Evaluating a novel dewormer and strategies to help control drug-resistant *Haemonchus* in sheep

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Gastrointestinal nematode parasites (GIN) can cause significant illness and death in sheep and are a common problem on sheep farms in Ontario. The most important GIN species on Canadian sheep farms are *Haemonchus contortus* (barber's pole worm), *Trichostrongylus* species (e.g. stomach hair worm) and *Teladorsagia circumcincta* (brown stomach worm).

The disease

Clinical signs in animals infected with *Trichostrongylus* and *Teladorsagia* include diarrhea, decreased appetite and poor weight gains. In contrast, *Haemonchus* is considered the most dangerous of all the gastrointestinal nematodes and can cause sudden death of animals in good body condition. This parasite consumes blood, resulting in anemia, bottle jaw, weakness, and death. Notably, however, *Haemonchus* does not cause diarrhea. Mixed infections commonly occur.

Outbreaks of *Haemonchus* are typically observed in lambs in the summer during the grazing season (Type 1 haemonchosis) and in ewes in the spring during lambing (Type 2 haemonchosis). Because the majority of *Haemonchus* larvae on pasture are unable to survive cold Ontario winters, this parasite has the ability to arrest its development while in the ewe in the fall, thus allowing it to survive the winter. During lambing and lactation, when the immunity of ewes is decreased, the dormant parasites resume development into adults; if burdens are high enough, clinical disease occurs in the ewes. During the grazing season, particularly in the spring, ewes typically contaminate the pasture with egg-laden feces; lambs develop infections through uptake of infective larvae that have developed on pasture.

Dewormers and their effectiveness in Ontario sheep

In Canada, the only dewormer approved for use in sheep is ivermectin (Ivomec), available as a drench or injectable. Benzimidazole products (fenbendazole, Safeguard; albendazole, Valbazen) are available for cattle in Canada and are often used extra label in sheep. Levamisole is no longer commercially available for livestock. Moxidectin and other macrocyclic lactones (drugs in the same class as ivermectin) are available for cattle, but none in a form suitable for use in sheep.

Recent work on sheep farms across Ontario has demonstrated resistance to ivermectin and fenbendazole in GINs on 93% (27/29) and 100% (20/20) of farms, respectively. Of particular concern, most of the observed resistance was associated with *Haemonchus*. As a result, there is an urgent need for a new dewormer on such farms. Several other dewormers are available elsewhere in the world, but not in Canada, some of which may be very useful for controlling *Haemonchus*. One of those drugs, closantel (Flukiver, Elanco Animal Health) is a narrow-spectrum drug, i.e. it only kills bloodsucking parasites such as *Haemonchus* but is not effective against other GINs.

We have recently completed the first year of a two-year field trial to determine the efficacy of closantel for treating *Haemonchus* infections that are resistant to ivermectin and fenbendazole. Preliminary

results from Ontario are encouraging; it appears that closantel is highly effective in reducing *Haemonchus* burdens in both ewes and lambs.

Delaying development of resistance to dewormers in parasites

While effective dewormers are an important tool for controlling *Haemonchus* outbreaks, it is equally important to delay the onset of parasite resistance to dewormers on sheep farms. As such, dewormers need to be used as one component of a larger management strategy. One practice that is thought to help delay resistance is "targeted selective" treatment, in which only those sheep that need treatment are treated. When the entire flock is treated with a dewormer a few parasites will survive, i.e. those that are resistant to the dewormer will continue to shed eggs and contaminate pasture, which speeds the development of drug resistance on a farm. When only a proportion of animals are treated (ideally those most at risk for disease from *Haemonchus*), the resistant parasites are diluted with susceptible parasites from untreated animals, which is thought to slow the development of resistance. As a result, another objective of this study is to determine whether "targeted selective" treatment of ewes at lambing controls *Haemonchus* as effectively as treating the entire flock. Selective treatment of ewes in our study is based on criteria thought to be risk factors for elevated fecal egg counts (e.g., low body condition score, FAMACHA scores indicating anemia, three or more lambs nursing, and ewe lambs that have grazed only one season). If "targeted selective" treatment reduces *Haemonchus* burdens as effectively as treating the entire flock, this may be a viable management tool for reducing parasite burdens, delaying the onset of drug resistance, and decreasing dewormer drug costs.

Predicting if and when *Haemonchus* is a problem

The final objective of this study involves developing a mathematical model to predict burdens of *Haemonchus* on pasture and in sheep. The model will incorporate farm management data, environmental parameters, and flock dynamics. This will help producers make decisions on when to treat and how often to treat.

The increasing severity of *Haemonchus* infections in Canada is of great concern for Canadian sheep producers. It is hoped that the outcomes of this project will help provide additional tools for producers to use in their fight against losses from drug-resistant parasites, both in the short- and long-term.

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