cattle to run in avoidance. Newly-hatched larvae bore into the skin and migrate through connective tissue between muscles. Common cattle grub larvae spend most of their development time in the submucosa of the esophagus; northern cattle grubs spend the fifth through seventh months of development in the tissues around the spinal cord. Both species migrate to the back of the animal to complete larval development just below the skin in which they cut small breathing holes. Mature larvae exit through the breathing hole, dropping to pupate in loose soil or other debris. Cattle grubs were once common, but have become rare with the advent of systemic insecticides.

Chemical management. Care must be taken in timing of treatment for cattle grubs, or other pests if the treatment may also kill grubs. Death of large grubs near the esophagus or spinal cord may cause surrounding tissues to inflame resulting in the esophagus swelling shut, or pressure on the spinal column (which may cause stiffness in the hind quarters, loss of balance, or inability to lift the hind feet). The standard recommendation is to apply control measures before October 31 to kill the pest without harming the animal. All insecticides administered for cattle grubs are systemic. Many are administered for internal parasites, and will also control grubs.

Pour-ons. Most popular pour-ons contain endectocides: the avermectins ivermectin, eprinomectin, and doramectin; and the milbemycin moxidectin. Formulations containing an organophoshate (coumaphos, famphur, fenthion, phosmet and trichlorfon) are also recommended as a pour-on.

Spray-ons. Formulations recommended as sprays contain organophosphates (coumaphos and phosmet) as active ingredients.

Injections. Ivermectin and moxidectin are active ingredients in formulations administered as injections.

Bolus. Ivermectin is also administered in a bolus.

Non-chemical management. None.

Mites

Description and Importance. 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.

Chemical management. Several of the products used for lice control will also control mites, however, products vary in their efficacy among the different mite species, and in general, do not provide the level of control obtained for lice. Sprays containing amitraz and permethrin (as an emulsifiable concentrate); permethrin pour-ons (synergized and 10% active ingredient); and ivermectin pour-on and injectable are for all three mite species. The eprinomectin pour-on is labeled for the chorioptic (*Chorioptes bovis*) and sarcoptic (*Sarcoptes scabei*) mites. Moxidectin pour-on is labeled for psorioptic (*Psoroptes ovi*s) and chorioptic mites. Doramectin pour-on is labeled for chorioptic and sarcoptic mites.

Non-chemical management. None.

Stable fly *Stomoxys calcitrans*

Description and Importance. Because their larvae develop in soggy organic material such as hay, grasses or feed, or manure well-mixed with hay, stable flies are primarily pests of confined livestock operations; therefore they are usually of minor importance in Kentucky and Tennessee where beef cattle are maintained and raised on pasture. However, they may be numerous in pasture situations near holding pens, where grasses are trampled in to muddy foot tracks, in old manure packs where cattle congregate or on spoiled bottoms of round hay bales. Stable fly adults, similar in size to house flies, take blood meals primarily from the feet and legs of cattle. Their bite is painful and can force cattle to stand for hours in ponds and creeks. (They will readily bite humans and other mammals.) Heavy infestations weaken animals from blood loss and irritation, and can reduce weight gain. They can also transmit anaplasmosis.

Chemical management. Ear tags used for horn fly control may reduce stable fly numbers. Permethrin is the active ingredient in recommended pour-ons, liquids for back rubbers, and spray-ons. Dichlorvos is the active ingredient in a spray-on. Malathion dust is also recommended for stable fly control.

Non-chemical management. The best non-chemical management tactic for stable flies is removal of breeding sites. Parasitoids that kill immature stable flies are commercially available. These non-chemical practices are of little relevance, however, to pastured beef cattle.

House fly *Musca domestica*

Description and Importance. Like the stable fly, house flies are usually associated with confined cattle operations. The larvae develop in fresh or aged manure and in the same materials that harbor stable fly larvae. In large numbers, which they rarely attain in pastures, they irritate cattle and are a nuisance to workers. Having sponging mouthparts, they do not bite, but feed by salivating and regurgitating on manure, feed, garbage and other organic material. Through feeding they can spread disease organisms from animal to animal and from manure to feed. But like stable flies, they rarely reach population numbers of economic importance in pastures.

