# Sustainable Parasite Control for Sheep and Goats

MISSISSIPPI STATE UNIVERSITY™ EXTENSION

One of the main drawbacks in small ruminant production systems worldwide is gastrointestinal nematode (GIN) infections. The lack of options for controlling GIN is mainly a result of increasing resistance these parasites have developed in the last decades. This has caused economic losses to farmers with grazing production systems.

Since 2001, GIN infection was the most prevalent disease, reported by 74 percent of the U.S. farmers surveyed in a National Animal Health Monitoring System study (USDA, 2003). According to the 2021 Census of Agriculture, U.S. producers have 5,170,000 sheep and 2,582,000 goats (USDA, 2021). In the last decades, these numbers have decreased annually. Studies are needed to determine if parasite resistance to commercial anthelmintics is a factor in this decrease.

## Gastrointestinal Nematode Life Cycle

Most GINs that affect sheep and goats have a direct life cycle, meaning they pass from the environment directly to the final host, without using an intermediary one. Thus, the host (sheep or goat) has adult male and female nematodes in its gastrointestinal tract that mate, allowing female worms to begin excreting eggs.

Figure 1 shows that these eggs are excreted from the animal's feces into the environment, where the soil humidity, temperature, and other weather conditions provide the perfect microenvironment for the eggs to hatch. During spring, summer, and autumn, environmental conditions favor egg hatching and stage 1, 2, and 3 larvae development. During winter, conditions are less adequate for all life stages.

When the eggs hatch, the L1 larvae are produced and develop into L2 larvae inside the feces, using bacteria as a food source. A second molt allows them to develop into L3 larvae (infective larvae) and migrate outside the feces, spreading into the pastures. When animals feed on forages, they ingest these L3s, and the cycle begins again.

L3 larvae are present in greater proportion in the lower strata of the grassland, and their survival and dissemination are favored by the presence of rains and the low intensity of sunlight (Silva et al., 2008). Environmental conditions also affect the length of the life cycle—from 7 to 21 days—depending on parasitic genera and favorable weather.

