Crop Profile for Sheep in Virginia

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Image Credit: Michael Thompson, USDA Online Photography Center

General Production Information 1, 2, 3a, 3b, 4

- Virginia is ranked 26th in the United States in sheep and lamb production.
- In 2002, 1,697 farms produced an estimated 71,819 sheep and lambs.
- Sheep and lamb production was valued at $2,933,000 in 2004.
- Sheep are raised mostly in northern and southwestern counties. In 2004, the top five sheep and lamb production counties in Virginia were Augusta (6,800 head), Rockingham (5,700 head), Highland (5,300 head), Shenandoah (3,000 head) and Montgomery (2,600 head).
- The state total for Virginia in January 2005 was 61,000 head.

Cultural Practices 5, 6

Sheep have the ability to convert forage and crop residues into high-quality meat and fiber. Ewes produce more than 100% of their live weight in offspring each year. Sheep are resourceful and feed on plants that are less palatable to other species. They also can graze hills and steep slopes, which not all livestock can manage. Additionally, sheep improve the quality of their pastures by consuming weeds that would otherwise have to be removed mechanically or chemically. Virginia is one of the best states in the eastern United States for sheep production because of its unique climatic characteristics. Relative
to other livestock enterprises, it costs very little to invest in sheep production, and it has been consistently profitable in recent years. In Virginia, lamb sales are 90% of a producer's income from sheep production.

Sheep production systems may be generally characterized by the season in which the lamb crop is born. *Winter lambing* occurs from November to February in covered facilities. Lambs are managed for rapid weight gain with primarily grain and harvested forage until they reach market weight. They are sold in the spring and the early summer. *Spring lambing* occurs from March to May in either the barn or the pasture. Abundant forages are available for the lactating ewe and growing lamb. Lambs are typically marketed through the fall and winter. Litter sizes are largest in the spring. High reproductive rates and heavy lamb market weights contribute to the high net returns, which characterize the spring lambing system. *Fall lambing* occurs from September to November, but it is challenged by breeding seasonality of the ewe, which generally limits reproductive rate and litter size. Increased usage of fall forage resources and mild climatic conditions favor the fall system. Fall-born lambs feed in fall and winter and are marketed through the winter and spring. Fall and winter lambing are best for farms with a sufficient winter supply of feed, appropriate facilities, and high summer temperatures. Spring lambing is preferred in the mountainous parts of Virginia with abundant forage resources.

Crossbred ewes have higher lambing percentages, better lamb survival, and wean more pounds of lamb. Because the emphasis in Virginia is on lamb production, the most popular breeds are Suffolk, Hampshire, Dorset, Rambouillet, and Finnsheep. Rams are typically Suffolk, Hampshire, or Dorset. The popularity and utilization of hair sheep breeds has increased in recent years. These breeds do not require shearing because they produce no wool. Hair sheep also exhibit enhanced tolerance to internal parasites and are well suited for low-input, extensive management systems.

Virginia's nearness to large metropolitan areas on the East Coast results in strong demand for lambs at various market weights. The ethnic lamb market (lambs processed to meet demands for consumption associated with religious/cultural practices) generally desires lambs with live weights ranging from 50 to 125 lbs. This provides a market for lambs raised under a variety of production and management systems. Lambs must be marketed before they reach one year of age or they will be labeled as yearling mutton and receive a price discount.

Over 90% of the wool in Virginia is gathered in June and July and sold cooperatively through the Virginia Wool Pool Program. However, producing sheep for their meat is much more profitable than selling their wool.

**Special Use Labels**

Section 18 Emergency Use Exemption and Special Local Need 24 (C) labels are used to supplement the chemical tools available to producers for pest control. Once the problem or gap in pest control has been
identified, specialists submit the proper documentation for the Emergency Use/Special Local Need label. Thus far, Extension specialists have been successful in obtaining these labels. Special Local Need (SLN) labels in Virginia are granted by the Virginia Department of Agriculture and Consumer Services (VDACS) and are usually only valid for limited time intervals. However, a fee must be paid annually by the registrant to keep the product registered for use in Virginia. Section 18 Emergency Use labels are evaluated and granted by the Environmental Protection Agency (EPA) and can be renewed annually.

**Worker Activities**

Spring and fall are the main times of year to treat livestock for parasites. Potential hazards include exposure to pesticides and injury resulting from animal handling. Sheep are not as likely as larger animals to injure workers, but they still may cause injury if they are not handled properly while pesticides are applied. Risks of exposure to pesticides are greatly reduced by following the recommendations on the product label and wearing personal protective equipment such as protective eyewear, face shields, boots, coveralls, gloves, masks, and hats. Workers are most likely to be exposed to pesticides while handling or mixing products before they are applied. Exposure via the skin, mouth, or nose is possible if pesticides are spilled, splashed, or become airborne during preparation. Dermal, oral, and inhalation exposure are also possible during the treatment itself. Workers may be exposed to pesticides when using high-pressure sprayers (75-100 psi) or power dusters to control pests. In addition to being sprayed, sheep may be dipped to treat for ectoparasites. Dipping increases the risk of exposure because splashing is very likely to occur as the sheep move through the vat. Pour-on treatments can end up on farm workers’ skin or clothes if an animal moves unexpectedly during the application process. Injectable products also present a risk of injury, particularly if animals are not properly restrained. Additionally, pesticide-impregnated plastic strips hung in livestock houses pose a risk of dermal or oral exposure to those who hang them.

**Insect Pests**

**ARTHROPOD PESTS 7, 8, 9, 10**

Control recommendations found below were modified from information presented in the 2005 Virginia Pest Management Guide, the Virginia Pesticide Information Retrieval System, and the Virginia Pesticide Database Search unless otherwise noted.

