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ST. PAUL, MINNESOTA
UNITED STATES OF MINNESOTA

What s New for Parasite Control in Cattle

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Parasite control programs can have significant impact on dairy production, from earlier calving to improved milk production. These programs have evolved considerably over the past 10 to 15 years in North America. In the past only a few animals, other than those suffering from clinical parasitism, were treated. As producers realized the benefits of parasite control they began administering anthelmintics to coincide with other management practices. Parasite control strategies today should be formulated on the epidemiology of the parasites as well as the management practices followed in a particular area. Such control programs are designed to strategically remove helminths from the host and to prevent contamination of the pasture with nematode eggs.

Outside of the avermectin and milbemycin classes of compounds, most anthelmintics have a maximum activity period of 2 - 3 days, after which the animals are readily reinfected. For parasite control under normal management practices, strategic anthelmintic treatment should be administered before moving cattle onto pastures that were of relatively low infectivity in order to prevent or at least delay reinfection. This type of program benefits from the use of a broad spectrum anthelmintic where the majority of adult and larval nematodes, including inhibited larvae are removed.

With the introduction of the endectocides (i.e., doramectin, ivermectin, moxidectin), compounds that have extended anthelmintic activity when compared to benzimidazoles and other older anthelmintics, new control options became available. These compounds effectively prevent cattle from becoming infected for longer periods of time after administration. For example, doramectin will prevent infection with *Ostertagia ostertagi* for at least 3 weeks. This period of extended activity also has benefits in the control of external parasites, such as mites, lice and grubs.

The goal of strategic parasite control programs is to manage parasitism by regulating pasture contamination, not just removing the adults and inhibited larval stages. This period of extended activity may allow producers to better control helminths throughout the grazing season with a second treatment given at about 8 weeks after the first treatment. We do not want to totally eliminate parasites so that the animal remains immunologically naive. A program that involves retreatment when parasites numbers are increasing would accomplish this goal, rather than more frequent, suppressive treatments that would prevent parasitism altogether.

Where are the Parasites?

The adult abomasal helminths, of which *Ostertagia ostertagi* is the most important, produce eggs which pass out in the feces. These eggs hatch and develop into the infective third larval stage(L_3). This L_3 retains it sheath form the last moult and is resistant to desiccation. As the grazing season progresses the number of infective larvae on the pasture increases to where about 95% of the parasites (infective larvae) are on the pasture and only 5% (adult worms) are in the cow. These worms have also adapted to their environment in that there is a reduced chance of success of completing the reproductive cycle in winter. The larvae key on the environment (photo period and temperature) of late summer and early fall and will become arrested or inhibited in the abomasum for the winter. They will become active and resume development in the spring, developing into adults parasites.

Environmental Factors Influencing Transmission

The free-living stages of gastro-intestinal nematodes on pasture (i.e., eggs, developing and infective larvae) are often overlooked and not considered by producers. The factors that influence the development, survival, distribution, or migratory behavior of the free-living larvae seen on pasture are primarily weather related. The deposition of helminth eggs in feces is the starting point for the contamination of the pasture and the subsequent development of the parasites. The cumulative numbers of eggs can be considerable by the end of the grazing season. Environmental factors will influence both development and survival of the larvae on pasture, as well as their distribution onto the herbage.

Eggs deposited on the pasture will hatch and develop to the infective L_3 stage. Under optimal conditions of moisture and temperature larvae of *Ostertagia ostertagi* will reach the infective stage in about five to six days. Developmental time varies from one geographic region to another depending on prevailing weather. Eggs hatch and develop more slowly at lower temperatures. Rate of development increases to a maximum at higher temperatures after which development will be adversely affected and death of the larvae occurs. It is difficult to evaluate the effects of temperature without considering moisture. Moisture must be present to prevent desiccation and death of the developing larvae.

Moisture has an effect on the movement and motility of the larvae. As the fecal pat dries out the larvae may desiccate and die. If the environment is dry, movement onto surrounding herbage would probably not be possible, thus forcing movement or migration into the soil beneath the fecal pat. Too much moisture (rain) may disrupt the pat, moving the larvae onto the surrounding herbage or carrying them away in the runoff.