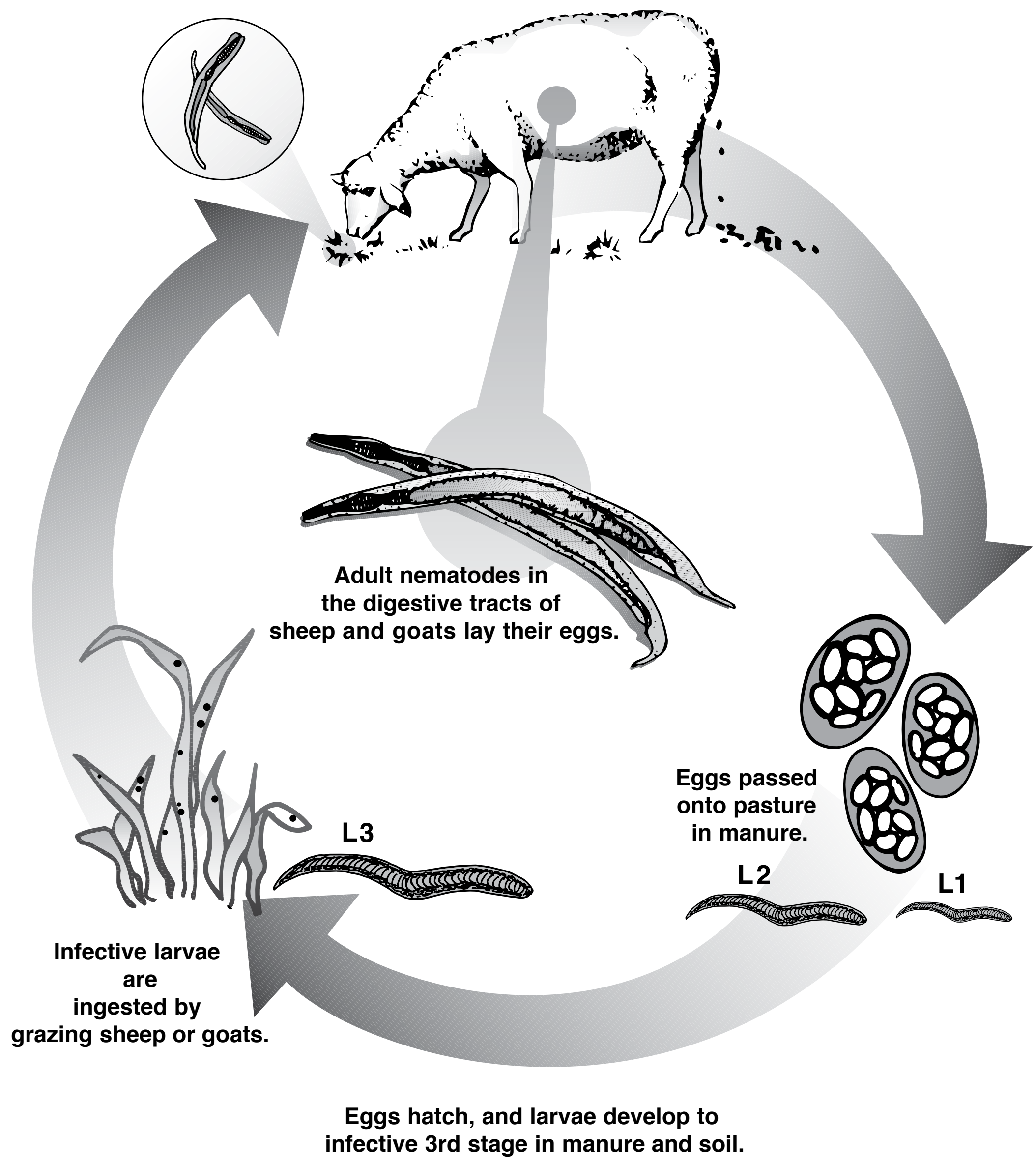


Figure 1. The direct life cycle of gastrointestinal nematodes that most commonly affect sheep and goats. Modified from Whittier et al. (2009).

## Most Common Symptoms of Parasitized Animals

The GINs that most commonly affect sheep and goats are *Haemonchus contortus* (barberpole worm) and *Teladorsagia circumcincta* (brown stomach worm), both found in the final stomach compartment or abomasum, and *Trichostrongylus colubriformis* (bankrupt worm or black scour worm), found in the small intestine (Taylor et al., 2007).

Common signs of gastrointestinal parasitism in both sheep and goats are weakness, loss of weight and body condition, bristly hair, submandibular edema, and anemia (Taylor et al., 2007). There are specific clinical signs for the different parasitic genera. In the case of *T. colubriformis*, signs can be confused with malnutrition, starting with reduced intake, low growth rate, and soft feces; as the infestation increases, diarrhea becomes dark, and severe weight loss and even death can occur. With *T. circumcincta*, signs are similar, including decreased intake and loss of body weight; diarrhea is not always observed. Severe anemia is the main sign of *H. contortus*. After 2 weeks of infection, an average of 5,000 nematodes per sheep can consume approximately 250 milliliters of blood each day, resulting in a significant reduction in red blood cells.

The animals most affected by GIN will be those that have the largest worm burdens and at the same time face malnutrition in terms of quantity and quality. This could be more common in weaned animals and ewes around parturition and lactation.

## Types of Dewormers

Pharmaceutical laboratories have three families of dewormers:

1. Benzimidazole: fenbendazole (Safeguard, Panacur) and albendazole (Valbazen)
2. Levamisole: levisol, tramisol, and morantel tartrate (Rumatel)
3. Macrolytic lactones: ivermectin (Ivomec) and moxidectin (Cydectin)

In the United States, only fenbendazole, albendazole, and morantel tartrate have been approved for use in small ruminants. The other dewormers can be prescribed only by a veterinarian for "extra-label" use. For sheep, the American Consortium for Small Ruminant Parasite Control (ACSRPC) recommends Valbazen (oral albendazole), SafeGuard (oral fenbendazole), Ivomec (oral ivermectin), Prohibit (oral levamisole), and Cydectin (oral moxidectin) (Kaplan, 2014a). For goats, ACSRPC recommends Valbazen (oral albendazole), SafeGuard (oral fenbendazole), Ivomec (oral ivermectin), Prohibit (oral levamisole), Cydectin (oral moxidectin), and Rumatel (morantel in the oral premix) (Kaplan, 2014b). Check for updates on these recommendations at ***https://www.wormx.info/***.

## Sustainable Practices for Parasite Control

Approximately 60 years ago, the first commercial veterinary dewormer, called Thiabendazole, was produced (Abongwa et al., 2017). It took only 3 years for the first case of parasite resistance to be reported (Drudge et al., 1964; Sangster et al., 2018).