The most common and important external pests of sheep are keds, lice, and several fly species. Other pests include mites, fleas, and ticks. The key to effective fly control is to prevent them from becoming a problem in the first place. Good sanitation is crucial-livestock pens should be cleaned once or twice each
week to interrupt the life cycles of flies that breed in manure and other decaying organic matter. Once manure is gathered, it can be spread thinly to dry or else stacked and covered COMPLETELY with black plastic. Both of these methods kill fly larvae (maggots). Wet feed, straw, and hay should also be gathered to remove potential fly-breeding areas. Proper drainage is important-gravel should be used to fill in low-lying pits that can become muddy and attractive to flies. These general cultural control methods should be implemented together with baits, residual sprays, space sprays, larvicides, and biological control methods, if possible.

**Semi-Aquatic Biting Flies**

*Mosquitoes, Aedes, Culex, and Ochlerotatus* spp.

*Deer and Horse Flies, Chrysops and Tabanus* spp.

*Biting Midges (Gnats), Culicoides* spp.

Mosquitoes are small flies that breed in stagnant water. Female mosquitoes are blood feeders while the males feed on nectar. Mosquitoes are more active at dusk and at night. Deer and horse flies are medium to large blood-feeding flies that lay eggs on aquatic plants. Adult deer and horse flies are most active on warm, sunny days. The biting midge, *Culicoides sonorensis*, is very small, active at night, and spreads bluetongue virus in sheep and cattle.

**Monitoring:** Watch for insect activity around animals that causes annoyance and interrupts grazing, leading to reduced weight gain. Animals will seek shelter from attack in dark, secluded locations.

**Chemical Control:** Repellent sprays may provide temporary relief from deer and horse flies. Insecticides can be used on walls. See the *Chemical Arthropod Control* section for more information.

**Biological Control:** No commercially effective controls are available.

**Cultural/Mechanical Control:** Improve sanitation, provide darkened shelters/shady areas for escape from deer and horse flies, keep animals away from wooded areas, drain wet areas, and empty containers that collect water.

**Face Fly, Musca autumnalis**

Face flies resemble the house fly. They are distributed throughout the United States but are more common in the northern states. Face flies do not bite but feed on animal secretions (tears, saliva, mucous, blood, and excrement). They are disease vectors in cattle. These flies overwinter in buildings and become active in early spring. Females avoid shade and do not enter shelters. Face flies breed in manure piles, and a new generation occurs approximately every two weeks until autumn. Populations tend to increase greatly during warm, wet weather.

**Monitoring:** Check sheep for flies around the head. Animals may be found hiding in shady refuges, which can result in less grazing and weight loss.
**Chemical Control:** Insecticides with quick knockdown action are good. Whole-body sprays offer only short-term relief. See the *Chemical Arthropod Control* section for more information.

**Biological Control:** No commercially effective controls are available.

**Cultural/Mechanical Control:** Fly masks may be used if they fit properly and are checked regularly. Maintain good sanitation practices.

**Horn Fly, Haematobia irritans**

Horn flies are half the size of house flies and are brownish gray to black with a yellow cast. They are distributed throughout the United States. The blood-feeding adult flies mainly bother cattle but will also annoy sheep. Horn flies prefer warm, moist weather and emerge in the spring. Larvae feed on and develop in manure, producing a new generation every one to two weeks until autumn.

**Monitoring:** Look for flies gathered at the base of horns, neck, throat, belly, back, and thighs (where they will not be disturbed.) Blood feeding causes weight loss, reduced vitality, and animals may injure themselves attempting to escape attack. Begin treatment when there are more than 100 flies/head.

**Chemical Control:** See the *Chemical Arthropod Control* section for more information.

**Biological Control:** Parasitic wasps, ants, birds, and mice are natural control agents; however, they are ineffective.

**Cultural/Mechanical Control:** Clean up manure-pile breeding grounds.

**House Fly, Musca domestica**

House flies are nonbiting pests, but they annoy livestock and people. They can also carry diseases and are a threat to public health. Eggs are laid in straw, spoiled grain, or other rotting organic matter. Several overlapping generations are produced each year. Flies are most prevalent in August and September; some overwinter in buildings as larvae or pupae.

**Monitoring:** House flies gather inside and on buildings and leave "fly specks" on walls.

**Chemical Control:** Residual wall sprays should be used sparingly because flies are becoming resistant. Alternate insecticides to limit resistance. Space sprays, mist foggers, and baits work well with biological control methods. See the *Chemical Arthropod Control* section for more information.

**Biological Control:** Beneficial wasps that attack pupae are available for purchase and release.
Cultural/Mechanical Control: Get rid of breeding sites such as feed bunk areas, spilled/wet feed in troughs, and manure-covered hay in damp, low-lying areas. Use flypaper (change often), electrocuting traps, bait traps, and automatic misters.

**Sheep Ked (a.k.a. Louse Fly), Melophagus ovinus**

The sheep ked is a wingless, parasitic fly with a flattened, leathery abdomen. Sheep keds are distributed throughout the continental United States. They spend their entire life cycle on their host and occur mostly on sheep, but occasionally on goats. Reproduction occurs throughout the year, slows in winter, and yields several generations annually. Females lay live maggots on the wool. Keds have sharp mouthparts and feed on the blood of their hosts. Lambs are damaged primarily; high populations of keds cause unthriftiness and emaciation. Also, feeding sites become irritated and produce "cockles," which reduce the price of tanned skins. Large populations of keds may limit weight gain, cause anemia, or make sheep vulnerable to other infections.