When moisture is adequate the movement of larvae on pasture may be affected by temperature. Temperature in the optimal range allows for larval activity and thus motility. Moisture provides a medium in which the larvae can move (there is probably little movement on dry surfaces). The effect of rainfall on dispersal of the larvae is also important, a raindrop may transport larvae as far as 90 cm from the dung pat. However, optimal larval recovery is only about 5cm (2 - 3 in) from the edge of the fecal pat, with decreasing numbers out to about 25 cm. We found that very few larvae migrated into the soil and most no further than 15 cm from the center of the fecal pat. Soil type may have a major effect of the ability of larvae to migrate. The predilection of larvae to remain relatively close to the fecal pat may have substantial impact on transmission, as cattle do not to graze close to fecal pats until forage is very limited. Therefore intensive rotational grazing may enhance transmission by forcing animals to graze the highly contaminated areas. At the same time, intensive rotational grazing causes increased disruption of fecal pats, thus enhancing desiccation.

When the larvae moult to the L_3 they retain the cuticle (sheath) of the second stage larva, which provides protection against environmental factors, particularly desiccation. Under optimal environmental conditions (25°C) in the laboratory *Ostertagia ostertagi* eggs hatch in 12 to 24 hours and develop into the infective L_3 in 5 to 6 days (Ciordia & Bizzell, 1963). These investigators also observed that only 30% of the eggs actually developed to the infective stage at 25°C, with even lower developmental success at higher (5.3% at 32°C) or lower (21.5% at 20°C) temperatures. This success rate has a significant impact on the total number of eggs produced by the example cow/calf pair that will develop to the infective L_3 (e.g. 50.0×10^6 eggs reduced to 15.0×10^6 infective L_3 at optimal temperature).

The major challenge is to estimate how many larvae are available form the pasture. Many investigators have utilized tracer calves grazing a pasture for a prescribed period of time to provide an indication of both species and numbers of worms present. Some investigators have used pasture larval counts, reporting number of larvae per kg of dry herbage and the genera present. Unfortunately these techniques are not practical in a commercial operation.

Parasite Survival and Transmission in Winter in Minnesota?

We found that parasites may survive on pasture over the winter. In a tracer calf study we found that there were infective larvae on pasture in April and the pasture had not been grazed since the previous July (Stromberg et al., 1991). In a similar study conducted in Maine, Gibbs (1980) found that infective larvae survived on pasture for a minimum of 12 months utilizing tracer calves. We also observed that tracer calves became infected in pens at the Grand Rapids Experiment Station all winter (unpublished observations).

Dynamics of parasites on pasture.

The contamination of a pasture with eggs of trichostrongyles, as well as other helminths, has often been estimated, but rarely quantified. For example, the monthly average eggs per gram of feces (epg's) for both cows and their calves has been determined (Stromberg et al., 1991) and presented in Figure 1. The data gives the appearance that the calf will pass a larger number of eggs throughout the grazing season and therefore it has been widely assumed that calves deposit more parasite eggs onto the pasture than do their dams. Also, cumulative epg's have been utilized to assess the degree of pasture contamination over the entire grazing season. Figure 2 shows the cumulative eggs shed by the cows and calves for the sample data. The average eggs shed for each month were subjected to the tapazoid rule and summed each successive month through the grazing season (Vercruysse et al., 1993). As with average epg's the data has been interpreted to show that the calf was responsible for the majority of pasture contamination. What has been overlooked is the defecation rate and/or the amount of feces produced.

To address these unknown aspects of host behavior, it was observed that a cow defecates an average of 8.1 times per day, while the calf will defecate an average of 6.23 times in the same observation period (unpublished observations). The actual weight of feces produced was directly related to the body weight of the animal, where pat weight and body weight (W) were in pounds.