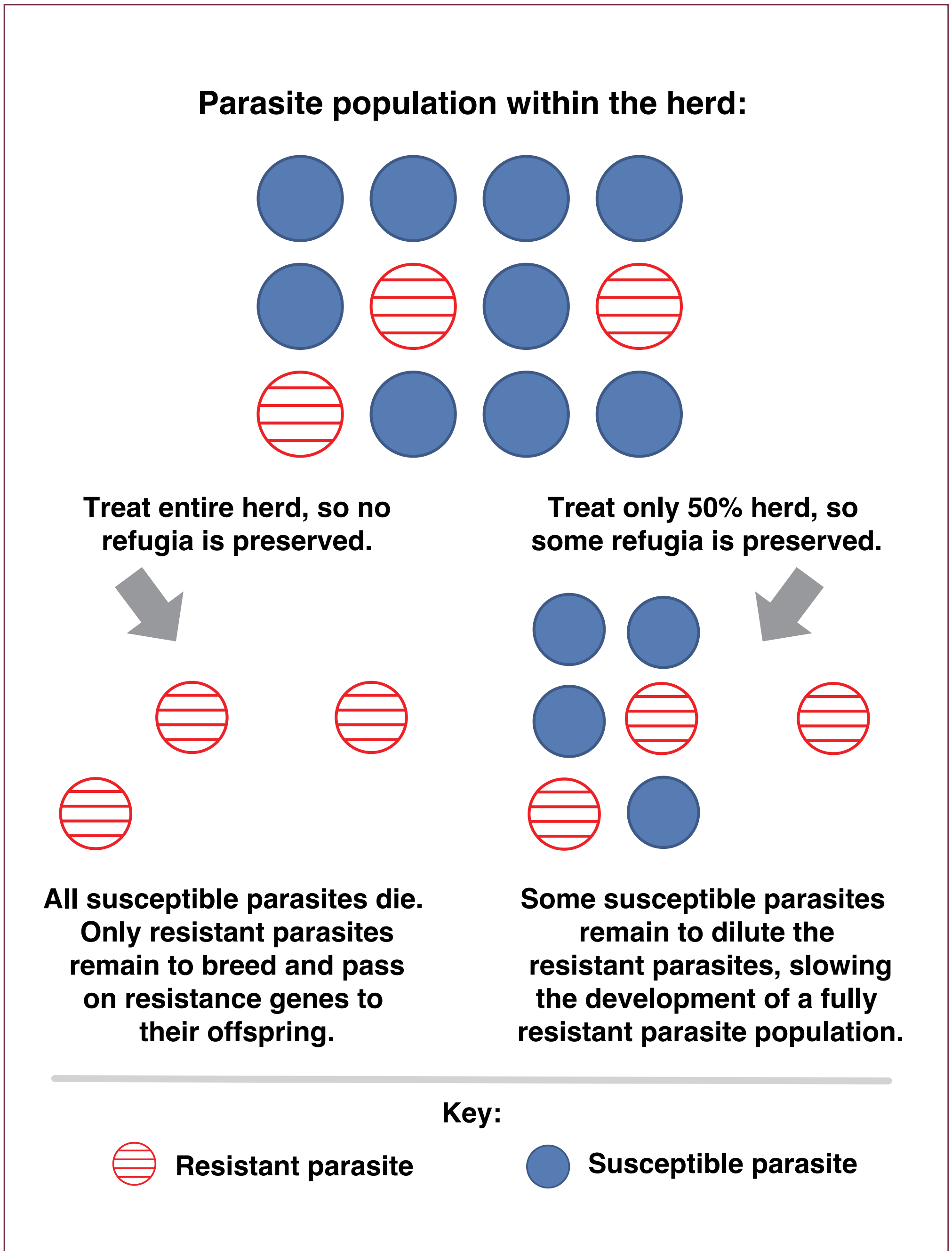


Figure 2. Importance of preserving refugia of the parasitic population in animals. Adapted from FDA Center for Veterinary Medicine (n.d.).

Parasite resistance is a worldwide problem and, therefore, scientists around the world are looking for alternatives.

Sustainable parasite control usually refers to using alternatives that prevent resistance and minimize disease and production losses (Besier, 2012). Integrated parasite control combines traditional control with alternatives that do not depend exclusively on commercial anthelmintics. Visual indicators and other control measures are used to space chemical deworming and, thus, reduce resistance to commercial chemical compounds (Kahn & Woodgate, 2012). The goal is to maintain *refugia*, which is a part of the parasite population that is protected from exposure to commercial anthelmintics so it does not become resistant. Refugia is achieved by not deworming all the animals (see Figure 2).