**Monitoring:** Ked numbers increase greatly in winter when sheep are close together. Part the wool to detect the presence of sheep keds. Symptoms include irritation, scratching, biting, and rolling on the ground. Fleece quality is reduced and is known as "dirty wool."

**Chemical Control:** Treat all individuals with insecticides after shearing. See the Chemical Arthropod Control section for more information.

**Biological Control:** No commercially effective controls are available.

**Cultural/Mechanical Control:** Animals fed a highly nutritious diet are not as affected. Shearing removes at least half of the adult keds and most of the pupae. Shear ewes before lambing so keds are not transferred to their offspring.

**Sheep Nose Bot Fly, Oestrus ovis**

Adult sheep bot flies are hairy, grayish yellow, and about the size of a horse fly. They are distributed throughout the United States. Females deposit larvae in sheep nostrils on calm, warm days between late spring and autumn. Sheep will run, shake their heads, stamp their feet, and push their noses in the dirt to avoid being parasitized. This pursuit can cause animals to become stressed, which hampers production. Bot larvae tunnel through the nasal passages and feed on mucosal secretions, thus making animals vulnerable to bacterial infections. Mature larvae crawl or are sneezed out of the nasal cavities in the following spring and pupate in the soil. Bot fly infestations may kill older sheep.

**Monitoring:** Look for fly activity around the face and avoidance behavior in sheep during the summer. The highest bot infestation levels occur in November and December. Bot fly larvae cause excess, sometimes bloody, nasal discharge; sneezing; inflammation; grating of the teeth; and labored breathing. Loss of appetite may cause weight loss or reduced weight gain.
Chemical Control: See the *Chemical Arthropod Control* section for more information.

Biological Control: No commercially effective controls are available.

Cultural/Mechanical Control: Sheep nose bot flies cannot travel far, so change pastures frequently.

**Stable Fly, *Stomoxys calcitrans***

Stable flies resemble house flies. However, they are dark gray, and both males and females take blood meals. They annoy animals with their painful bites, causing reduced grazing and weight loss. Several generations arise each year from eggs laid in manure or rotting straw. Adult flies will enter buildings in bad weather, but they prefer to rest outside in sunlight.

**Monitoring:** Stable flies are most prevalent and annoying in the summer. Sheep will stomp their feet when their legs and bellies are being attacked.

**Chemical Control:** Pyrethrin sprays offer temporary relief to sheep. Use residual wall sprays sparingly because flies are developing resistance. Space sprays, mist foggers, and baits can work in harmony with biological control methods. Avoid treating manure and bedding because it harms beneficial insects. See the *Chemical Arthropod Control* section for more information.

**Biological Control:** Beneficial wasps that attack pupae are available for purchase and release.

**Cultural/Mechanical Control:** Prevention is the best cure, so make efforts to improve sanitation. Get rid of or spread manure and wet straw weekly to destroy breeding sites. Use flypaper in areas where the pests travel.

**Wool Maggots (Fleeceworms)**

*Phormia regina*
*Phormis cuprina*
*Cochliomyia macellaria*

Several species of blow flies will lay their eggs in wet, matted wool soiled with urine, feces, or blood and in open wounds during the spring and summer. Wool maggots hatch and feed on dead tissue. Sometimes living skin or muscle tissue is consumed as well. Larval feeding causes large amounts of wool and flesh to be lost if infestations are left untreated. Wool maggot infestation may cause secondary infection and even death.

**Monitoring:** Sheep may become restless, stamp their feet, bite at irritated areas, or leave the flock and hide. Check sheep periodically during warm, wet weather for infestations, especially the manure-
covered areas around the tail and on the hind legs.

**Chemical Control:** If sheep become infested, use insecticide sprays, foams, or dusts. See the *Chemical Arthropod Control* section for more info.

**Biological Control:** No commercially effective controls are available.

**Cultural/Mechanical Control:** Limit exposure to hazards that may injure animals and cause wounds that would attract flies. If animals are hurt, dress and medicate wounds to prevent infestation. Shear wool or clean dirty areas before blow fly season in spring. Shearing with early season lambing helps to remove breech contaminated with birthing material that is attractive to flies.

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**Lice**

- **Sheep-Biting Louse, Bovicola equi**
- **Sheep Foot Louse, Linognathus pedalis**
- **Goat-Sucking Louse, Linognathus stenopsis**
- **Sheep Face and Body Louse, Linognathus ovillus**
- **Long-Nosed Cattle Louse, Linognathus vituli**

Sucking lice feed on blood while chewing lice feed on hair and skin secretions. Lice are mainly transmitted by animal-to-animal contact, but they can also travel on flies. Sheep are more often afflicted by lice than are goats. The most common louse found on sheep is the sheep-biting louse. It consumes skin scales and causes great irritation. Sheep foot louse is more often found on rams than on ewes. Heavy infestations can result in reduced milk production, weight loss, listlessness, and anemia.

**Monitoring:** Examine sheep directly to detect lice infestations. Do spot checks on different parts of the animal. The sheep-biting louse occurs all over the body, the face and body louse occurs everywhere except the legs, and the foot louse is found on the legs. Lice populations increase in the fall and reach their peak in winter or early spring. Symptoms of infestation include excessive scratching; dull and/or matted coat; raw, irritated areas; and hair loss. Treatment is necessary if the animal is infested to the point that it scratches excessively. Some say the treatment threshold is 3 lice / inch². More than 10 lice / inch² is considered a severe infestation.

**Chemical Control:** Treat sheep on a warm, sunny day in spring after shearing, or in winter if the infestation levels are very high, to avoid losses. Pesticides do not kill louse eggs, so they must be reapplied two weeks after initial application to give the eggs time to hatch. **ALL** sheep should be treated to avoid re-infestation. See the *Chemical Arthropod Control* section for more details.