$$\text{Pat Wt.} = 0.000285*(\text{body weight}^{\wedge 1.361})$$

For example a 500 lb calf would deposit about 1.3 lb of feces each time it defecates and if it defecates 6.23 times it would deposit 8.4 lb per day. Similarly, a 1200 lb cow would produce about 4.4 lb of feces per defecation or 35.8 lb per day. The total helminth egg deposition onto a pasture per day, month or grazing season can be calculated knowing the age (cow or calf), weight, and egg count (epg's) for the animal. The cows and calves in the cited study were turned out onto pasture with a body weight of 508.7 and 64.8 kg, respectively. The cows weighed 540.0 kg and the calves were 167.2 kg at weaning. When one adjusts the egg shedding data for body weight (determined monthly) and the amount of feces produced, a different egg shedding profile was observed. The total egg count for a single day each month for an average cow or calf is shown in Figure 3. From this data it becomes apparent that the cow actually deposits more eggs onto the pasture from May to August and the calf is responsible for greater egg output at the end of the grazing season. This can be adjusted for the number of days on pasture each month and the potential cumulative pasture contamination can be determined (Figure 4). This analysis indicates that the cow is responsible for a greater level of contamination than the calf over the entire grazing season. By the end of the grazing season, the cow had deposited approximately 33% more eggs onto the pasture than the calf. The example cow/calf pair would have deposited more than 50 million nematode eggs onto the pasture over the grazing season and when this number is adjusted upwards for the size of the herd the numbers become quite striking. These observations of the dynamics of egg deposition (Figure 4) suggest that a strategic anthelmintic treatment prior to turnout would reduce egg deposition by the cows and thus result in lower infection rates and egg output by the calves. It must be realized that the eggs deposited onto the pasture must survive and develop to the L_3 before transmission is possible.

How can we Prevent Infection in Replacement Heifers?

If we remove all of the parasites from heifers before they are turned out onto pasture in the spring we will remove the production robbing worms and we will prevent pasture contamination. Using an anthelmintic that has activity against the inhibited larvae we also remove the potential of these larvae developing to adult worms and contaminating the pasture. However, we still have the larvae that have survived over the winter on the pasture. Controlling these overwintering larvae requires the traits of the newer anthelmintics.

We have several choices in which anthelminthic to use. The benzimidazoles (white wormers) are efficacious, but short acting. They will kill worms for about 2-3 days post treatment, after which any infective larvae that are ingested will continue their development to adults. The new endectocides have an extended period of activity and can kill ingest larvae for 21 or more days after administration. This means that we can treat these heifers at turnout with one of these long acting compounds and any infective larvae that they ingest will be killed for the next 21+ days. They essentially function as vacuum cleaners on the contaminated pasture. We prevent infection for 21 to 28 days and then any larvae ingested it will take an additional 21 days to develop to the adult egg laying worm. We would not expect to see any eggs in the feces for the first 49 days on pasture. Therefore, we recommend retreatment at 56 on pasture. We do not want to totally eliminate parasites so that the animal remains immunologically naive. A program that involves retreatment when parasites numbers are increasing would accomplish this goal, rather than more frequent, suppressive treatments that would prevent parasitism altogether.

When heifers are raised indoors and fed a TMR it is good practice to remove all worms when then enter the confinement period. There should be little opportunity for reinfection to occur under these conditions.

Parasite Control in the Lactating Herd?

Dairy cows maintained in total confinement should not need parasite control. However, when they have the opportunity to graze they may be exposed to parasite infection. When dry cows are pastured parasite control must be considered. Treatment at freshening may provide improvements in milk production. When dairy cows are grazed or rotationally grazed a strategic parasite control program is worth while. Current recommendations are to treat when the cows are first turned out onto grass and again about 28 days later. An alternative program would be to treat cows at about 28 days or after their first complete rotation through the rotationally grazed pastures. A study in Pennsylvania (Gasbarre, personal communication) utilized this treatment protocol and found an improvement in milk production (~ 4lb/cow/day).

What Anthelmintics are Available?

Benzimidazoles
- albendazole (Valbazen)
- fenbendazole (Safeguard/Panacur) *
- oxfendazole (Synanthic)

Endectocides
- doramectin (Dectomax)
- eprinomectin (Ivomec- Eprinex) *
- ivermectin (Ivomec)
- moxidectin (Cydectin)

Other
- levamisole (Lavasole, Ripercol, Tramisol)
- morantel (Rumatel) *

* = approved for use in lactating diary cows

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Figure 1. Average eggs per gram of feces from a cow/calf herd sampled monthly during the grazing season for two successive years.