## Estimating the Parasitic Burden of Animals

Counting nematode eggs in the animal's feces (number of eggs per gram of feces, or EPG) is used to indirectly estimate the parasitic population. This estimation is made using the McMaster technique, which mixes feces (taken directly from the animal's rectal ampoule) with a saturated solution of sugar or salt (called Sheather's solution). This mixture is placed into a McMaster slide, where the eggs from GIN will float and can be counted (RVC, 2021).

## Indicators of Parasitism

Figure 3 shows the Five-Point Check, developed by Bath and van Wyk (2009), summarizing other indicators of parasitism. These indicators are important when deciding whether to deworm an animal in targeted selective treatment (TST).

1. Nasal discharge: Even when it is not an indicator of nematode infection, the clear or purulent nasal discharge can be caused by *Oestrus ovis* (a nasal parasite that has a fly as a vector). In addition to affecting the welfare of the animals, this infection can lead to immunosuppression and bacterial infections.
2. Ocular mucosa: Trained individuals can examine the eyes for signs of anemia. Developed in South Africa in 1990, the FAMACHA chart is used as an indirect measure of anemia caused by the hematophagous parasite *H. contortus* (ACSRPC, 2021). For more information, see ***https://www.wormx.info/***.
3. Submandibular edema: This edema is a typical indicator of hypoproteinemia (low levels of protein in the blood) caused by GIN parasitism.
4. Body condition score (BCS): Body condition scoring is determined through observation and palpation of the back and sides of the animal. This assessment typically uses a scale from 1 to 5 (Figure 4).
5. Dag score: This scale measures the level of feces or diarrhea that accumulates on the rear end of animals.

