Lungworms in Sheep and Goats

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THE thread lungworm (*Dictyocaulus filaria*), the hair lungworm (*Muellerius capillaris*), and the red lungworm (*Protostrongylus rufescens*) are serious parasites of sheep and goats in the United States. The first two species are widespread. The red lungworm occurs sporadically.

The thread lungworm causes more sickness and death than the other two species. Lambs and kids seem to be more susceptible to it than older animals are. Some mature sheep and goats acquire resistance to it after recovery from an attack, and others apparently have a natural resistance to it. In sections where the thread lungworm is a disease factor, the use of naturally resistant animals for breeding may be desirable.

Lambs less than 6 months old usually do not have serious infections of hair lungworm.

THREAD LUNGWORMS are white, up to 4 inches long, and as thick as coarse thread. When the air passages of the lungs of infected animals are opened at autopsy soon after death, the worms can be seen wriggling about.

The female worms deposit their eggs in the lungs, where they hatch. The larvae are coughed up or carried up in mucus, swallowed, and passed onto the pasture with the droppings.

After about a week's development on the ground, if temperature and moisture are favorable, the larvae reach the stage that is infective to the host.

Low temperatures delay development. Drying destroys the preinfective larvae. The infective larvae are more resistant to unfavorable influences and many remain viable on pastures for at least several weeks.

In favorable conditions the larvae migrate onto herbage and are swallowed by grazing sheep and goats. The larvae also may be swallowed with water. Once they get to the intestine, they penetrate its delicate membrane, enter the lymph system, and reach the abdominal lymph glands, where further development occurs.

About a week after infection, the young worms are carried by the blood stream to the lungs. Prenatal infection of lambs may occur when the larvae migrate from the placental blood vessels of the ewe into the blood vessels of the fetus. The larvae migrate in the lungs from the blood vessels to the air passages. They are still small at this time; they develop to maturity while they are in the lungs. The worms reach fertile maturity, and the new generation of larvae they produce is usually first found on the droppings about 5 weeks after infection.

The irritation of the mucous membrane of the air passages by the worms produces an inflammation, which may cause excessive amounts of a watery, straw-colored fluid and of mucus to form. The mucus and fluid sometimes contain traces of blood. Pus also forms. In massive infections, the air passages may be packed with worms. This blockage at times causes death by suffocation. The accumulation of worms and fluid in the lungs and drainage into the air spaces also may result in the partial blocking of the air passages. Breathing becomes difficult and noisy.

Coughing may begin 17 days after infection. The cough is usually strong and harsh in light infections, but in heavy infections it may be soft or absent. If the animal does not succeed in expelling the worms and fluid, affected areas of lung tissue collapse, become consolidated and of fleshy consistency, and sometimes atrophy. Con-

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siderable portions of the lungs may thus be rendered functionless. To get enough air, the animal breathes rapidly and sometimes keeps its mouth open and its neck extended.

Marked coughing may result in emphysema, the enlargement, and at times rupture, of some of the remaining functional alveoli, or air cells. The animal becomes weak, is not inclined to feed, and loses weight. The condition may lead to extensive pneumonia, sometimes complicated by the invasion of the tissues by bacteria, and death. Because the blood has too little oxygen, the skin often becomes blue just before death.

THE HAIR LUNGWORM is one-half inch to 1 inch long and as thick as a fine hair. It occurs embedded in the tissues of the lungs and is easily overlooked in casual postmortem examination. The presence of the worms is frequently indicated by slightly raised, yellowish-gray or greenish-gray areas, about one-fourth inch to 1 inch in diameter, on the surface of the lung. The deeper lesions are detected less readily. The lesions contain adults, eggs, larvae, and usually dead tissue and pus.

The eggs are deposited in the lungs and the larvae reach the pasture in the same way as thread lungworm larvae.

Unlike the thread lungworm, the hair lungworm does not have a direct life history—an intermediate host is required. The larva must enter the tissues of any of several different species of small land snails and slugs, where it develops in about 2 weeks to the stage that is infective to the final host. It may remain viable in the intermediate host for many months, and infection of the final host occurs when the snail or slug is swallowed by the grazing animal. The larvae are released in the process of digestion and reach the lungs in the same manner as the thread lungworm. The worms develop to maturity and their larvae are usually first recoverable from the droppings about 6 weeks after infection.