**Biological Control:** No commercially effective controls are available.

**Cultural/Mechanical Control:** Check new individuals for lice before introducing them to the flock. Keep animals healthy, remove lice "carriers" from the flock, shear wool to remove lice, and clean
grooming equipment between animals to avoid re-infestation.

ARACHNIDS

Mites

Mange Mites (Sheep Scab), Psoroptes ovis
Psoroptic Ear Mite, Psoroptes cuniculi
Chorioptic Mite, Chorioptes spp.
Sarcoptic Mite, Sarcoptes spp.

Mange mites infest the skin throughout the year. They are highly contagious, and serious infestations can be fatal. Virginia has been declared free of the disease for the past several years. If you suspect mange mites, notify your county Extension office or State Veterinarian's office of the Virginia Department of Agriculture and Consumer Services (VDACS) in Richmond.

Monitoring: Signs of sheep scab include: shabby fleece, excessive scratching and rubbing, loss of wool, and rough, scabby skin. Mange mites predominately affect the withers, back, sides, and rump. Skin scrapings are necessary to positively identify mites.

Chemical Control: See the Chemical Arthropod Control section for more information.

Biological Control: No commercially effective controls are available.

Cultural/Mechanical Control: Remove infested individuals from the flock.

Ticks

Ticks are blood feeders that are more closely related to spiders and mites than to insects. There are two types: soft (Argasidae) and hard (Ixodidae). Ticks can serve as disease vectors in livestock and humans. Rarely, ticks can be lethal if they occur in high numbers.

Monitoring: Use a flannel drag to identify tick-infested areas. Signs of infestation include itching and swelling, bite wounds, and anemia.

Chemical Control: See the Chemical Arthropod Control section for more information.

Biological Control: No commercially effective controls are available.

Cultural/Mechanical Control: To prevent ticks, cut or burn brush, keep grass short, cultivate tillable land, and isolate new animals. Remove ticks that are feeding with blunt forceps and clean the bite area with antiseptic.
Chemical Arthropod Control

Residual sprays are applied to walls, ceilings, partitions, stanchions, posts, and other places flies rest or congregate. They are more effective in stanchions than in open barns. Smooth surfaces require less spray than rough surfaces. Use spray pressures of 80-100 psi.

Bait treatments should be applied after floor litter and manure have been removed. Use baits liberally for best results. More bait may be needed when fly breeding is heavy. Use baits with other control methods to be most effective. Do NOT use baits in areas where animals can slip on them and fall or where children could access them.

Space treatments use pesticides known for their rapid knockdown of adult flies. Air movement should be restricted as much as possible for this application method to be most effective.

For larvicultural treatments to work, all manure must be treated within a rather large area. Because they do not kill adult flies, use them with other treatment methods.

- **Calcium Polysulfide (Lime-Sulfur Solution 29SC)** - Inorganic
  - For control of chorioptic scab mites, mange mites, psoroptic scab mite, sarcoptic mange, and scab mite on sheep, use as directed.
- **Chlorpyrifos (Duratrol Darkling Beetle Spray 20%)** - Organophosphate
  - For control of ticks and flies in livestock facilities, use as directed.
- **Citric Acid + Propanetricarboxylic Acid (FlyCracker 100%)** - Organic Acid
  - For larvicultural control of fly maggots around the perimeter of livestock areas, apply 1/8 cup per sq. ft. of treatment area. The area should have a salted appearance after application. Apply every 7 days during fly season.
- **Coumaphos (Co-ral 25WP)** - Organophosphate
  - For spray or dip control of lice, sheep keds, ticks, and fleeceworms, follow label directions. Repeat as necessary. Do NOT use within 15 days of slaughter. Do NOT use on sick, stressed, or overheated livestock. Do NOT use on animals less than 3 months old. Do NOT treat animals within 10 days of shipping, weaning, or vaccination. Do NOT apply in conjunction with oral drenches or other internal medication. Do NOT use on animals treated with natural or synthetic pyrethrins or their synergists. Toxic to birds and fish.
- **Deltamethrin (Annihilator Premise Spray 0.02%)** - Pyrethroid
  - For medium-term residual spray control of stable flies; horn, face, and house flies; deer flies; mosquitoes; and gnats in livestock facilities, apply until surfaces are wet. Do NOT apply more than once per week. Do NOT spray animals or humans. Do NOT contaminate feed or drinking water. Do NOT use in milk rooms or milking parlor. Toxic to bees, fish, and other aquatic organisms.
- **Diazinon (Dryzon 50WP)** - Organophosphate
  - For long-term residual spray control of flies, mix 2 lbs. of product in 25 gal. of water and...
apply at a rate of 1 gal. per 350-750 sq. ft. of area. Spray to the point of runoff and repeat, if necessary. Do **NOT** use in dairy barns, milk rooms, or poultry houses. REI for animals - 4 hours.

- **For bait treatment control of flies**, mix 0.5 lb. of product with 1 lb. of sugar in 2.5 gal. of water in a knapsack sprayer, and spot treat cracks, crevices, doorways, windowsills, and other areas where flies congregate. **For sprinkling can application**, mix 2 oz. of product with 1 lb. of sugar in 5 gal. of water, and sprinkle over areas of the floor that flies contact. Do **NOT** contaminate feed or drinking water. Do **NOT** apply to animals. Toxic to ducks, geese, and bees. Do **NOT** mix with copper compounds.

