Parasite Control and Prevention in sheep and goat

Introduction: It is important to realize that each region of the country will have different parasite problems and potentially different prevention/treatment programs. Therefore, it is important to involve a local veterinarian in all parasite control programs. Proper nutrition is of extreme importance in the control of the effects of parasitism. Animals in good condition and receiving adequate feed are often able to establish some resistance to internal parasites. Poorly fed animals are unable to cope with parasitism, and death losses are often great. Parasitic disease problems increase with intensification of production and lack of attention to strict sanitation.

Causative Agents: In general, parasites can be broken into two major categories: internal parasites (endoparasites) and external parasites (ectoparasites). Each parasite is then further classified into additional groups according to their structure, growth, and life cycles.

Internal parasites - general: Internal parasites may be divided into four (4) classifications:

1. Roundworms - (Nematodes)
2. Tapeworms - (Cestodes)
3. Flukes - (Trematodes)
4. Protozoa - (Coccidia)

The roundworms are by far the most economically important internal parasites of sheep and goats. Flukes produce damage of economic importance in some geographic areas, while adult tapeworms are usually of minor importance. The following lists contain some of the most common parasites found in small ruminants. These lists do not contain all possible parasites.

Internal Parasites Common to Sheep and Goats:

Roundworms - Nematodes:

1. Large stomach worm, barber pole worm, twisted worm - *Haemonchus*
2. Brown stomach worm - *Ostertagia*
3. Stomach/intestinal hairworm, small stomach worm - *Trichostrongylus*

4. Thread-necked worm - *Nematodirus*
5. Hookworm - *Bunostomum*
6. Nodular worm - *Oesophagostomum*
7. Large-mouthed bowel worm - *Chabertia*
8. Whipworm - *Trichuris*
9. Large lungworm - *Dictyocaulus filaria*
10. *Cooperia*
11. *Strongyloides*

Tapeworms (adult and larvae) - Cestodes:

12. Broad tapeworm - *Moniezia expansa*
13. Fringed tapeworm - *Thysanosoma actinioides*
14. Hydatid cysts - *Echinococcus granulosus*
15. Cysticercosis - *Taenia ovis*
16. *Taenia hydatigena*
17. Gid - *Taenia multiceps*

Flukes - Trematodes:

18. Common liver fluke - *Fasciola hepatica*

Protozoa - Coccidia:

19. Coccidia (coccidiosis) - *Eimeria*

External Parasites Common to Sheep and Goats:

20. Lice - *Damalinia*
21. Mites - *Chorioptes, Psoroptes, Sarcoptes, Demodex*
22. Flies - *Lucilia, Calliphora, Chrysomya*
23. Ked - *Melophagus ovinus*
24. Ticks
25. Nasal bot - *Oestrus ovis*

Locations of Common Stomach and Intestinal Roundworms:

Abomasum:
Haemonchus
Ostertagia
Trichostrongylus

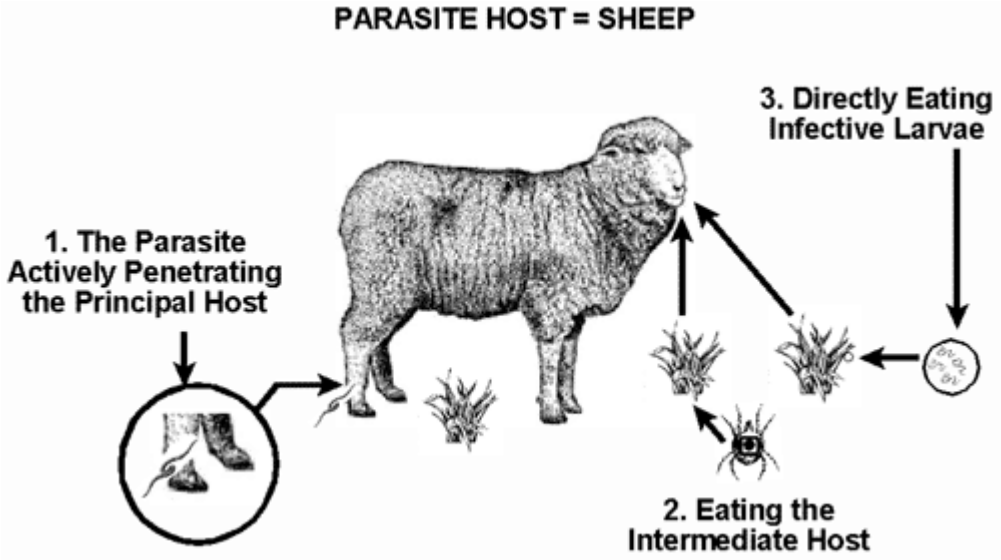
Large intestine:
Oesophagostomum
Chabertia

Small intestine:
Trichostrongylus
Nematodirus
Bunostomum

Caecum:
Trichuris

Clinical Signs: Signs of parasite infestation are most common in young, very old, or diseased animals. Each infected animal, depending on the parasite or parasites it is infected with, will have different signs of disease. In general, most infections cause weight loss, unthriftiness, and poor weight gains. Some parasites can cause diarrhea, decreased appetite, poor conception rates, and fluid retention (bottle jaw). Parasites can also cause poor fiber production.

Disease Transmission: Some internal parasites are spread by orally ingesting the infective stage of the parasite. This most commonly occurs during grazing. External parasites and some internal parasites are spread by direct contact or having infested animals in close association with other animals. The following diagram shows the various routes that are commonly used by parasites to enter the host animal.



Diagnosis:

A. Internal parasites - Most of these infections can be detected using a fecal egg count. This is done by collecting a fecal sample and sending it to a local veterinarian for fecal flotation. See page D228 for more specifics. Often these infections can also be diagnosed at necropsy.
B. External Parasites - Parasites or the signs associated with infestations
can be observed upon routine examination of the animal.

Fundamentals of Internal Parasite Control: When considering the prevention of internal parasite infections, it is important to focus on two major areas:

1. Avoid grazing on pastures and areas with large populations of worm larvae.
2. Prevent pasture contamination with large populations of worm larvae.

Avoid Contaminated Pasture: Susceptible sheep and goats should be moved to "safe" (parasite free) pasture at critical times. The following grazing areas are listed in order from the most parasites free, to the areas where parasite numbers can be excessive:

- Previously un-grazed crops and stubbles.
- Pastures not grazed by sheep or goats for 3-6 months.
- Pastures grazed by wethers or dry ewes/does during late summer/fall.
- Pastures grazed during the spring by ewes or does about to lamb or kid.

Prevent Pasture Contamination: Parasite eggs are deposited on pasture by worm-infected sheep or goats. The parasites are then spread to other animals when they ingest the infective stage of the parasite. To prevent eggs from contaminating pasture and infecting other animals, de-worming is an essential part of management. (See page C174 for drenching procedures.) When animals are de-wormed, then moved to a safe pasture (stubble or cattle pasture), they will not significantly contaminate the pasture with eggs for several months. Because of the added stress placed on the ewe/doe after lambing or kidding, an increase in parasite egg shedding is often noticed. Proper management of these females prior to and after giving birth can help reduce egg shedding and pasture contamination.

Treatment/Prevention: The following recommendations are the general basis of parasite control. They are not intended to be rigid guidelines and should be varied, even between pastures on individual farms or ranches where experience indicates that more or less control is needed. Also, the timing of de-worming may be altered to suit individual producer needs. All these decisions should be made with the help of a local veterinarian. Many of the products that are discussed in this manual are not approved for goats and sheep. Therefore, their use would be considered extra label. Many times, goats require doses that are 1.5 times higher than the typical sheep dose for many of the internal parasite products. Some veterinarians recommend giving only oral internal parasite products to goats. Studies indicate that many of the pour-on products are not very effective in sheep and goats. Refer to Section G for dosage information.