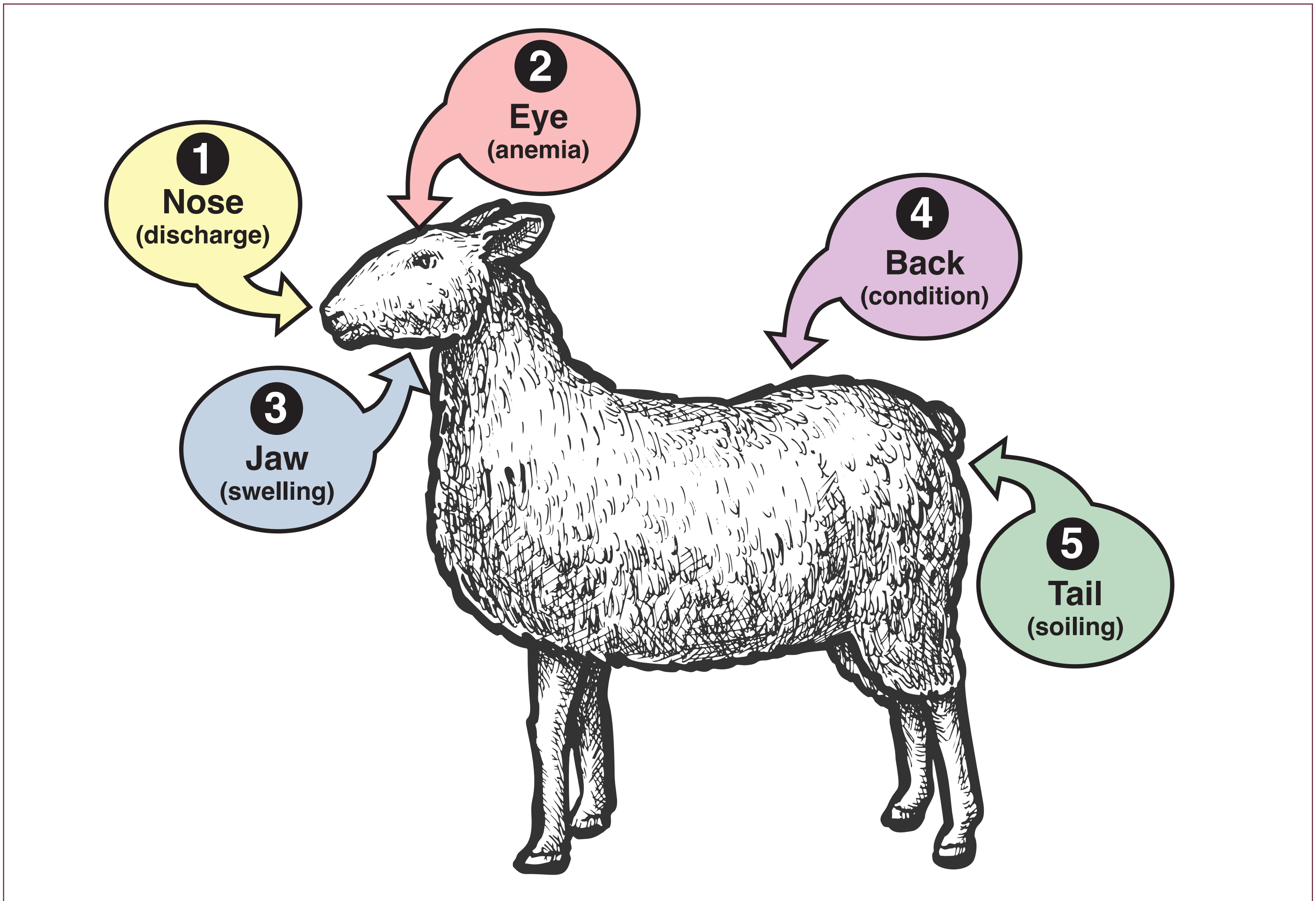


Figure 3. Five-Point Check indicators. Adapted from Bath and van Wyk (2009).

Body condition score and dag score are subjective. For consistency in scoring, the same person should evaluate animals each time.

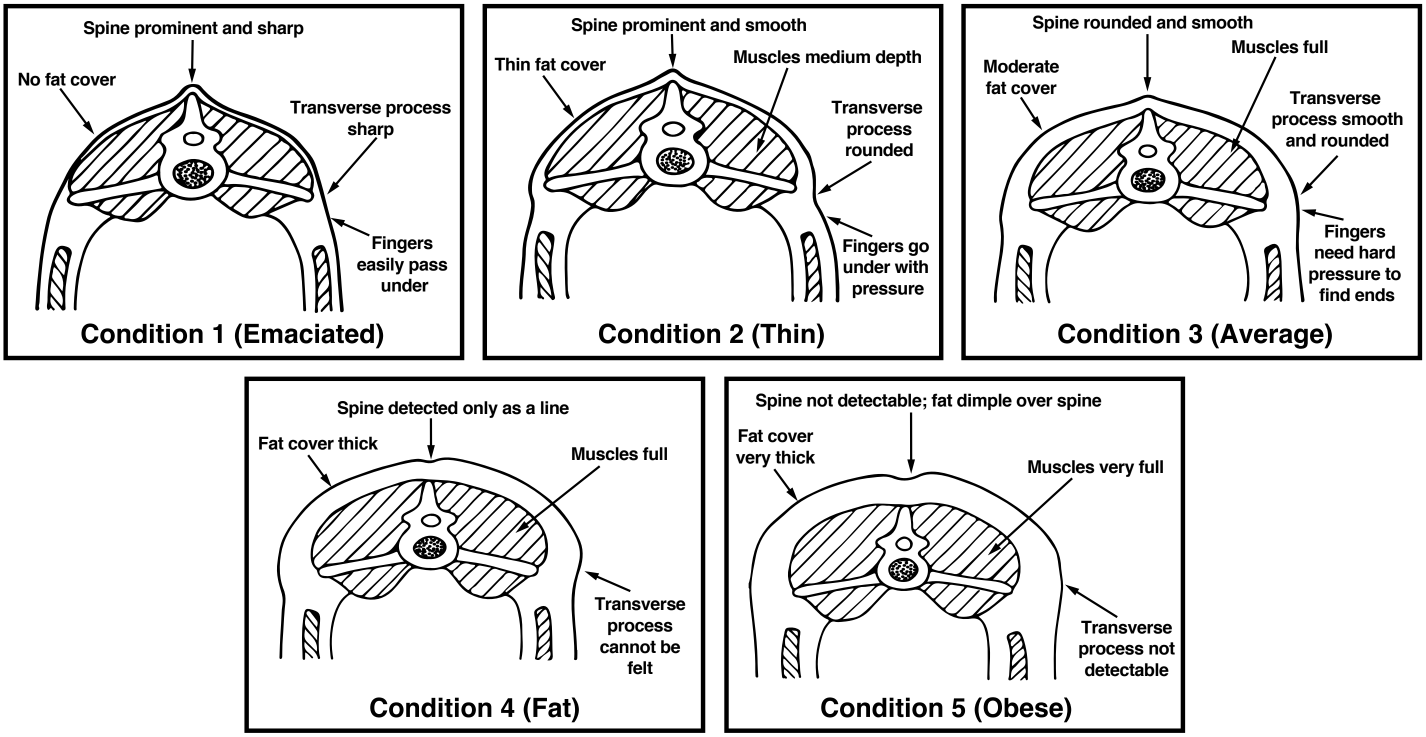


Figure 4. Body condition scale for small ruminants. Used with permission from Thompson and Meyer (1994).