  - **Dichlorvos (Vapona Concentrate 43.2%)** - Organophosphate
    - **For short-term residual spray control of flies** in feedlots, stockyards, holding pens, and corrals, create a 0.5% solution by mixing 1 gal. of product in 100 gal. of water, and apply the diluted spray to the premises, particularly areas where flies congregate. Animals **CAN** be present during treatment. Do **NOT** contaminate feed, water, milk, or milking instruments. Toxic to bees and fish. Do **NOT** combine with alkaline compounds.

  - **(Vapona 23.4EC)** - For **space treatment of flies**, apply fog or mist at a rate of 1 qt. of 0.5% solution per 8,000 cubic feet. Reduce airflow before applying. Do **NOT** use around animals that have received a direct application within 8 hours. Do **NOT** allow feed, water, milk, or milking instruments to become contaminated.

  - **(Vapona Resin Strips)** - For **space treatment of flies**, suspend from the ceiling according to label directions. Do **NOT** place over water or feed. Keep strips away from animals and children.

  - **Fenvalerate (Ectrin 10WDL)** - Pyrethroid
    - **For spray or dip control of lice and sheep keds**, mix 1 qt. of product with 100 gal. of water. Wet animal thoroughly with up to 1 qt. of solution. Repeat application in 30 days if needed. Do **NOT** use more than twice in the spring and twice in the fall.

    - **For pour-on control of lice and sheep keds**, mix 4 oz. of product in 1.5 gal. of water. Apply up to 4.0 oz. of solution down the midline of the back 1-2 times in the spring. Repeat the application in 30 days, if necessary. One application after shearing is usually adequate for sheep ked control. Do **NOT** apply more than twice in the fall pest season.

    - General Precautions: Do **NOT** use on lactating sheep or goats. Do **NOT** use on sick or stressed livestock. Do **NOT** use on animals less than 3 months old. Do **NOT** treat animals within 10 days of shipping, weaning, or vaccination. Do **NOT** apply within 2 days of slaughter. Do **NOT** apply in conjunction with oral drenches or other internal medication. Toxic to fish and bees. Do **NOT** mix with alkaline materials.

  - **Ivermectin (Ivomec 0.08%)** - Macrocyclic Lactone
    - For control of **sheep nose bot flies**, a systemic oral drench administered at 3.0 mL/26 lb. body weight is recommended in the 2004 Code of Federal Regulations. Do **NOT** apply within 11 days of slaughter.

  - **Malathion (57EC)** - Organophosphate
    - **For control of sheep keds, lice, and ticks** on sheep, use as directed.

  - **Methomyl (Improved Golden Malrin Fly Bait w/ Muscamone 1%)** - Carbamate
    - **For bait treatment control of flies**, scatter bait around the outside of feed lots and livestock
barns at a rate of 0.25 lb. per 500 sq. ft. of fly-feeding area with 1- to 2-inch gaps between particles. Do NOT allow food-producing animals to access treated areas. Do NOT contaminate feed or water with product. Toxic to fish, bees, and birds. Do NOT mix with alkaline materials.

- **Methomyl (1%) + (Z)-9-Tricosene (0.025%)** (Farnum Bluestreak Fly Bait) - For *bait treatment* control of flies, follow label directions.

- **Naled (Dibrom 8E 58%)** - Organophosphate
  - For *short-term residual spray* control of flies, follow label directions. Avoid applications when bees are highly active. Do NOT apply when the temperature is above 90°F.

- **Permethrin (Atroban 11EC)** - Pyrethroid
  - For *spray or dip* control of lice, mites, sheep keds, and ticks, mix 1 qt. of product in 25 gal. of water. Apply 1-2 qt. of coarse spray per animal over the entire body surface. Do NOT contaminate feed or drinking water. Do NOT use on sick or stressed livestock. Do NOT use on animals less than 3 months old. Do NOT treat animals within 10 days of shipping, weaning, or vaccination. Do NOT apply in conjunction with oral drenches or other internal medication. Toxic to fish and bees.

  - *(Atroban 25WP)* - For *long-term residual spray* control of flies, mix 6.67 oz. of product in 10 gal. of water, and apply at a rate of 1 gal. of spray per 1,000 sq. ft. Do NOT apply directly to animals, feed, or drinking water.

  - *(Boss Pour-On 5%)* - For *pour-on* control of lice, and sheep keds, apply 0.05 oz./50 lbs. body weight, up to 0.61 mL/animal. Repeat application as necessary, but NOT more than once every two weeks.

  - *(Durasect 1%)* - For *pour-on* control of lice and sheep keds, apply 0.25 oz./50 lbs. of body weight (up to 3 oz./animal) along the back. Do NOT use on lactating sheep or goats. Do NOT use on sick or stressed livestock. Do NOT use on animals less than 3 months old. Do NOT treat animals within 10 days of shipping, weaning, or vaccination. Do NOT apply more than twice in the fall pest season. Do NOT apply within 2 days of slaughter. Do NOT apply in conjunction with oral drenches or other internal medication. Repeat application as necessary, but NOT more than once every two weeks. One application after shearing is usually adequate for sheep ked control.

  - *(Permethrin II 10EC)* - For *long-term residual spray* control of flies, mix 1 qt. of product in 25 gal. of water, and apply at a rate of 1 gal. of spray per 750 sq. ft. Can be used in barns, dairies, feedlots, stables, and poultry houses.

  - *(Catron IV 0.5%)* - For control of bloodsucking lice, gnats, mosquitoes, blow flies, and wool maggots, use as directed.