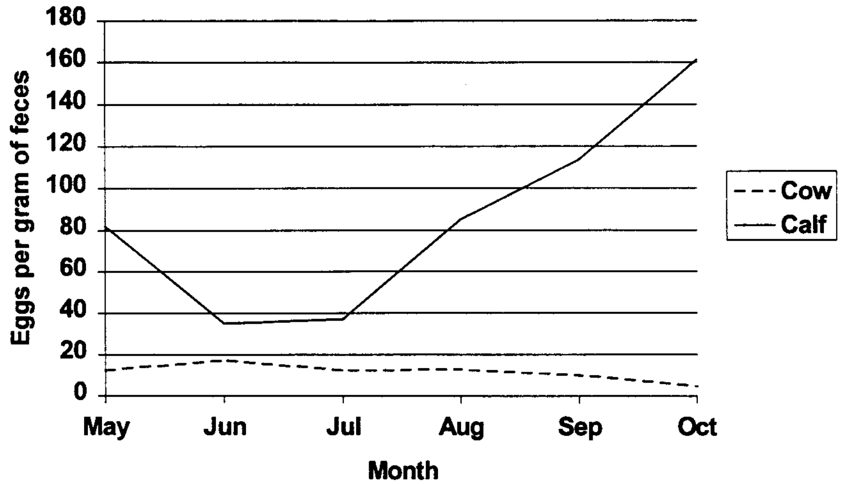

Figure 2. Cumulative egg counts for a cow/calf herd sampled monthly during two successive grazing seasons.

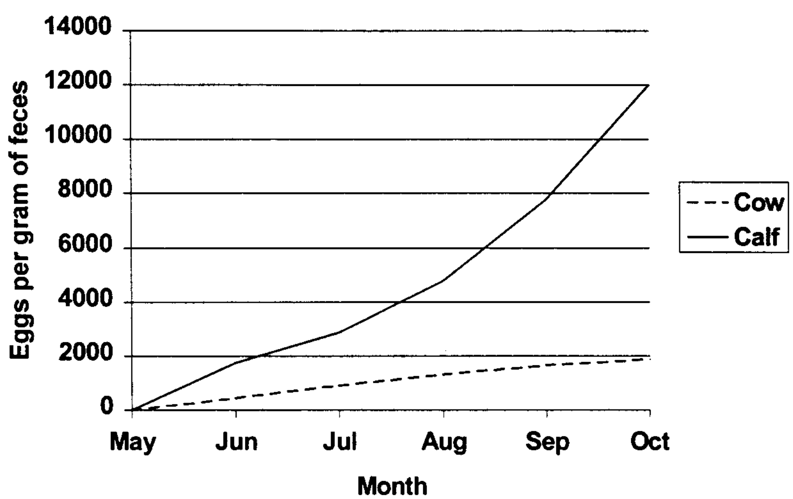

Figure 3. Total egg output for cows and calves on the sample day each month, based on the average egg counts for a cow/calf herd sampled monthly for two successive years.

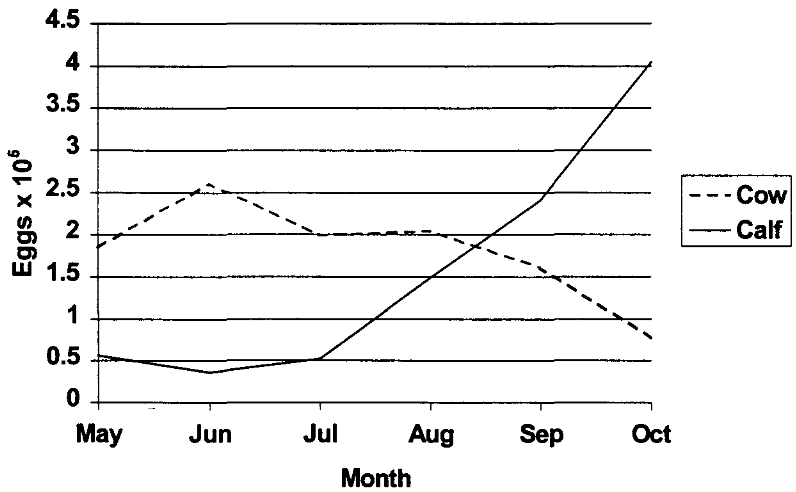

Figure 4. Cumulative total egg output for a cow / calf pair over the grazing season, based on the average egg counts for a cow/calf herd sampled monthly for two successive years.