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Parasite control for cattle and small ruminants – a discussion of the common internal and external parasites and methods of controlling disease year to year.

Introduction:

Parasite control in livestock has evolved over the last decades as over use of anthelmintics has lead to development of parasite resistance. This has created challenges in animal welfare and production. This seminar is a review of the current strategies for parasite control on farm.

Learning objectives:
Understand nematode life cycle
Be able to advise clients on strategic parasite management
Understand how anthelmintic resistance develops

Internal parasites cause the livestock industry about $3 billion in annual losses.
Parasite management in the US livestock systems has relied heavily on the use of anthelmintics. When macrocyclic lactones (ML) entered the market in 1981 with ivermectin, consumers narrowed their drug use due to high efficacy against a broad range of internal and external parasites. Other chemical classes like benzimidazoles and imidathiazoles lost market share. The introduction of topical ML formulations increased convenience and lowered labor cost of treatment. Consumer demand restricted anthelmintic use to a single class, with a strong preference for convenient routes of administration, resulting in parasite control being reduced to a recipe and a scheduled appointment on the farm calendar.
Industry-wide dependence on potency and spectrum of a single class of chemicals, along with complacent adoption of rote programs, lead to conditions for a perfect parasite storm (McArthur et al 2014).

The parasite:

The most common family of parasites found in grazing cattle are Trichostrongyloidea that produce an oval egg with a thin shell filled with multiple blastomeres. The four genera identified in cattle are; *Haemonchus*, *Ostertagia*, *Trichostrongylus* and *Cooperia*. Not uncommonly species of *Nematodirus* can be found temporarily high in young calves in Northern regions. These have a distinctive egg that is much larger and is reported separately. (Hildreth et al 2020). It is not possible to differentiate the 4 trichostrongyle genera based on egg morphology so they are counted together or identified by adults in necropsy samples.
The trichostrongyle nematodes have a direct life cycle with 4 free living stages (egg, first-, second-, third-larval stages) in the pasture and two parasitic stages (fourth-larval and adult stage) in the hosts abomasum. L3 can survive for extended periods on pasture and some species can overwinter as L3s in the soil. For most economically important trichostrongyles in cattle, L4s are able to arrest their development in the wall of the abomasum and remain in a hypobiotic state for extended periods.

The climate and weather play and important role in parasite loads on pasture. Warm, wet conditions lead to rapid development of infective larvae and high survival rates. In Northern climates overwintered L3s average survival half-life was 15 days (Hildreth et al 2020). The rate of decline depends on the general temperature and moisture levels of the region and on available microhabitats present in pastures, making survival times vary year to year. The depressed metabolic rate of the arrested L4s make them less susceptible to anthelmintics. Therefore reduced efficacy of anthelmintics caused by resistance is seen first in the L4 stage. MLs also show some persistence against incoming L3s that ranged from 14-35 days. As resistance develops, persistency is lost. Strategic spring-time deworming programs are designed to attack the gastrointestinal nematode life cycle during its weakest period, using anthelmintics with persistent efficacies that are long enough to permit significant natural die-off of pasture-wintered L3.

Anthelmintic resistance:
Positive selection occurs when worms carrying resistant alleles are exposed to an anthelmintic to which they have lost their susceptibility. Individual nematodes that survive an anthelmintic treatment are afforded transient reproductive advantage in the absence of competition by susceptible worms in the alimentary environment.
Frequency of treatment is also potent selector. If a resistant-prone drug is used often, especially at intervals shorter than the egg reappearance period of the target parasite, susceptible genotypes will never have the opportunity to reproduce. Thus, the entire population may arise from resistant worms.
Refugia: ‘The solution to pollution is dilution’.
Refugia is any subpopulation of parasites that is not exposed to an anthelmintic at the time of treatment. This includes larval stages in the environment, parasites of herd members that were not treated contemporaneously, and parasitic stages within the animal that are not exposed to the treatment due to physiologic or pharmacokinetic factors. Refugia provides a source of susceptible worms to mate resistant worms and thus dilute their genes. (McArthur 2014)
From the second grazing season onwards, cattle usually develop significant immunity to gastrointestinal nematodes and have minimal parasite control requirements. Leaving these animals untreated provides a source of potential refugia. Therefore, using these cattle to ‘seed’ the pastures with untreated eggs or commingling with weaned calves would help maintain susceptible parasites in all age groups when cattle are segregated by class. It is estimated that within a herd, 20 % of cattle harbor 80% of internal parasite infections due to differences in immune status and genetics.
Producers are resistant to change. ‘If it ain’t broke, don’t fix it;. 2010 NAHMS report (USDA 2010) found less than 1% farmers administered dewormers based on fecal testing. Further, more than 85% of beef producers surveyed dewormed by schedule rather than using diagnostic indicators like fecal egg counts or weight gains. In addition, generic macrocyclic lactone formulations have encouraged rote treatment since they are less expensive than selective monitoring.

Selective deworming can be based on a hierarchy of need. For beef farms, the greatest needs are for stocker cattle and replacement heifers, followed by herd bulls, then suckling calves and lastly brood cows. For dairy, replacement heifers have priority, weaned calves raised on pasture, and adult cows. Cattle raised totally in confinement have minimal need for anthelmintic treatment, so feedlot calves will not have nematodes if effectively dewormed at arrival (McArthur 2016).