- **Permethrin + Piperonyl Butoxide (Backside Plus 1%)** - Pyrethroid + Synergist
  - For *pour-on* control of lice and sheep keds, apply 0.25 oz./50 lbs. of body weight (up to 3 oz./animal). Do NOT use on lactating sheep or goats. Do NOT use on sick or stressed livestock. Do NOT use on animals less than 3 months old. Do NOT treat animals within 10 days of shipping, weaning, or vaccination. Do NOT apply more than twice in the fall pest season. Do NOT apply within 2 days of slaughter. Do NOT apply in conjunction with oral drenches or other internal medication. Repeat application as necessary, but NOT more than once every two weeks. One application after shearing is usually adequate for
sheep ked control.
  - (Livestock and Barn Fogging Spray 7.4%) - For spray or dip control of lice and sheep keds. Check label for instructions. Can be applied to sheep and their premises.
  - (Delice-S and Synergized Delice Pour-On 1%) - For pour-on control of lice and sheep keds, apply 0.25 oz./50 lbs. body weight, up to 3 oz./animal. Repeat if necessary, but NOT more than once every two weeks.

- Pyrethrins + Synergists (Purina Insecticide Mist 0.1%) - Botanical
  - For space treatment of flies, close doors and windows and apply as a fog or fine mist, directing spray to ceiling and upper corners of the room until the area is filled with mist. Wear a mask or respirator to avoid breathing fumes. Use about 0.5 oz. of solution per 1,000 cubic feet. Allow the mist to settle on the animals. Leave the room closed for 5 minutes after treatment, but ventilate area before re-entering. Repeat if necessary. Wash teats of dairy animals before milking.
  - (PY-80 0.5%) - For short-term residual spray control of flies, mosquitoes, fleas, and wasps in livestock facilities, close windows and doors and apply at a rate of 2-3 seconds/1,000 cubic feet of area. Do NOT remain in treated area. Vent area after 15 minutes.
  - (Multi-Purpose Pyrenone 0.1%) - For short-term residual spray control of stable flies, house flies, and horn flies in barns, milk rooms, and dairies, follow label directions.
  - (Pyganic Crop Protection II 1.4EC) - For control of flies on sheep, mix 5-14 oz. per gal. of water and apply to thoroughly wet the animal. Repeat every 5-12 days as necessary. For control of lice, mix 1 qt. per 16 gal. of water and thoroughly wet the entire animal, including the tail and head. Repeat 10 treatment 10 days later to kill newly hatched lice. For control of face flies, mix 9 oz. per gal. of water and apply at a rate of no more than 1.5 oz. per animal.

- Spinosad (Elector 2.46F) - Spinosyn
  - For space treatment of stable and horse flies on livestock premises, mix 20 oz. of product per 5 gal. of water, and apply at a rate of 1 gal. of solution per 500-1,000 sq. ft. Do NOT use in overhead sprinkler system. Safe for use with beneficial insects.
  - (Extinosad PSP 44.2EC) - For control of darkling beetles, hide beetles, horse flies, and stable flies in animal buildings, mix 2 oz. of product per 10 gal. of water, and apply to surfaces at a rate of 1 gal. of solution per 500-1,000 sq. ft. Remove animals before applying and let surfaces dry before allowing their reentry.

- Sulfur (Clean Crop Microfine Sulfur 90WP) - Inorganic
  - For treatment of ticks on sheep, dust liberally and rub into the wool.

- Tetrachlorvinphos (Rabon 50WP) - Organophosphate
  - For long-term residual spray control of flies in animal buildings, follow label directions. Remove calves and lactating animals before spraying. REI for animals - 4 hours. Do NOT contaminate feed and drinking water. For larvicidal treatment of fly maggots in manure in livestock facilities, apply 1 gal. of 1% solution per 100 sq. ft. of manure piles. Repeat every 7-10 days until control is achieved. Do NOT spray animals directly. Toxic to bees and fish. Do NOT mix with dodine or alkaline compounds.

- Tetrachlorvinphos (23%) + Dichlorvos (5.3%) - Organophosphate
- (Ravap EC) - For long-term residual spray control of flies in animal buildings, mix 1 gal. of product in 25 gal. of water (or 1 gal. of product in 12.5 gal. of water for heavy infestations), and apply at a rate of 1 gal. of spray per 500-1,000 sq. ft. of walls, ceilings, or other areas where flies congregate. Remove animals before spraying. REI for animals - 4 hours. Do NOT contaminate feed or drinking water. For larvicidal treatment of fly maggots in manure in livestock facilities, apply mix described above at a rate of 1 gal. of spray per 100 sq. ft. of manure. Repeat at 7-10 day interval until dropping cone up; thereafter, treat only hot spots with large numbers of maggots. Do NOT spray animals directly.

- Zeta-Cypermethrin + Piperonyl Butoxide (Python 0.075D) - Pyrethroid + Synergist
  - For dust control of lice, sheep keds, flies, and ticks on non-lactating sheep, check label for specific instructions. Moderately combustible. Toxic to fish and bees.

Weeds 17, 18, 19

Virginia has 1.5 million acres of steep pastures that must be properly managed to ensure their continued use as forage sites for livestock. Weeds are not as palatable as other forage, they make pastures less attractive and nutritious, and they reduce yield. Undesirable plants can have three kinds of effects on livestock: 1) they can be toxic or cause photosensitization, 2) they can lead to reduced foraging and production, or 3) they can cause meat and dairy products to be off-flavored. Toxic and/or photosensitizing plants include black locust (Robinia pseudoacacia), cherry (Prunus spp.), bouncing bet (Saponaria officinalis), sorghum or Johnson grass (Sorghum spp.), yew (Taxus spp.), Jimson weed (Datura spp.), nightshade (Solanum spp.), oak (Quercus spp.), perilla or purple mint (Perilla frutescens), poison hemlock (Conium maculatum), rhododendron (Rhododendron or Kalmia spp.), water hemlock (Cicuta spp.), white snakeroot (Eupatorium spp.), milkweeds (Asclepias spp.), and some clover (Trifolium spp.), among others. Plants that interfere with foraging behavior and production efficiency typically have spines or are difficult to digest, such as spiny pigweed (Amaranthus spp.), thistles (Cirsium spp.), and dandelions (Taraxacum spp.). Plants that give meat and dairy products a bad flavor include wild garlic (Allium vineale), yarrow (Achillea millefolium), and wormwood (Artemisia spp.).