## Alternative Practices for Parasite Control

Two kinds of practices can be included in a sustainable parasite control program: those that help control the parasite burden in the animal/host and those that help reduce infective L3 larvae from the pasture.

## Control at the Animal Level

**Selection/culling:** Select the most productive and parasite-resistant animals to keep in the herd, and cull those that require constant deworming or that permanently present high parasitic loads. Consider culling older animals, which develop teeth problems that affect their intake and compromise their immunity, making them more susceptible to nematodes.

**Parasite-resistant breeds:** Some sheep and goat breeds tend to be more tolerant to parasitism and, despite their parasite load, grow and reproduce properly. For example, St. Croix and Katahdin were found to have a higher resistance to parasitism than other hair sheep breeds (Burke & Miller, 2004).

**Selective deworming or targeted selective treatment (TST):** Use indicators to maintain refugia, deworming only those animals that require it. However, it is important to deworm animals that have compromised immunity (near weaning and peripartum), as well as new animals coming into the herd. Some indicators that can be used for TST or selective deworming are fecal analysis (1,000 EPG or above), FAMACHA score (4 and 5), and BCS score (lower than 3). Use any of these indicators or a combination of indicators.

**Strategic supplementation:** The relationship between adequate nutrition and an animal's level of immunity to diseases is well known. Animals must receive a proper diet, especially during the growth and reproduction stages.

**Alternative treatments:** In goats, intraruminal copper particles, also called copper oxide wire particles (COWP) or copper needles, can be very effective. These can be applied as boluses every 3 months in adult and young goats (Vatta et al., 2012). Farmer experience indicates that applications every 6 months are effective. COWP is effective only against *H. contortus* and *T. circumcincta* (in some cases). It can be used in sheep only on farms with copper-deficient soils. See ***www.wormx.info*** for more information.

## Control at the Grazing Level

**Adequate paddock rotation/rest periods:** Allow enough time between groups of animals to prevent the larvae of the first group of animals from infecting the next group. An adequate resting period varies according to the weather and time of year. The life span of L3s in the grass is 21 days in tropical conditions and up to 6 or more months in temperate conditions.

**Graze young/low-immunity animals in "clean" paddocks or pastures** that have not been grazed previously by contaminated adult animals.

**Avoid overgrazing:** The life cycle of the GIN indicates that most L3s will be in the lowest part of the forages, near the soil and feces. When animals overgraze paddocks, they eat closer to the lower strata of the biomass, where there is a greater possibility of L3 contamination. Adjust stocking rate to paddock size to have enough biomass during the grazing period.

**Use bioactive forages or plants containing secondary metabolites:** These plant metabolites (tannins, saponins, lectins, and others) can have an anthelmintic effect on animals and decrease their parasitic loads.

**Use multispecies paddocks:** Animals can select an appropriate diet that allows them to better cover their nutritional requirements, and better-fed animals are more able to resist parasitism.

**Use plants of different heights:** This allows animals (mainly goats) to alternate grazing with browsing and avoid the most contaminated pasture strata.

**Use mixed animal species grazing:** Grazing sheep and goats with other species, such as cattle and horses, decreases the levels of infective larvae in grazing areas. After sheep or goats finish grazing, cattle or horses can act as "vacuum cleaners" of L3 larvae, lowering the chance of infection in small ruminants. Sheep and goats are top grazers that prefer the upper, immature parts of forages.

**Alternative treatments:** A new option is to use nematophagous fungi (*Duddingtonia flagrans*, BioWorma®), a nematode-trapping or predatory fungi that traps and kills larvae in the feces, avoiding contamination of pastures and animals.

## Summary

Parasite resistance leaves very few options for farmers who rely only on traditional deworming with commercial anthelmintics. To minimize the progress of parasite resistance in sheep and goat herds, more holistic and sustainable approaches are needed, reducing the effect of GIN on animals and the spread of larvae in grazing areas.

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