Chemical management. Ear tags, sprays (containing synergized pyrethrin, dichlorvos or permethrin), and permethrin pour-ons aid in reducing house fly numbers.

Non-chemical management. As with stable flies, the best management tactic is sanitation (removal of larval breeding sites). Parasitoids are commercially available for the biological control of house flies, but are not used for beef cattle on pasture.

Maggots in wounds

Description and Importance. The larvae (maggots) of blow flies, belonging to the dipteran (fly) family Calliphoridae, develop in carrion or other decaying organic matter, but may infest the open wounds of cattle. Maggots are white to yellowish and upon completion of development drop to the soil to pupate. Their feeding is usually does not seriously injure cattle and they rarely infest healthy tissue.

Chemical management. Coumpahos, administered in spray-on and dust formulations, is used for controlling fly maggots infesting wounds.

Non-chemical management. None

Imported fire ants

Description and Importance. All three species of imported fire ant (IFA), the black IFA (*Solenopsis richteri*), red IFA (*S. invicta*) and a hybrid of the black and red are found in Tennessee. They occur across the southern one-third of the state (which also contains the major beef cattle producing areas) with the black predominating in the west and the hybrid in the east;

and are slowly spreading northward. The red IFA is rare in Tennessee. Fire ants are highly defensive and their multiple stings may injure, or in rare cases kill, newborn calves. Their dome-shaped mounds can damage mowing and hay-baling equipment.

Chemical management. There are relatively few insecticides available for fire ant control in pastures. Insecticidal baits are broadcast over large areas. Active ingredients include the slow-acting toxin hydramethylnon (a trifluoromethyl aminohydrazone); growth regulators pyriproxyfen or S-methoprene; or spinosad. Individual mound drenches contain the active ingredient carbaryl, a carbamate.

Non-chemical management: A parasitoid (biological control agent) is established throughout almost all of the IFA-infested areas of Tennessee, but its effect on ant populations has not been studied. Mounds can be destroyed by pouring boiling water in their centers or by digging out the ant colony. Neither of these tactics is practical for controlling many mounds over a large area, such as a pasture.

Appendices.

Appendix 1. Seasonal occurrence for beef cattle pests in Kentucky and Tennessee.

Pest	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
Horn fly		-						-
Face fly		--						-
Cattle lice		--					--	-
Hog lice			------	------			------	------
Stable fly		--					--	
House fly		-				------	--	
Horse flies		--			-	-		-
Black flies	-		--					
Cattle grubs (adults)	-	-				-		
Mites	-	------	------	------		-	------	-
Mosquitoes	--	------				-	------	------
Ticks		---				------		

Dashes indicate times of infrequent activity.

Appendix 2. Pesticide application methods and the average percentage of cattle on which the methods were used (based on survey of participants at PMSP meetings).

Application method	Kentucky	Tennessee	Combined
Pour-on	74.2	53.3	63.7
Oiler/scratcher/rubber	54.2	18.3	40
Feed/mineral additives	30.8	12.5	23.4
Ear tags	35.8	30	32.1

Sprays/aerosols	16.7	9.2	13.4
Injection	17.2	6.7	12.9
Oral	10	1.9	6.9
Dusts/dust bags	0	7.8	2.5
Bolus	0	1.8	0.6
Dip	0	0.3	0.1

Appendix 3. Efficacy of insecticides for beef cattle (based on discussion of products at PMSP meetings).