Monitoring: Observe sheep for abnormal symptoms including diarrhea, vomiting, tremors, convulsions, staggering, anemia, excess salivation or "foam" around the mouth, paralysis, thirst, loss of appetite, weakness, bloat, difficulty breathing, rapid breathing, or photosensitivity. If an animal dies suddenly, have its stomach contents checked. If a poisonous plant is identified, remove other livestock until all plants are destroyed.

Chemical Control: Consult an Extension agent, identify the weed, and treat it with an appropriate herbicide.

Biological Control: Biological control agents are available to control some troublesome pasture weeds.
Consult an Extension agent for more information.

Cultural/Mechanical Control: Well-managed pastures are not as hospitable to the growth of weeds. Keep weeds mowed down or pull them from the ground. Keep supplemental feed on hand so that animals do not grow hungry enough to eat poisonous plants. Control weeds by fertilizing and managing desired plants into a thick, healthy stand. Do NOT overgraze nutritious plants; this gives weeds an opportunity to flourish. Use many types of livestock that will consume all types of plants, either together or in succession. Clip annuals at the early bloom stage before seed production. If clipping or grazing cannot control weeds, only then use herbicides.

Diseases

BACTERIAL DISEASES

Anaplasmosis, *Anaplasma ovis*  
Anaplasmosis is an infectious bacterium that destroys red blood cells. It is transmitted via biting insects (horse flies, stable flies, or mosquitoes), ticks, or dirty needles/surgical instruments. There are four stages of the disease: incubation stage (three to eight weeks), developmental stage (four to nine days), convalescent stage (two to three months), and carrier stage (until death). Animals either die or begin to recover one to four days after symptoms first appear.

Monitoring: Symptoms in the developmental stage include clinical anemia, fever, a rapid decrease in milk production, lethargy, refusal to eat or drink, pale or yellow skin, and weight loss.

Chemical Control: Spray or dip animals periodically to control insects and ticks. Tetracycline antibiotics can be given to manage the infection.

Biological Control: No biological controls available.

Cultural/Mechanical Control: Graze animals where fly populations are lower and cull carrier animals. Sterilize instruments before using them on other animals, and use clean needles to administer medications.

Anthrax, *Bacillus anthracis*  
Anthrax is a bacterial disease that occurs in livestock, but rarely in the United States. Anthrax was once a problem in the United States but is no longer widespread, due to better quarantine and hygiene efforts, antibiotics, and vaccinations. Anthrax was once known as "wool sorters' disease" because workers in
woolen mills were frequently infected. Anthrax spores form after an animal dies and can persist in the environment for up to 37 years. These spores can be spread via flooding. The most common way livestock become infected is by eating contaminated feed. The other modes of infection are by inhalation or cuts in the skin. Once infected, animals can die within hours of developing symptoms.

**Monitoring:** If any animals die SUDDENLY, contact a veterinarian. Other symptoms include high fever and bloody discharge from body openings.

**Chemical Control:** No chemical controls available.

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

**Cultural/Mechanical Control:** Keep predators away from infected carcasses to limit the spread of spores in the environment.

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**Foot Rot**

*Dichelobacter nodosus*

*Fusobacterium necrophorum*

Two bacteria work together to produce foot rot, which is characterized by lameness, reddening between the toes, and a foul odor. It spreads via walking on the ground, in manure, and on bedding. It only enters the flock by the introduction of new, infected sheep. Consult a veterinarian.

**Monitoring:** Prevention is the best option. Watch sheep for signs of infection. Trim and treat the feet of new sheep, and re-examine them during the 15- to 30-day isolation period.

**Chemical Control:** Use footbaths/foot soaks, dry chemicals (walk-through box), or drying agents to reduce moisture. Sheep can be given an oral treatment of zinc sulfate (0.5 g / day for 21 days) or antibiotics (consult with vet). Zinc sulfate, copper sulfate, or oxytetracycline can be used directly on the feet.

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

**Cultural/Mechanical Control:** Trim the feet (disinfect tools between animals), and do **NOT** buy sheep from infected flocks.

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**VIRAL DISEASES**

**Bluetongue Virus**

Bluetongue virus is spread by biting midges between late summer and early fall. The mortality rate can
reach 50% in an infected flock. Side effects include abortion and deformed lambs. This disease has blocked the shipment of domestic lambs to foreign markets for the last 25 years. Vaccinations provide some measure of protection.

**Monitoring:** Inspect flocks for suspicious symptoms including panting; high fever; hemorrhaging or open sores on the tongue, mouth, or nostrils; redness of skin, face, neck, or body; swollen, reddish blue tongue; lameness with swollen, reddish blue area at base of horns and coronary bands of feet; weakness; and loss of wool.

**Chemical Control:** No chemical controls available.

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

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

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**Nematode, Flatworm, and Sporozoan Pests**

**NEMATODES**

**Barber-Pole Worm**, *Haemonchus contortus*

*Ostertagia* spp.

*Trichostrongylus* spp.

*Oesophagostomum* spp.