The Following Practices are Recommend in All Areas:

- To stop intestinal worms from accumulating, do not use the same pastures for lambing or kidding every year.
- Rotate pastures used for grazing every 3-6 months.
- If clean grazing such as stubble is available, sheep or goats should be given an effective broad spectrum de-wormer before they are moved on to it.
- If possible, all animals that are de-wormed should be held in a dry lot for at least 3 days. This is because most de-wormers do not kill the parasite eggs, just the adult worms. Waiting 3 days will help the animal eliminate most of the parasite eggs in the dry lot and not on pasture where other animals may ingest the eggs.
- Prevent the post-lambing/kidding rise in parasite egg production.
- Have a veterinarian perform a fecal egg count to check the effectiveness of any de-worming or parasite control programs. This should be done 10-14 days after de-worming. Use these fecal egg counts to determine whether sheep or goats need additional de-worming.
- Avoid resistance problems by not using the same products year after year.
- Select for animals that are parasite-resistant. These are sheep and goats that have a natural resistance to internal parasites. These animals are often identified through the use of fecal egg counts.

De-worming Program for Internal Parasites: In general, there are four common times when animals are de-wormed:

1. In colder climates where the animals are moved off of pasture for the winter, a dose can be given just before the move is made.
2. A second time for de-worming occurs 1 month prior to the lambing/kidding season. De-worming ewes/does about 2-4 weeks before lambing/kidding and then moving them to a safe pasture, will prevent the rise in production of worm eggs after lambing/kidding. If the ewes/does are not moved after this dose, additional doses are required at 3 week intervals throughout the lambing/kidding season. The final dose should be given 2-4 weeks after the last lamb/kid is born.
3. A de-wormer for lambs or kids at weaning should also be given. After the de-worming, the lambs/kids should be moved to a "safe" pasture.
4. Breeding males are often de-wormed 1 month before the breeding season.

Products Used to Treat Internal Parasites: Different treatments are based on the common parasites encountered and geographical location. The following table identifies the most common products used for parasite control and what parasites they are effective against.

Brand Name (Active Ingredient)	**Effective Against
*Ivomec Sheep Drench (Ivermectin)	# 1-11, 21, 25
*Tramisol or Levasole (Levamisole)	# 1-7, 9, 10
*Bovatec (Lasalocid Sodium)	# 19
*Rumensin (Monensin)	# 19
*Corid (Amprolium)	# 19
*Dectomax (Doramectin)	# 1-11, 21
*Valbazen (Albendazole)	# 1-4, 7, 10, 12, 18
*Panacur (Fenbendazole)	# 1-4, 7, 10-12

** Many of these products are not labeled for use in goats and often sheep. Their use in these cases is considered "extra-label."*

*** These numbers correspond with the numbers above.*

Products Used to Treat External Parasites: Most external parasites are controlled on a flock/herd wide basis. This means that when one animal is diagnosed with external parasites, a dip, dust, or spray is used to treat the problem that animal as well as the entire flock/herd. The following table outlines the common products and the treatments used to treat the external parasites:

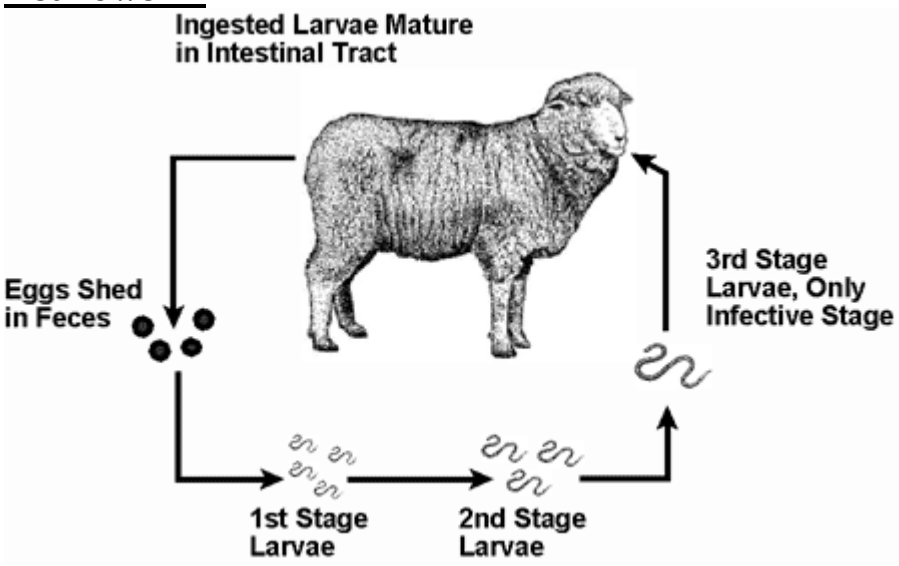
Active Ingredient	Effective Against	**Treatments
*Malathion	Mites, lice, keds	0.5% spray; 4% dust
*Lime-sulfur	Mites, lice, keds	2-5% dip
*Coumaphos	Mites, lice, keds	0.05-0.3% spray or dip; 0.5%-1% dust
*Phosmet	Mites, lice, keds	0.15-0.25% dip
*Methoxychlor	Mites, lice, keds, ticks	0.5% spray or dip; 5% dust

** These products are not labeled for use in sheep and goats. Their use in these animals is considered "extra-label."*

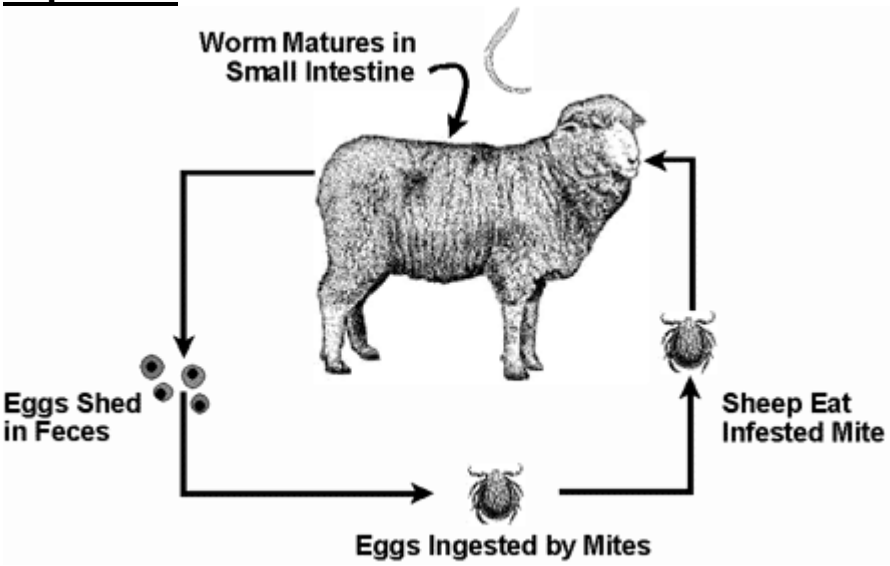
*** Many of the dose recommendations used came from Pugh DG: Sheep & Goat Medicine, Ed 1, Philadelphia, 2002, WB Saunders.*

Internal Parasite Life Cycles:

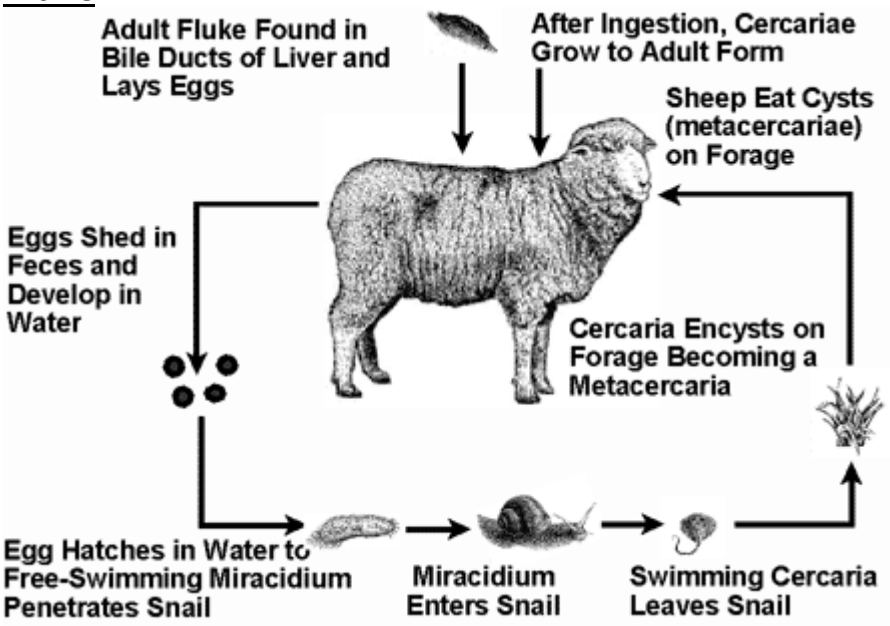
Roundworm



Tapeworm

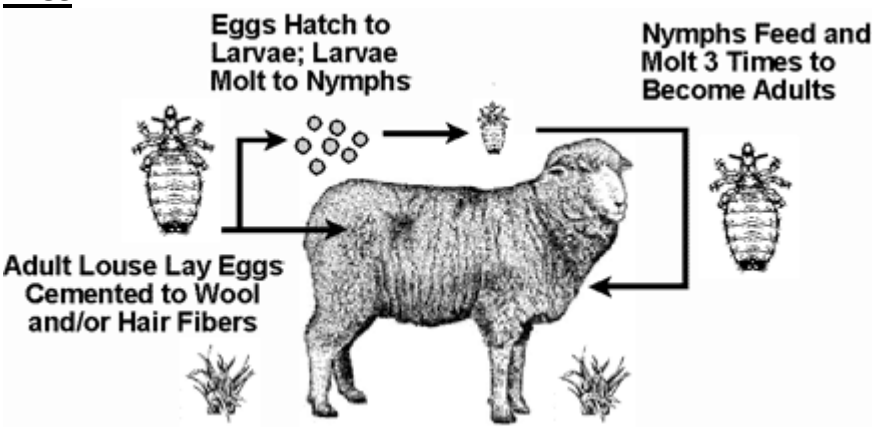


Fluke

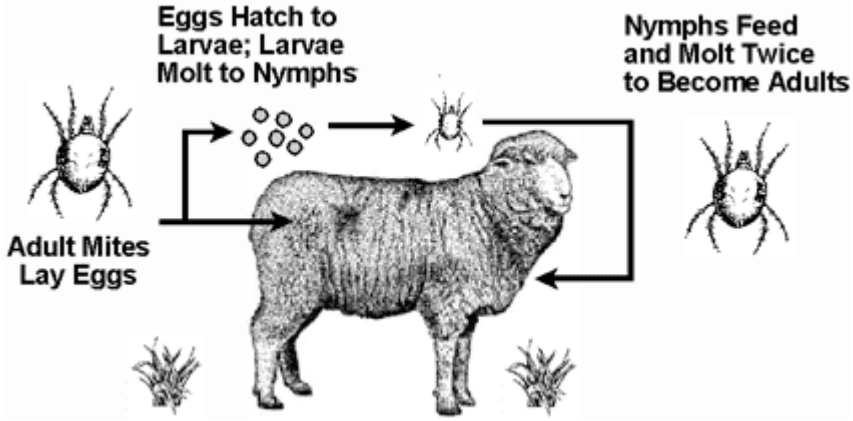


External Parasite Life Cycles:

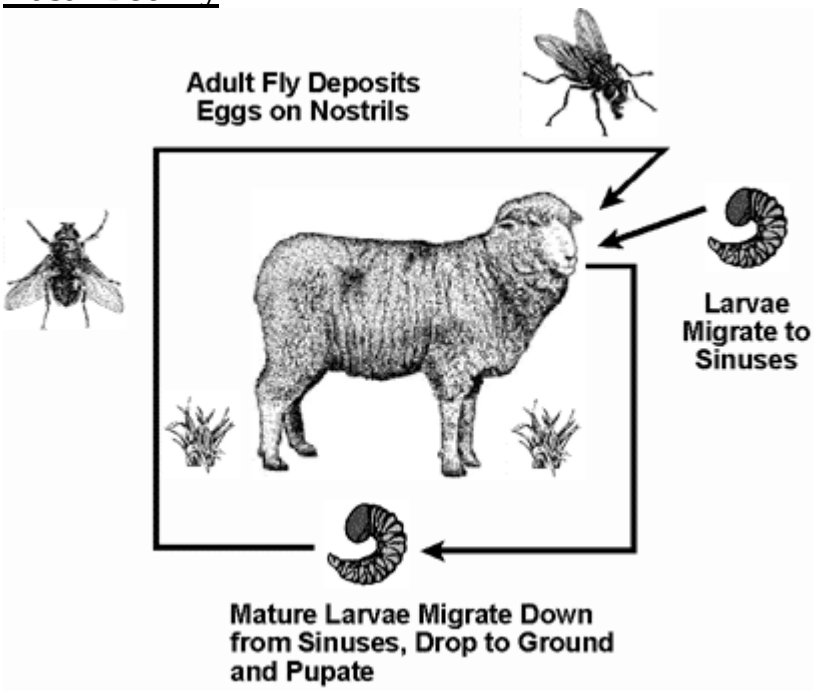
Lice


Eggs Hatch to Larvae; Larvae Molt to Nymphs
Nymphs Feed and Molt 3 Times to Become Adults
Adult Louse Lay Eggs Cemented to Wool and/or Hair Fibers

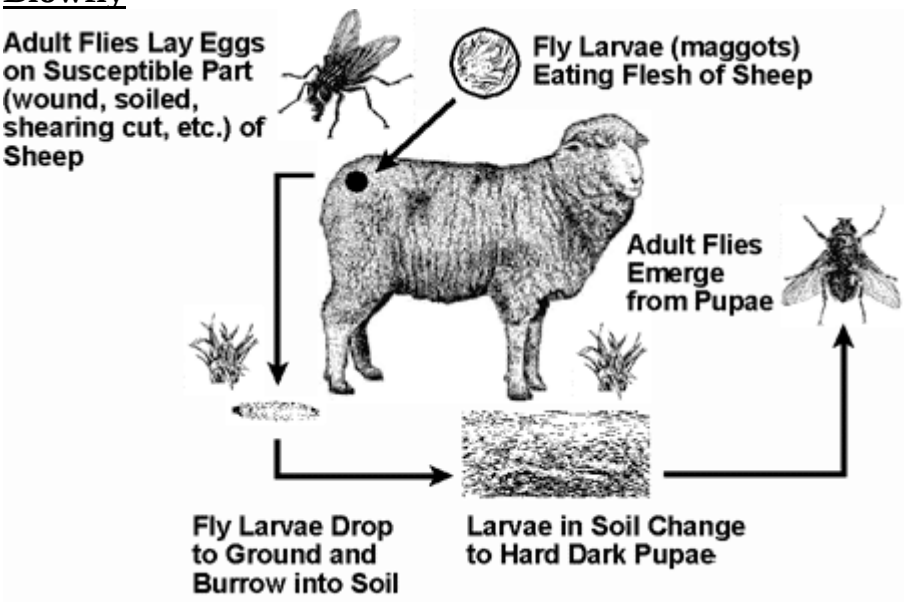
Mites


Eggs Hatch to Larvae; Larvae Molt to Nymphs
Nymphs Feed and Molt Twice to Become Adults
Adult Mites Lay Eggs