(E = Excellent, G = Good, F = Fair, P = Poor)

Active Ingredient (trade name)	**Product Efficacy Rating by Pest**										
	Horn fly	Face Fly	Lice	Ticks	Stable fly	Grubs	Other biting flies	House fly	Mites & scabies	Maggots in wounds	Flies in live-stock facilities
amitraz (Taktic)			G	G					G		
b-cyfluthrin ear tag (Cylence Ultra)	E	G									
coumaphos (Co-Ral EC spray)	G	G	G	G		G					
coumaphos (Co-Ral WP Fly & Tick spray)	G										
coumaphos (Co-Ral Backrubber Oil)	G	G	G	G							
coumaphos (Co-Ral 4% OS pour on)			G								
coumaphos (Co-Ral Cattle Ear Tag)	G										
coumaphos+diazinon (Co-Ral Plus ear tag)	G	G		G							
cyfluthrin ear tag (Cutter Gold)	G	E									
cyfluthrin (CyLence pour-on)			G						G		
cyfluthrin (Countdown, Tempo SC Ultra)											G
cypermethrin+chlorpyrifos (Max-Con ear tag)	G	G									
diazinon (Optimizer ear tag)	E	G									
diazinon (Patriot, Cutter 1 ear tag)	E	G									
diazinon+chlorpyrifos (Warrior ear tag)	E	G									
diazinon (Dryzon WP)											G
doramectin (Dectomax pour on)	G		G			G			G		

Active Ingredient (trade name)	Product Efficacy Rating by Pest										
	Horn fly	Face Fly	Lice	Ticks	Stable fly	Grubs	Other biting flies	House fly	Mites & scabies	Maggots in wounds	Flies in live-stock facilities
eprinomectin (Eprinex pour-on)	G		G								
ethion (Commando ear tag)	F	F									
famphur (Warbex OS pour on)						G					
ivermectin (Ivomec solution, pour-on)	G		G			G			G		
lambda-cyhalothrin (Saber Extra, Excalibur ear tags)	E	E		E	E			E			
lambda-cyhalothrin+pirim- phos methyl (Double Barrel ear tag)	E	E		E	E			E			
malathion 5% dust	G			G	G						
malathion Backrubber oil	G			G	G						
methomyl (Apache, Gol-den Malrin, Tailspin baits)*											G
Methoprene (Altosid mineral block or mix)	G	G									
Methoprene/s-methoprene (Moormans feed additive, block, premix)	G	G									
moxidectin (Cydectin pour-on)			G			G			G		
permethrin ear tag (Gard Star Plus)	G	F									
permethrin EC spray (Atroban, Ectiban, Permectrin II)	G	G	G	G	G		G	G	G		
permethrin Rubbing Mixture	G		G	G	G						
permethrin (Back Side, Ectiban, Permectrin II for rubbers)	G		G	G	G						
permethrin (Atroban, Back Side Plus, Boss, Brute, DeLice, Durasect, Permec- trin CD, Permectrin CDS, Ultra Boss pour-ons)	G	G	G	G		G	G	G			
phosmet (Del-Phos, Prolate/Lintox sprays)	G	G	G	G		G					
phosmet (GX-118 EC pour on),						G					

Active Ingredient (trade name)	Product Efficacy Rating by Pest										
	Horn fly	Face Fly	Lice	Ticks	Stable fly	Grubs	Other biting flies	House fly	Mites & scabies	Maggots in wounds	Flies in live-stock facilities
phosmet (Lintox-HD for rubbers)	G	G									
pirimphos-methyl (Dominator ear tags)	F	G									
stirofos/tetrachlorvinphos (Rabon dust)	G		G								
stirofos/tetrachlorvinphos (Rabon oral larvicide)	E										
stirofos/tetrachlorvinphos (Rabon premix larvicide, mineral block)	G	G	G					G			
stirofos+dichlorvos (Ravap EC rubbing oil)	G		G	G							
stirofos+dichlorvos (Ravap 28.7% EC spray)	G		G	G							
trichlorphon (Dipterex bait)											G
Zeta-cypermethrin (Py-thon, Zetaguard ear tags)	E	E									
zetacypermethrin (Python dust)	E		E								

(E = Excellent, G = Good, F = Fair, P = Poor)