Although symptoms are not marked, the worms cause the destruction of lung tissue. The lungs are permeated in severe infections with nodular lesions, which result from the body's attempts to wall off affected tissue and parasites by surrounding them with fibrous connective tissue. The infection results in a catarrhal lobular pneumonic condition, contributes to the debilitation of the animal, and opens the way for invasion by bacteria.

THE RED LUNGWORM is reddish, about 1 inch to 2.5 inches long, and as thick as a hair. Usually it occurs in the medium and smaller air passages.

Its life history is like that of the hair lungworm. It seems to require a longer period and warmer conditions during the development of its larval stages than the other species of lungworms. Unlike the hair lungworm, it can use only a few species of snails as intermediate hosts. Such factors may account for its sporadic distribution.

Symptoms are usually not marked in animals infected with the red lungworm. When the worms are present in considerable numbers, they may cause pathological conditions similar to those produced by the thread lungworm.

Diagnosis of lungworm infections often can be made readily by floating a few fresh droppings in a small amount of water and examining the water for larvae, after about 15 minutes, with a dissecting microscope. The larvae occur in the mucous layer surrounding the pellets and migrate into the water. Lungworm larvae are the only kinds that may occur in fresh droppings of sheep and goats.

THE LARVA of the thread lungworm, the largest of the lungworm larvae, has a cuticular knob at the anterior end of the body and a blunt tail.

The larva of the hair lungworm, the smallest of the three species, has a sinuous, sharply pointed tail with a short, dorsal, subterminal cuticular spine.

The larva of the red lungworm is intermediate in size. It has a sharply pointed, straight tail.

No satisfactory medicinal treatment for the destruction of thread lungworms is known. Inhalants and intratracheal injections of various drugs have been tried, but frequently they are more injurious than beneficial to the host and they are hard to give.

The hair lungworm can be killed by an intramuscular injection of emetine hydrochloride, but such a treatment should be administered by a veterinarian. Emetine hydrochloride is a potent drug, and an overdose may result in serious damage or death. Care must be used to keep it from contact with the eyes, as it is highly irritant. It should not be used near shearing time because it may cause sheep to shed.

Preventing infection is the best means of combating lungworms. The general measures recommended for keeping livestock healthy apply.

The following measures are especially important in minimizing lungworm infection. The use of wet areas for pastures should be avoided as they are favorable habitats for the development of the thread lungworm larva and the intermediate hosts of the hair lungworm and the red lungworm.

It is desirable to rotate animals to clean pastures whenever practicable.

The use of dry feed, in racks designed to prevent contamination with droppings, and uncontaminated water will minimize the acquisition of parasites.

Sick animals and heavily infected ones should be kept from contaminating pastures with their droppings. They should be removed to dry lots to prevent additional infection with lungworms.

An adequate diet, and removal of gastrointestinal parasites by anthelmintics, remedies for worm infections, are deemed to be of considerable value in building up the vigor of the animal and consequently counteracting the effects of lungworm infection.

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Scabies in Sheep and Goats

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FIVE KINDS of parasitic mites cause scabies, or scab, in sheep and goats.

Common scabies, or psoroptic scabies, is highly contagious to all classes of sheep. It is transmitted readily and quickly from one animal to another by direct contact.

It is caused by tiny, ovoid, pearl-white mites, *Psoroptes equi* var. *ovis*. The female mite is about one-fortieth of an inch long. A hand lens should be used when one examines infested animals for the mites. The adults have four pairs of brownish legs and sharp, pointed, brownish mouth parts.

The mites live on blood serum that oozes from skin punctures, which the mites make with their sharp mouth parts. Into the tiny wounds they probably secrete a poisonous substance. Bluish-red, inflamed, swollen areas surround the puntures. The serum on the skin becomes mixed with debris, which soon dries, hardens, and forms a crust, or scab. As the lesion develops, the skin becomes thickened, hard, and wrinkled. It might crack and bleed when it is manipulated with the fingers. The uniformly thickened condition of the diseased skin is readily