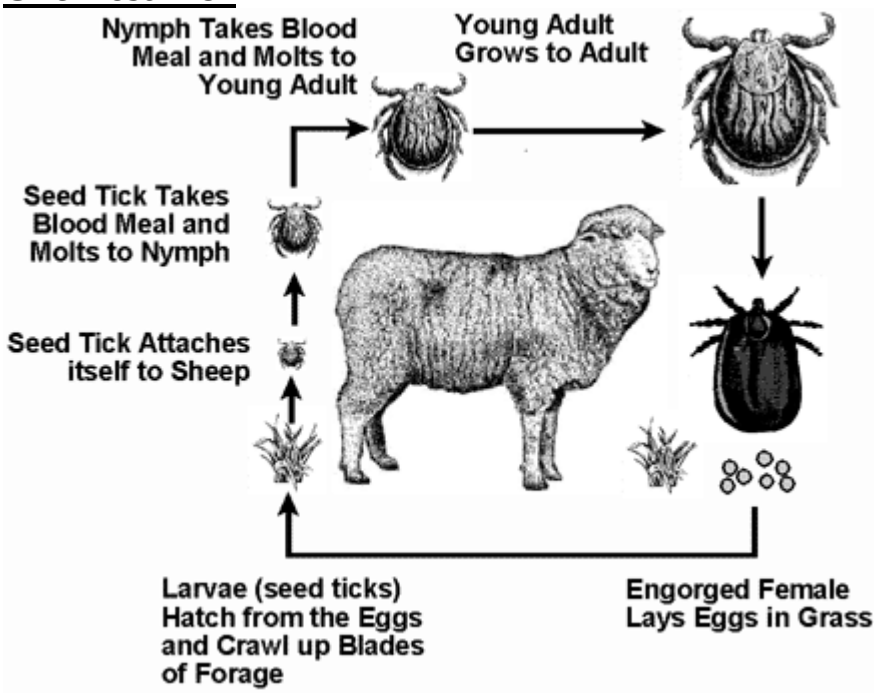
Nasal Bot Fly



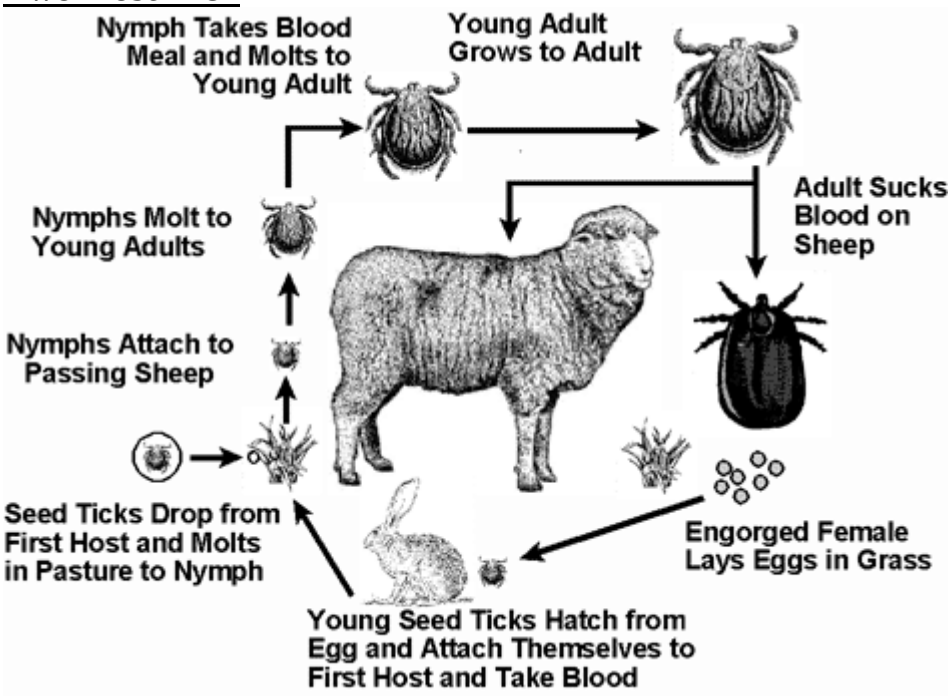
Blowfly



One Host Tick



Two Host Tick



Control of External Parasites of Sheep and Goats

1. Introduction

External parasitism results in poor quality sheep and goat products especially skins and lost income to producers. Common external sheep and goat parasites include ticks, lice, keds and mites. Some parasites feed on blood causing blood-loss anemia, especially in young animals. The result is unthrifty, poor-performing sheep and goats.

A regular program of treatment and prevention of external parasites should be an important part of a flock health program. The benefits of an effective external parasite control program include increased comfort for animals, improved performance, and higher quality of products. This technical bulletin assesses the damage caused by external parasites and also the prevention, control and treatment measures to minimize the effects of external parasites on sheep and goat productivity.

2. Effects of external parasites

External parasites limit production in sheep and goats in many ways and result in economic loss. The following are some of the major ones:

 Attachment to the host causes irritation of the skin with subsequent ulceration and secondary infections.

 They feed on body tissue such as blood, skin, and hair. Heavy infestations are associated with anemia (adult female ticks can, for example, suck up to 10 ml of blood).

 Cause discomfort and annoyance. Weight loss, loss of condition and reduction in milk production may occur as a result of nervousness and improper nutrition because animals spend less time eating. The wounds and skin irritation produced by these parasites result in discomfort and irritation to the animal.

 External parasites can transmit diseases from sick to healthy animals due to their habit of moving from one host to another. Some of the transmitted diseases are serious with fatal consequences.

 Bites can damage sensitive areas of skin (teats, vagina, eyes, etc.)

 Tick attachment between the claws of the feet may cause severe lameness.

 Cause huge economic losses through skin damage rendering it unsuitable for the leather industry. Ethiopia used to get the second largest foreign currency earnings from the export of skins and hides. This has been deteriorating due to the decrease in skin quality. Thirty years ago tanneries in Ethiopia used to produce 70% of processed skins with grades 1-3. About 10-20% of the skins were graded as poor quality. Currently, only 10-15% is in the good category while the rest are downgraded or rejected due to the increase in external parasite infestations during the period.

 The financial burdens of diagnostic, therapeutic or preventive programs at flock, community and national levels have large financial requirements.

3. How do we know if an animal is suffering from external parasites?

 Sheep/goats with an irritated skin will be persistently scratching themselves. They will use their teeth, hind hooves and horns (if they are horned). In extreme cases, affected animals will rub on walls of shelters, fence posts and any solid object they can find.

 Remember that most parasitic infections will give rise to a generalised irritation whereas skin diseases will probably be more localised.

 grating teeth, loss of appetite and shaking the head frequently for seemingly no reason is indicative of nose bot fly infestation

 Lesions consist of foul smelling ulcers resulting from severe fly infestation. The ulcers often have a ‘honey combed’ appearance and are filled with larvae (maggots).

 Decreased feed intake, resulting in decreased weight gains and milk production

 Skin damage, hair loss, Scale formation, thickening and wrinkling

4. The major external parasites

Sheep and goats can suffer from a range of external parasites; the major ones include ticks, mites, lice, ked, fleas and flies. A short description of each is presented below.