The barber-pole worm is the most important internal parasite of sheep in Virginia. Other nematode parasites listed above may cause some losses but are not as serious. These parasites are usually controlled indirectly by dewormers administered for the barber-pole worm. Barber-pole worms live entirely in one host; they do not need other animals to complete their life cycle. Ravenous blood feeding by the adults can cause anemia or even death. They occur seasonally after warm, moist weather and flourish in warm climates. Adult worms live in the true stomach of sheep, where they feed on blood and lay eggs that pass into the manure. Within a few days, eggs hatch into larvae that crawl onto pasture plants and are eaten by sheep. Developing larvae damage the gland cells of the stomach, which disturbs digestion. The life cycle from ingested larva to reproductive adult is two weeks.

**Monitoring:** Symptoms include weight loss, lethargy, anemia, and diarrhea. Sheep may also exhibit "bottlejaw," which is symptomatic of low protein levels. Consult a veterinarian if these symptoms appear.
Chemical Control: Treatment should start with a hypobiotic dewormer (kills dormant worms) when sheep first begin grazing. Thereafter, sheep can be treated every two weeks; however, treating too often can produce resistant worms. If conditions become dry, treatment can be discontinued until the next rainfall. ALL sheep must be treated to prevent immediate re-infestation. Ewes should be dewormed two weeks before lambing. Approved treatments include Levamisole, Thiabendazole, and Ivermectin. Thiabendazole does not treat hypobiotic larvae.

Biological Control: No biological controls are available.

Cultural/Mechanical Control: Pasture sheep in areas where parasite densities are low (pastures harvested for hay, silage, or small grain and cattle or horse pastures). Pastures that have not been grazed by sheep for a few weeks are NOT necessarily free of worms—it takes a year or more to be considered safe. Keep infected sheep out of safe pastures. After sheep are dewormed, move them to safe grazing areas.

**Brainworm, Parelaphostroneylus tenuis**

White-tailed deer are the natural hosts of the brainworm, or meningeal worm. This parasite invades the central nervous system (CNS), which includes the brain and spinal cord. It is not problematic in deer but can be very destructive in unnatural hosts, such as llamas, goats, and sheep. Livestock can contract brainworms from late summer until the first hard freeze. Cool, moist summers with mild winters will extend the period of vulnerability. Brainworms are present throughout the year in the CNS of deer and are contracted by eating infected snails or slugs. Worm larvae spend three months developing inside the deer. Eventually they migrate to the lungs, are coughed into the mouth, swallowed, and then passed in the droppings. Once out of the deer host, larvae parasitize snails and slugs for about a month until they become infective, and the cycle can begin again. Livestock are dead-end hosts; brainworm larvae never reach the adult stage in hosts other than deer. The worms merely wander around the CNS causing inflammation, swelling, and neural damage. Livestock on lowland areas near populations of white-tailed deer are more at risk. There is no test to definitively determine if animals are infected while they are alive, but cerebrospinal fluid can be tested. Infected animals typically have more cells and protein in their neural fluid.

Monitoring: A mild, localized infection in one particular area of the brain or spinal cord may cause a limp or weakness in one leg. A severe infestation can cause paralysis. If worms infect only the spinal cord, animals will be paralyzed but very alert. Other symptoms include blindness, head tilting, circling, and loss of appetite.

Chemical Control: Anthelmintics may be of some help, but most chemicals cannot control worms once they have migrated past the blood-brain barrier.

Biological Control: No effect commercial biological control agents are available.
**Cultural/Mechanical Control:** Prevention is the best treatment. Do not allow animals to graze on lowland areas that deer frequent until after the first hard freeze. If animals must be grazed on these areas, deworm (injectable or oral dose) livestock every two weeks throughout summer, or continuously deworm them via their feed or a mineral supplement.

**FLATWORMS**

**Sheep Tapeworm, Moniezia**

The sheep tapeworm is transmitted by a nonparasitic mite that lives on pasture grasses. Mites are ingested by the sheep; soon thereafter, tapeworms take up residence in the small intestine. Tapeworms do not cause much damage.

**Monitoring:** Possible symptoms include weight loss and diarrhea.

**Chemical Control:** No chemical controls are recommended.

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

**Cultural/Mechanical Control:** No cultural controls available.

**SPOROZOANS**

**Coccidia**

Coccidia are very common sporozoan pests in sheep. Younger animals are more susceptible to infection and disease than older sheep, which have developed some resistance over the years. Lambs frequently develop coccidiosis during weaning, from being physically stressed, from being held in confined conditions, or after entering feedlots. Coccidia enter the body as eggs through dirty water or pastures contaminated with manure. Clinically diseased lambs may exhibit stunted growth or die if the infection is left untreated.

**Monitoring:** Symptoms of coccidiosis include watery, bloody diarrhea, dehydration, and weight loss. Coccidia can be positively identified at the vet's office by examining feces with a microscope.

**Chemical Control:** Administer anti-coccidial drugs before clinical coccidiosis: Lasalocid (*Bovatec*) can be used at a rate of 15 to 70 mg/head/day. Sulfamethazine (*Purina Sulfa-Nox*) can be used as a 0.015% water mix for three to five days. Consult a veterinarian if you suspect clinical coccidiosis.

**Biological Control:** No biological controls available.
Cultural/Mechanical Control: Prevent contamination by cleaning and observing proper sanitation techniques. Use feeders and waterers that are designed to keep out manure.

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On-Line Resources

- "Insects and Related Pests of Man and Animals"
  [http://ipm.ncsu.edu/AG369/index.html](http://ipm.ncsu.edu/AG369/index.html)
- Virginia Agricultural Statistics Service
- Virginia Tech Pesticide Programs
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