Macrocyclic lactones are a broad-spectrum anthelmintic, which when initially used in a herd is effective, but with repeated use resistance developed decreasing effectiveness. When used in combination with a benzimidazole (oxfendazole) Hernandez et al (2022) found that the treated calves did better as far as growth, reduced FEC and value ($$) compared to calves treated with individual anthelmintics or nothing.

Animal nutrition is important for prevention of all disease, including production losses and mortality associated with parasites. Pastures that have not been grazed in order to harvest hay, pastures grazed only by adult cows (without calves), crop residue fields, and pastures grazed by other species like sheep and goats, would have low parasite contamination and are ideal for young cattle.

Grazing management is important for reducing intake of parasites. Research has shown that 75% of the worms are in the bottom 2 inches of grass, and 90% of the worms are in the bottom 4 inches. Typically, parasite populations are reduced in extremes in weather. However, in drought times animals congregate near water or remaining grasses, creating focal areas of high contamination. A drought will also decrease the overall feed available resulting in cows grazing tufts of grass close to the ground where the higher larval concentrations are. In addition, cows are more likely to eat hay that has been trampled or defecated on if there is reduced access to feed. Keeping the feed up off the ground can help reduce contamination by feces. Removal of trampled feed may also reduce parasite exposure risk.

Condensed tannins (*sericea lespedeza*). It is believed that the consumption of legumes with condensed tannins, causes a disturbance in the biology of the worms, thus improving the health of sheep and goats. This alternate feed source can be used as part of an integrated parasite control strategy.

Copper oxide wire particles (COWP) have been used at a low dose in sheep and goats to control barbers pole worms.

Take home: There is no one-size-fits all solution to internal parasites. Historic anthelmintic use, parasite load in the pasture, and herd density all can influence which anthelmintic is cost effective.

External parasites:

Cattle are infected by horn flies, face flies, stable flies, ticks, lice and mites.

Horn flies (*Haematobia irritans*) only leave cattle to lay eggs in manure. They feed on blood all day. Treatment is recommended when horn fly numbers exceed 100 flies per animal. Cost, convenience, and herd management practices, such as grazing rotation, can be considered when designing a control program that fits best. Backrubbers allow cattle to treat themselves while loafing and scratching. Dust bags are most effective when used where cattle have to pass under them daily to get to water or mineral. Feed additives target horn fly maggots breeding in fresh animal manure. High pressure sprays can be used to treat cattle thoroughly and inexpensively on a per head basis. Insecticide-impregnated cattle ear tags release small amounts of an insecticide which are distributed over the animal during grooming or rubbing. Pour on insecticides are ready-to use formulations that are applied in measured doses to animals based upon body weight.

Face flies (*Musca autumnalis*) closely resemble house flies. Face flies cluster on the faces of cattle and feed on secretions from the mucus membranes of the eyes, nose, and lips. Face flies do not suck blood. They do irritate the surface of the eyeball and carry and spread bacteria and viruses that contribute to pinkeye problems. They spend only a small portion of their life on cattle which makes them more difficult to control than horn flies. The threshold for treatment is >15 flies per face as more than 20 flies per face have been associated with less grazing behavior and more avoidance behaviors.

Stable flies (*Stomoxys calcitrans*) feed primarily on the legs and lower abdomen of cattle. The mouth parts penetrate the skin and allow them to engorge on blood two to three times a day depending on the weather. Once full they move to a resting place, usually in the shade, to digest the blood meal. The blood loss and pain associated with the bite of stable flies results in substantial economic loss. The threshold for treatment is 5 flies per front leg.

Ticks cause blood loss, discomfort, and spread diseases like anaplasmosis. Tick control is extremely difficult in areas with high tick populations. High concentrations of ticks usually occur in brushy pastures and woodlands so habitat management is an important part of tick control. Control on cattle through persistent use of approved pesticides is achieved by spraying, dipping, ear tags, pour-ons, dust, and backrubs. A good residual insecticide is necessary to prevent infestation.

Lice cause skin irritation and itching. Both biting and sucking lice infest cattle. Infested cattle can experience reduced appetite and appear unthrifty. Lice reside entirely on the host cow. Lice are present on cattle year around but increase in numbers in winter. In spring most parasites are lost with the winter hair coat. Lice control is most important in the fall and early winter when the lice populations increase. Treat with ectoparasiticides. Macrocyclic lactones work better on the sucking than chewing lice. Treatment needs to be repeated in three weeks to kill hatching lice since most insecticides do not successfully kill eggs. Sprays and pour-ons are common methods to treat cattle lice.

Mite infestations cause Mange. These are not common but can cause hair loss and thickening of the skin. Control of mites is difficult because mites burrow into hide. Injectable products or pour-on products with systemic activity work to control mites best. As with lice, a second application is necessary in two to three weeks to kill newly hatched mites.

Control of ectoparasites.
Key management goals are habitat reduction and sanitation.
Macrocyclic lactone use for control of external parasites can result in the exposure of ticks infesting treated cattle to a sublethal dose when the macrocyclic lactone product is applied as indicated on the label for an endoparasite infection, which in this scenario will select for

resistance in that tick population. In addition, it is unlawful to use an ectoparasiticide product in a manner inconsistent with the label instructions.

Permethrins, Synthetic pyrethroids and organophosphates are commonly used in control.

The Nebraska extension has an excellent summary of available treatment options for external parasites (Boxler 2015).

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