4.1. Ticks

Ticks are one of the most serious ectoparasites in Ethiopia. They cause the greatest economic losses in livestock production. Their effects are various including reduced growth, milk and meat production, damaged hides and skins, transmission of tick-born diseases of various types and predispose animals to secondary attacks from other parasites such as screw worm flies and infection by pathogens such as Dermatophilos congolensis, the causative agent of streptothricosis. Other losses directly attributable to ticks include skin damage that greatly lowers value of the skin. Some of the tick borne parasitic infections in sheep and goats include:

- ***Babesia ovis:*** transmitted by *Rhipicepalus bursa* and Rhipicepalus evertsi;

- ***Babesia motasi:***transmitted by *Haemophysalis spp, Dermacentor spp, and Rhipicepalus bursa;*

- ***Theileria ovis:*** transmitted by Rhipicepalus bursa and *Rhipicepalus evertsi;*

- ***Anaplasma ovis:*** transmitted by *Rhipicepalus bursa and Rhipicepalus evertsi;*

- ***Heart water:*** transmitted by *Ambylomma herbarium and Ambylomma variegatumand*

- ***Tick paralysis:*** transmitted by *Ixodes rubicundus , Rhipicepalus evertsi, Ambyloma and Dermacentor*.

Different tick species have different locations of attachment. The location can indicate the type of tick. Table 1 shows the sites of attachment of different tick species.

Common sites of attachment	Site of tick attachments on animals
	Tick species
Ear, limbs, dewlaps, neck, tail, axial, groin and abdomen	*Haemaphysalis*
Ear, limbs, dewlaps, abdomen and chest	*Boophilus microplus*
Abdomen, limbs, dewlap and groin	*Boophilus decoloratus*
Under the tail, margin of the anus, limbs and groin	*Ambylomma variegatum*
Neck, under the tail and around the anus	*Rhipicephalus evertsi*
Chest, abdomen, neck, udder and scrotum	*Hyaloma a. anatolicum*

Ticks may be divided into two major groups namely the soft ticks (Argasids) and the hard ticks (Ixodids). Hard ticks can further be divided into three (one host, two host and three host ticks) depending upon the number of hosts involved in their life cycle.

Treatment, prevention and control of ticks

 Acaricide application is the most widely used and effective method of tick control.

 Some ticks can live on the ground for up to 300 days without feeding. In areas where many ticks exist, reinfection of the host occurs continuously and treatment, therefore, must be repeated regularly.

 In subhumid areas the period of highest tick activity is the wet season and only few ticks are found on animals during the dry season. In lowland areas most ticks are active throughout the year and must be controlled continuously.

 Be sure to treat all new animals before adding them to the flock.

 Treat with acaricides only where ticks are present in large numbers. Do not use acaricides if tick numbers are not large. In this case, you can use a needle or thorn to kill them.

 Knapsack spraying is the most practical method if more intensive control measures are needed for a small number of animals. The most efficient method of hand spraying is as follows:

 Spray along the entire length of the back

 Spray the sides and flanks in a zigzag pattern

 Spray the brisket

 Spray each leg

 Spray the belly, udder or scrotum

 Spray the tail and anal area

 Finally spray the head, head, face, neck and ears.

4.2. Lice

Infestation of sheep and goats with lice is widespread in most parts of the country. Lice are small wingless insects. The head is broad and flat with mouth parts adapted to chewing. There are two types of lice, the biting lice and the sucking lice.

 Biting lice graze on epidermal tissue, hair and other organic waste. They cause intense itching by their action.

 Sucking lice have a narrow head with mouthparts adapted for penetrating the skin of the host and sucking blood. Both immature and adult stages suck the blood or feed on the skin.

Lice are easily overlooked because of their small size. They can multiply very fast before being discovered. By this time, the animal might be too anaemic and emaciated to recover. Transmission among animals is by way of direct contact. Lice, unlike ticks, have a marked degree of host specificity, even sheep and goats having their own distinct species. Lice can survive away from their host only for a limited period. The whole life cycle is spent on the host's skin. They are generally transmitted from one animal to another by direct contact. Transmission from flock to flock is

usually accomplished by introduction of infested animals to healthy flock. Lice are of minor importance in the transmission of disease.

The saliva and feces of lice contain substances capable of causing allergies giving rise to severe irritations to the skin. This is usually shown by the animal rubbing itself against objects. General unthriftyness, matted, dull fleece with tufts of wool may indicate lice infestation. Animals exhibit reduced weight gain and loss in production. Lameness can result from the foot lice of sheep. Lice are also associated with development of cockle. Cockle is an inflammatory response of the skin to the presence of lice and their saliva. This is seen after the wool or hair has been removed from the skin. Animals in poor body condition are likely to be seriously affected.

Most lice populations on animals vary seasonally, depending on the condition of the host. Lice populations on animals are greater during the rainy months. Animals under stress will usually support larger lice populations than found under normal conditions. Lice do not transmit a serious disease in sheep and goats.

Diagnosis of lice infestation: If lice infestation is suspected, part the hair and examine the skin carefully. You will see small oval shaped lice moving within the coat, sometimes in clusters. They are dark brown/black in color and move quickly through the coat. Their eggs are oval and cream colored and adhere to the hair follicle. "Droppings" from the lice will be seen as small black specks. If the lice have only recently arrived, the animal will not look too bad but if it has been infested for more than a few days, bare patches will have begun to develop and it will generally be rather miserable and probably beginning to lose weight with all the activity involved in scratching. After two weeks the goat will be in a dire state and in urgent need of treatment, so do not delay! Lice are probably the most common cause or irritation.

Treatment and control of lice infestation: Spraying or dipping with insecticides is effective, but it should always be carried out twice, the first time to kill the lice currently on the body, the second 14 days later to kill lice hatching from eggs present at first treatment. Eggs are not affected by insecticides. If you have more than one goat, then all must be treated or the problem will just keep reoccurring.

4.3. Sheep ked

Sheep ked, commonly known as sheep ticks, are adult hairy wingless brown six legged flies about 6 -7 mm long. They are permanent ectoparasite and feed on blood. They transfer from animal to animal through direct contact. Sheep ked can live up to 6 months, during which time the female produces around 10 to 15 young ones every eight days. Reproduction is continuous. Unlike most insects, a female ovulates a single egg that hatches into maggot-like larvae. The maggots are nourished within the body of the female ked until they are fully grown. The mature larva is expelled and glued to the host's fleece. The larva is whitish, oval, and without legs. The skin turns brown within a few hours after birth and forms a brownish bean shaped pupa that can be found stuck to the wool on the belly, shoulder or thigh.

An adult ked emerges from the pupa in 2 to 5 weeks, depending on temperature. It crawls over the skin and feeds by sucking blood. This causes irritation followed by scratching, bitting and rubbing against standing objects, fences stones and shrubs which damages the skin and wool. Both male and female keds are blood feeders and feed several times every day. Heavy infestation may, therefore, cause severe anaemia. Skin puncture by blood sucking keds causes an inflammatory response of the skin to the presence of keds and their saliva known as cockles. This is recognized after the wool or hair has been removed from the skin. Cockle causes down grading of the skin because it weakens and discolours it. Keds are mainly seen in colder areas and infestation may be reduced when the animals are moved from cold to hot dry areas.

Ked treatment and control:

 The shearing of woollen sheep greatly reduces the infestation, not only because of the removal of the keds with the wool, but those remaining on the skin are exposed to the environment and this greatly stops their development.

 Spraying or dipping with insecticide after shearing will destroy keds.

4.4. Mange Mites

Mites are tiny in size and most difficult to see and identify without the aid of microscope or at least a hand lens. The life cycle of mange mites is similar to ticks with egg, larva, nymph and adult stages. All the stages stay on the animal, feeding on the epidermis, serum, hair, and in some cases, burrowing beneath the epidermis or into hair follicles. A female mite lays up to 16 eggs in her lifetime. Life cycle is completed in about one month. Mites spread from one animal to another mainly through direct contact. Mites do not live very long when removed from the animal. Mites damage leads to skin inflammation and is often accompanied by hair and wool loss. High temperature, humidity and sunlight favour mange mite infestation. Major mange mites may be psoroptic, Sarcoptic or demodectic according to the species of infesting mite.

4.4.1. Psoroptic (Sheep scab)

Psoropts is a highly contagious disease of sheep and goats. Psoropts affecting different animals are highly host specific and a species parasitic on one host will not readily infest a host of a different species. Psoropts mites live on the surface of the skin and are non-borrowing. They pierce the skin and suck the host's tissue fluids causing irritation, inflammation, discharging lymph fluid that dries to form yellowish crusts and scabs that often protects them.

Psoroptic mange (sheep scab) is the most frequent type in sheep. Sheep scabs can affect sheep of all ages but may be particularly severe in young lambs. It occurs almost exclusively on the tickly wool areas where it produces large scaly, crusted lesions. Intense itching is generally the first sign. When large skin areas are involved, the animals show gradual emaciation and anaemia. The psoroptic mites may be found even in the ear canal (ear mange).

It is located in most areas of the body, such as shoulders, sides and back. Affected skin is covered with exudates. This dries to form a scab. Massive loss of hair usually occurs.

The whole lifecycle is completed in 10-11 days. All stages are capable of survival away from the host for up to 10 days. Optimum conditions for development include moisture and cool temperatures. When conditions are adverse, as in summer, mites survive in protected sites of the body.

Mites are usually more active in winter and the oviposition rate is higher at lower temperatures. In summer the disease progress more slowly, lesions are not obvious and can be missed. Inguinal pouches, scrotum, under tail, ears and skin folds are areas of focus for mites; and serve as hiding places during the dry season; migrate to the general body surface with the onset of cold season.

4.4.2. Sarcoptic mange

Sarcoptic mange is caused by infestation with Sarcoptes scabei variety capri in goats and variety ovis in sheep. It is more common and severe in goats, spreading extensively and in some instances causing deaths. Sarcoptic mange is more acute than the other forms of mange in that it may involve the entire body surface in a short time. It usually starts on a relatively hairless part of the skin and may latter generalize. The complete life cycle may be completed in ten days, although fourteen days is the average period.

The mites burrow the skin and form galleys where they remain for the rest of their lives. They cause small red papules of the skin. The affected area is itchy and frequently damaged by scratching and biting. Loss of hair, thick brown scabs and thickening and wrinkling of surrounding skin is observed.

Sarcoptic mange is highly contagious. The spread is mainly by close physical contact between infected and healthy animals. Sarcoptes are very susceptible to dryness and unable to live more than a few days away from the host.

4.4.3. Demodectic mange (Hair follicle mite):

Demodectic mange invades hair follicles and sebaceous glands of all species of domestic animals. The disease very severe in goats, spreading extensively before it is suspected and in some instances causing death. It causes significant damage to the skin. The disease is severe in goats. It causes the small pinholes in the skin which interfere with its industrial processing and limits its use.

Demodectic mange lesions consist of thick scabs overlaying the skin which was reddened and thickened usually present round the eyelids,

nose, the brisket, lower neck, forearm and shoulder and the tips of the ears. In severe cases there may be a general hair loss and thickening of the skin. Animals with severe demodectic mange generally have immune systems that do not function properly.

The disease spreads slowly and transfer of mites takes place by contact. Demodectic mange causes small nodules and pustules which may develop into large abscess. The contents of the pustules are usually white in colour and cheesy in consistency. In large abscesses the pus is more fluid. It causes small nodules and pustules which may develop into larger abscess. There may be a general hair loss and thickening of the skin.

Factors that contribute to the spread of mange mites

 Increase in livestock trade

 Absence of veterinary regulations for ectoparasite control in the movement of livestock across borders

 Poor awareness of farmers and poor level of management

 Mange mites can survive outside the host.

 They do not cause visible mange in every animal.

 Irregular ectoparasite control

 Despite acaricide application, possibly development of resistance to acaricides might also contribute

Control and treatment strategy for Mange mites:

 Treatment and control should focus on all animals in a flock to achieve control;

 If spraying, start at the head, finish at the tail, and spray all areas of the body thoroughly.

 There is no acaricide yet which readily destroys the eggs of mange mites; thus a 2nd treatment is necessary after 7days for psoroptic mange and 14 days for sarcoptic mange to get the newly hatching parasites.

 Thick scabs and crusts should be loosened or removed mechanically with a comb before spraying. The animal can be washed with soap and water to soften and remove the epidermal scales.

 Spray animal houses and pasture fences with acaricides

 Animals newly introduced to a flock are the main source of infection. Quarantine newly bought animals and treat twice before they join the herd.

 Dipping is more effective than spraying. Acaricides such as Diazinon 60% or Ivermectin injection (200 mg/kg) are effective.

4.5. Fleas

Fleas are small, wingless insects varying from 1.0 to 8.5 mm in length. They are narrow insects compressed on the sides with spines directed backwards.

Most species move about a great deal and remain on the host only when they obtain a blood meal. The legs are well developed and they can jump as far as 7 to 8 inches.

- The flea under favourable conditions a generation can be completed in as little as 2 to 3 weeks. Mating take place on the host and eggs also lay on the host. Since the eggs are not attached, they drop to the ground and hatch in from 2 days to several weeks. Development occurs most commonly in the bedding of the resting area of the host. The larvae are very small worm like, legless insects with chewing mouth parts. In several weeks they go through 3 larvae stages, feeding on organic debris.
- The pupa stage lasts approximately one week, and then the newly emerged adult flea is ready to feed on blood within 24 hours.

- The stick tight flea is the most common flea on sheep and goats. It attaches firmly to its host usually on the face and ears. This species remains attached to its host for as long as 2 to 3 weeks. During this time, eggs are layed.

-They drop to the ground and hatch into larvae. Large populations of this flea may cause ulcers on the head and ears. Flea infestations spread to other animals including humans.

5. Prevention of external parasites

Rather than waiting until the problem of external parasites becomes serious, farmers should maintain a strict preventative regimen to controlling external parasites.

 Conduct a thorough physical evaluation of your sheep and goats at least once weekly. Run your hand over each animal's hair coat, visually inspecting for excessive hair loss, flakes of loose skin, areas of skin irritation, and any crusty lesions or bumps that might indicate infection with an external parasite.

 immediately separate and place any animal that shows sign of parasite infection or seems to be unthrifty. This helps to reduce the chances of passing infection on to the rest of your animals. Quarantined animals should not be mixed with the main flock until treatment is complete and the parasite eradicated.

 Isolate newly introduced animals and treat them for external parasites before mixing them with other animals.

 Practice good sanitation habits.

o Clean animal houses regularly.

o Seal with cement or mud all cracks in the floor and walls of livestock housing.

o remove grass/plants around the barn

o All litter and discarded wool must be collected and burnt or deposited out of animal contact.

 Spray housing with an appropriate pesticide every two weeks if possible.

 Farmers should also be aware of ways to reduce the number of ticks on pasture.

o Rotate the land where livestock graze.

o Avoid pasture which has many ticks as long as possible

o Chickens can be kept in places where there are many ticks, for example around watering places, etc.

 Control by good animal hygiene

o Shearing of sheep regularly – for lice and keds

o Shearing and wetting/washing animals regularly with detergents effective especially against lice

 If the above measures are not effective, treat the animals with appropriate pesticide.

6. Treatment and control of external parasites

Dipping is very effective; currently, mobile dipping vats for sheep and goats are available.

 Thorough treatment of the infested area is required, especially when ticks infest the ears and under side of the tail or mites infest localized patches on the skin.

 After treating place the animal in the sun to dry.

 Due to the biological cycle of the ectoparasites, a single treatment may not be efficient. The first treatment will only kill the active stages of the parasite present on the animal at the time of treatment. The second treatment will kill any eggs that have hatched since the first treatment.

 All animals introduced to a farm must be treated immediately upon arrival to avoid the spread of new parasites on to the farm.

 If external parasites are seen on an animal, it should be treated immediately to prevent transmission to others.

 Some traditional methods of external parasite control can help. These include.

o Washing the animal with salt water.

o Smearing the body of the animal with spent oil

o Using repellent herbs

o Using kerosene to rub the predilection sites.

o Use tick grease and/or old engine oil, to reduce parasite numbers on animals. Soaking cloth with a mixture of old engine oil and insecticide and placing it on a tree or on a pole where animals will rub against it will help to apply the material to the animal.

 Once the animals are treated the buildings/ paddocks, barns must be thoroughly cleaned and disinfested with a suitable chemical. No sheep should be housed/grazed in the disinfested area for at least 21 days.

 External parasites can develop resistance to acaricides and this is encouraged by frequent dipping and the use of dip solutions at a lower than recommended concentration. The manufacturer's recommendations should be strictly followed.

 Acaricides are toxic to people as well as animals and care should be taken to limit contact with the skin and prevent any possibility of dip fluid being drunk. Or contaminating ground water.

 Acaricides are also very damaging to wildlife and fish so great care is needed when discarding used dip fluid.

 Do not recommend unnecessary external parasite control. This will waste a farmer's money and increase possibility of development of drug resistance.

 Burning of pasture and raising poultry that can reduce parasite numbers help in external parasite control.

 Effect and incidence of ectoparasites can usually be reduced by improving nutrition, hygiene of animal houses and by occasional spraying or dipping

 Regular removal of moist bedding, hay and manure along with preventing the accumulation of weed heaps, grass cuttings and vegetable refuse is very helpful.

7. Methods of applying chemicals to livestock

Acaricides may be applied to animals by several methods. The following are the most common methods used.

 Dipping: This is very effective if large numbers of livestock need to be treated. Concrete dipping baths that are stationary or a mobile vat can be used especially for sheep and goats. All body parts have adequate contact with the chemical solution since animals are completely wetted. Mobile dipping vats are recently increasingly used in many parts of the country. The mobile plastic vat overcomes the problem of maintaining the concrete vat. The sheep/goats can quickly be lifted in and out of the mobile dipping vat. Farmers can make a good dip tank using half of an old drum.

Hand Spraying: Hand spraying using knapsack sprayers is the most commonly used method of applying acaricides in Ethiopia. It is effective especially if a small number of animals are to be treated. If a sprayer is not available, then the pesticide can be applied with a paint brush or a cloth or sponge on the end of a stick. KDA's/Animal health assistants should train sheep and goat producers how to apply sprays. During spraying, the animal should be tied securely and the entire animal should be sprayed by following a strict sequence starting at the head and finishing at the tail to cover all areas of the body thoroughly.

8. Use of pesticides

A great number of chemicals are widely used to control ectoparasites. Early chemicals included sulphur and arsenic compounds. These were replaced in the 1940s by chemicals such as DDT, Dieldrin and Lindane (chlorinated hydrocarbons) – now known to be very dangerous both to livestock and humans. These are now banned in most countries.

Organophosphorus chemicals such as Malathion and Diazinon were then developed and are still in use, though great care must be taken to avoid any contact with the skin, eyes or mouth.

Another group of chemicals is called Organocarbamates, such as Carbaryl and Baygon. These are not so toxic and are in regular use.

The safest of all chemicals are known as synthetic pyrethroids, such as Fenvalerate and Deltamethrin. These are very effective but also much safer than any of the above chemicals. However, they are also very expensive.

8.1. General precautions

Always use the recommended dosages for chemicals. Ask for help if you are not sure. Using too high concentrations will not kill more parasites. Instead, it may kill the animal and make the operator ill. Take the following precautions during application of chemicals:

 Apply pesticides only as directed on the labels. Stop and read all warnings, directions, and precautions carefully before using any pesticide.

 DO NOT spray animals in a confined, non-ventilated area.

 DO NOT dip animals when thirsty or overheated. Water animals well before treatment so they will not drink the vat fluid.

 DO NOT contaminate feed or drinking water.

 DO NOT apply insecticides to sick animals or animals under stress.

 DO NOT apply pesticides to lambs/kids less than 3 months old. Use light applications on lambs 3 to 6 months old.

 DO NOT treat sheep and goats just before slaughtering – check the time interval recommended for the pesticide used.

 Store all pesticides in their original container away from food or feed and out of reach of children and pets

 Wear gloves (or plastic bags) to avoid any contact with the skin.

 Wear protective clothing, goggles and face mask to avoid any chemical splashing into the eyes or mouth. If there is any contact, wash immediately with soap and water.

 Never use cooking pots to mix chemicals.

 DO NOT eat, smoke or drink while handling chemicals

 Take care not to damage the environment. Do not pour into rivers or ponds any unused solution dip contents. Dip contents can be drained into pits. The pits should be at least 150 m away from water sources.

 Clean sprayers immediately after use.

-It is extremely dangerous to reuse an empty acaricide container. The containers should be punctured or crushed. The containers should then be buried in an isolation area at least 50 cm below ground surface.

 Wash yourself and your clothes well with soap and water after treatment is finished

Common Parasites in Sheep and Goats:

Parasite	Description	Symptoms/Site of Disease	Geographic Area, Environment	Prevention	Miscellaneous
Brown stomach worm (Ostertagia spp.)	Brown, thread-like worms that measure up to 12 mm long. Males are smaller.	Loss of weight is a symptom although this parasite is mostly accompanied by others and detection of exclusive Ostertagia infestation is difficult. The pH of the gut often rises from 2 to 7 resulting in poor digestion and increased growth of bacteria. Strongyle-type eggs appear in feces.	Universal; most prevalent in western U.S.	Pasture management is important.Anthelmintics should be administered at proper times. Adequate iron in the diet is important.	Wool production is decreased. Infected animals lose their appetite.
Cooperia (Cooperia spp.)	Brownish-red hair like worms that	Strongyle-type eggs appear in the feces of infected animals. Diarrhea often accompanies	Universal	Proper pasture management aids in	Damage is not severe unless animals are heavily infected.

	measure 4 to 6 mm in length. The anterior end is swollen.	infested animals. Depression, loss of appetite, loss of weight, and lack of growth are also symptoms.		control along with proper anthelmintics.	
Hookworm (Bunostomum trigonocephalum)	Anterior end is bent toward its back. The mouth is cup-shaped and has two cutting plates. Males are 12-17 mm long; females are 19-26 mm.	Can cause anemia, edema, and general unthriftiness. Symptoms are generally similar to those of the stomach worm. Adult worms attach to the intestinal wall and suck blood. Bleeding often continues even after the parasite is gone.	Universal; heaviest infestations in warm, moist climate of southern U.S.	Maintain well drained pastures and manage manure properly. Treat infected animals with proper anthelmintics.	Strongyle-type eggs appear in feces, but may be scarce. Animals become unthrifty when infected causing large economic losses.
Intestinal threadworm (Strongyloides papillosus)	Only the female is parasitic. They are small, threadlike worms that measure up to 6 mm long.	Site of infection is the small intestine. Can cause erosion of the intestinal lining and diarrhea. Loss of appetite can occur along with bloody diarrhea. If entry is gained through the skin, intensive itching can occur.	Universal; especially in warm, humid climates.	Administer proper anthelmintics and keep animals in clean, dry areas.	This parasite enters animals through ingestion or skin penetration. Entry through the feet can predispose animals to foot rot.
Liver fluke (Fasciola	Flattened, leaf-	A pot-bellied condition might	Much the	Anthelmintic	Death may occur with heavy infestation

hepatica)	like brown worm.	appear. This is caused by escaped fluids from damaged liver into the body cavity.	same pattern as occurs in cattle; southeastern states along the Gulf, California, northwestern U.S. and on irrigated pastures.	treatment followed by good feeding program. Animals should be removed from infested ground. Wet pastures should be avoided.	without apparent symptoms. Infection c be transmitted to offspring.
Lungworm (Dictyocaulus filaria)	White with a dark line running the full length of the worm. Length of males are 3 to 8 cm and females range from 5 to 10 cm.	Accumulation of adult worms and eggs can occur in the airways and cause obstruction. This can cause the lung tissue to collapse. Suffocation can then occur. Animals can show a symptoms by coughing and having difficulty breathing.	Universal; most prominent in warm, moist areas.	Proper pasture management is important, keeping animals away from infected areas. In addition, proper anthelmintics should	Serious losses can occur. Pneumonia ca develop from secondary bacterial infection.

				be administered. Vaccination against Dictyocaulus is effective.	
Nodular worm (Oesophagostomum spp.)	White worm with a narrowed front end. Adults measure up to 20 mm long.	Found in the cecum and colon. Larvae burrow into the wall of the gut anywhere from the stomach to the rectum. From there they enter the large intestine. Cause diarrhea. Animals might go off feed; eaten feed is often poorly digested and absorbed.	Universal; mostly in central, southern and eastern U.S.	Proper pasture management and use of anthelmintics.	Ingestion of the third-stage larvae produces infection. Wool and meat production are impaired. If nodules rupture in the abdominal cavity, infection can result in death. Damage is caused to the intestines, making them unsatisfactory for use in making sausage. This is a significant loss.
Stomach hair worm or bankrupt worm (Trichostrongylus axei)	The adult worm measures only 0.5 cm and is hair-like.	The adult worm can penetrate the lining of the abomasum. Wart-like swellings may occur in these areas and cause diarrhea.	Universal	Reduce populations of infective larvae on pastures.	Serious weight loss can occur along wit Poor weight gain. Young animals are most susceptible.
Stomach worm, wire worm, twisted barber-pole worm (Haemonchus contortus)	Measure 10 to 30 mm long. Females have white ovaries wound	Cases that are not fatal produce weakness in animals. Anemia is the most pronounced problem. Other problems include edema (bottle-jaw) and wool breaks. The	Universal; Incidence is greatest in warm, wet areas.	Self-immunity can occur. Use recommended anthelmintics	This parasite problem precludes profitable sheep production in southwestern U.S. Young animals are apt to die from

	spirally around the red intestine giving a barber-pole appearance. Males are completely red.	parasite punctures blood vessels in the stomach wall and feeds on the blood that is released.		for control. Pastures should be rotated on two-week intervals.	infestations. Death can occur while animals appear to be in good health.
Tapeworm (Moniezia expansa and Thysanoma actinoides)	Length may be up to 600 cm. They are long, flat and ribbon-like in appearance. The body of the adult consists of hundreds of segments which are essentially egg-filled (gravid) sacs (proglottid) that break off and pass	There are no specific symptoms but infestation can cause loss of weight and poor wool production. Proglottid resembling cooked rice grains sometimes appear in feces of infested animals.	Universal; young animals are more susceptible than adults.	Proper anthelmintics and pasture management. There is an apparent acquired immunity in animals over one year of age.	The major concern with this parasite is that it robs the host of nutrients.

	into the feces.				
Thread-necked strongyle (Nematodirus spp.)	Body is long and thin measuring from 10 to 30 mm in length. The head is larger than the tail end.	Diarrhea and dehydration occur. Loss of appetite and weight may occur.	Universal	Pasture management and anthelmintics control this parasite.	Both larvae and eggs are resistant to extreme cold.
Lice (Linognathus spp.)	Wingless with sucking mouthparts. The head is long and narrow.	Mostly found on the legs and feet where the animal is free of hair. Infested animals go off feed. Wool and growth are inhibited. Scratching can cause wool breaks. Signs of infestations can be matted or cotted fleece.	Universal	Insecticides on the animals. If animals are confined, the building can be fumigated.	Causes economic loss in lack of growth and poor wool quality.
Mites (Psoroptes communis ovis)	Circular in shape and very small. All its legs project beyond its body.	Locate in heavily wooled areas such as the shoulders, sides, and back. Causes loss of weight, wool loss and death in severe cases. Infested animals show signs of rubbing and eventually have raw skin exposed.	Universal; only found sporadically in the U.S.	Dipping, spraying, jetting, etc., with proper chemicals are most effective. Entire flock must be	Highly contagious causing rapid spread

				done at the same time.	
Nose or nasal bot (Oestrus ovis)	The grayish-brown adult flies measure 12 mm in length. Young larvae are nearly white in color and develop dark transverse bands on their upper surface as they mature. They reach 3 cm in length.	Adult flies deposit larvae around the nostrils of the host (sheep) which then crawl into the nasal and frontal sinuses. The full-grown larvae crawl out of the nose and pupate on the ground. Infested sheep show unthriftiness, loss of appetite, nasal irritation and discharge, and sneezing. The flies are often difficult to detect unless the sheep dies.	Universal	Oral doses of systemic insecticides or fumigation.	A complication that can result from infestations of the nose bot is migration of the larvae through the skull where it injures the brain, causing neural incoordination and other nervous disorders.
Sheep ked (Melophagus ovinus) (Often mistakenly called a sheep tick [8 legs], actually a	Hairy, bloodsucking, wingless fly that measures 4 to 6 mm	Infested animals show a marked reduction in condition along with biting and scratching. The wool also becomes stained by ked feces. Most infestations occur on	Universal; Infestations are generally worse in	Dips and sprays can be used effectively. Treatment of	Poorly managed animals are more apt to become infested. These parasites spend their entire life on the animal.

wingless fly [6 legs].)	long. The legs are strong and have claws at the end.	the neck, shoulders and belly. As the sheep rub the fleece becomes damaged. A raised blemish on the pelt known as “cockle” can occur reducing the value of the pelt.	winter months and the cooler climates.	infested animals should be given after shearing since shorn sheep offer little protection to the sheep ked. One application of insecticide per year should be adequate.	
Wool maggots (Chrysomyia spp., Lucillia sericata)	Blowflies are 8 to 10 mm long and bluish-green in color.	Attach to sheep having open sores, dirty wool from lambing, or wool soiled from urine or feces. The flies lay their eggs in these dampened and dirty areas. Maggots hatch and begin to feed. Infested sheep will lay along fence lines or in shaded areas. When forced to move they will kick the hind legs showing irritation.	Universal; mostly in the Pacific Northwest, the South, and Southwest.	Wool around infested areas should be shorn. Treatment can then be administered.	Open sores infested by the maggots may become infected with bacteria Causing animals to die. It is a severe problem economically.

		Production is lowered.			