PARABAN™ and *Ostertagia ostertagi*

Daniel L. Otto, DVM

The Bottom Line

- The value of PARABAN to a veterinarian or a producer is its ability to guide how to establish a strategic control parasite program.
- Fecal egg counts are the only diagnostic tool with which to evaluate active egg laying adults. However, fecal egg counts do not evaluate actual parasite loads.
- Strategic deworming maximizes resources spent on controlling internal and external parasites in cattle on grass.
- *Ostertagia ostertagi* is perhaps the most common cause of internal parasitism and is economically considered the most damaging internal parasite in cattle.

Introduction

PARABAN is a computer-generated modeling program that was developed to simulate both Type I and Type II parasite life cycles of *Ostertagia ostertagi*. PARABAN plots four different parameters of these parasitic infections:

- mean worm burden, which corresponds to the number of adult worms attached to the gastric lumen in the animal;
- pasture contamination, which represents the number of third-stage (L3) larvae developed from eggs an animal deposits on the ground;
- fecal egg count is the amount of eggs found in one gram of fecal material;
- arrested (inhibited) worm burden, or hibernation state, which is described below under Type II infections.

Environmental conditions (temperature and rainfall) play an important part in determining the speed of development of L3s and survival of these larvae on the pastures. Thirty-year averages of annual temperature and rainfall are programmed into each specific geographic area to provide average climatic conditions for that region of the country.

*Ostertagia ostertagi* is commonly called the brown stomach worm. The adults are slender, reddish-brown, up to 1.0 cm long, accruing on the
surface of the abomasal mucosa (stomach lining) and are only visible on close inspection. The larval stages occur in the gastric glands and can only be seen microscopically.

*Ostertagia ostertagi* is perhaps the most common cause of internal parasitism and is economically considered the most damaging internal parasite in cattle. The disease, often known as ostertagiasis is characterized by weight loss and diarrhea. Typically it affects young cattle during their first grazing season. However, herd outbreaks and sporadic individual cases have been reported in adult cattle.

**Life Cycle**

The life cycle of *O. ostertagi* requires optimal temperatures (approximately 50-75°F) and adequate moisture. Eggs which are passed in the feces hatch and develop to third-stage (infective stage) larvae (L3) in about 2 to 3 weeks. The L3 develop in the fecal pad and migrate to the surrounding grass. After ingestion by cattle, development occurs in the lumen of the abomasal glands. These glands are permanently damaged once penetrated by *O. ostertagi* larvae, and once damaged, they are unable to produce enzymes for digestion of feedstuffs.

Development of *O. ostertagi* to young adults takes 18 to 25 days. These enter the lumen of the abomasum from the gastric glands. The young adults attach to the lumen and mature to egg-laying adults within a week, thus completing the life cycle.

**Bovine Ostertagiasis**

Bovine ostertagiasis is known to occur in two forms:

- **Type I** occurs when third-stage larvae are ingested by grazing animals. The normal maturation of the life cycle occurs and adults develop and produce eggs. This occurs in northern climates (Example 1), by an increase in fecal egg counts during spring and early summer months. In southern climates (Example 2), fecal egg counts increase during mild fall and winter months.

- **Type II (inhibited)** occurs during the late fall and winter months in the northern climates. This results from the maturation of larvae ingested during the previous fall which, because of unfavorable environmental conditions, such as extreme cold weather, which do not favor their survival. They have discontinued their life cycle and have become "inhibited" at the fourth stage (L4) within the gastric glands. Inhibited larvae can remain dormant for up to six months. They remain so until such time as environmental conditions favor continuation of the life cycle.
The main clinical sign of both Type I and Type II is profuse diarrhea, anorexia (decreased feed consumption) and weight loss.

**Example 1: Inhibited Larvae (Northern)**
This example depicts a weaned calf going out on pasture in the spring in western North Dakota. At this point, the calf would be carrying little or no internal parasites; however, the pastures will be contaminated from larvae that wintered in the soil.

As the summer progresses, mean worm burden and fecal egg count increase, and subsequently so does pasture contamination. However, the inhibited worm burden remains low until later in the fall. When conditions turn adverse, inhibited worm burden starts to increase as pasture contamination decreases. As fecal egg count increases, pasture contamination also increases during the grazing period.

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**Client’s Name: EXAMPLE 2**
Operation: Weaned Calf
Parasite: *Ostertagia ostertagi*
Location: Louisiana-South
Date of Turnout: Feb. 15, 1999
Stocking Rate: 2.0/acre
Initial Pasture Contamination: 500/lb
Worm Burdens Monitored (mo): 12
Date of Removal from Pasture: Dec. 1, 1999
Example 2: Inhibited Larvae (Southern)
This example depicts a weaned calf on pasture in Louisiana, when during fall and winter grazing, Type I is prevalent. Mean worm burden shows its highest levels during the hot summer. Fecal egg count directly relates to pasture contamination— in both southern and northern regions. Inhibited larvae are most prevalent during the hot summer months. This is due to environmental conditions that are unfavorable to larval survival.

Example 3: Inhibited Larvae (Northern and Southern Mixed)
Here we have an example that depicts a weaned calf on pasture in northern Kansas. Mean worm burden shows its highest levels during the summer months similar to Examples 1 and 2. Peak pasture contamination occurs during the fall and winter months. Again, fecal egg count looks similar to the northern inhibited cycle (Example 1). Although the inhibited larvae in this northern Kansas model depicts the northern pattern in Example 1, what is seen in most midwestern states (e.g. Kansas, Missouri, etc.) is a mixture of northern and southern life cycles. This ability to adapt is essential for the parasite to survive. Realizing the differences in the life cycles in the Midwest helps to explain low fecal egg counts during late fall and winter. This low fecal egg count is false negative.

Economic Importance
The value of PARABAN to a veterinarian or a producer is its ability to demonstrate how strategically to control parasite damage. This model can show the best time to deworm cattle on grass.

Parasite control represents a major component of the cost of processing pasture cattle, whether they are cows and calves or yearlings. Research has shown that controlling parasites like *O. ostertagi* makes sound economic sense. However, the value of treatment can be measurably improved when the time to treat with a product that kills both adult worms and inhibited larvae in a specific area of the country is identified. Veterinarians and producers alike can utilize PARABAN to design deworming programs using any of the IVOMEC® Brand Products.
### Treatment Programs

As the graphs indicate, *O. ostertagi* has the innate ability to adapt to different environmental conditions in order to survive. It is able to sense undesirable environmental conditions and protect itself by becoming inhibited and waiting until environmental conditions are right before it continues its life cycle. The practical application of PARABAN modeling lies in developing strategic deworming programs. In Example 4, weaned stocker calves were treated with IVOMEC (ivermectin) Pour-On at turnout, and again when the cattle came off pasture in October in North Dakota.

The program shows that pasture contamination, mean worm burdens and fecal egg counts are marginally effect by this timing of treatment because the cattle continue to graze contaminated pasture and thus become re-infected. However the inhibited worm burdens are measurably reduced.

Examples 5 and 6 show results of deworming cattle with a southern *O. ostertagi* inhibition life cycle (southern Louisiana). In Example 5 the cattle were treated three times with IVOMEC EPRINEX® (eprinomectin) Pour-On for Beef and Dairy Cattle at turnout, midsummer, and when the cattle come off the pasture. Pasture contamination is slightly reduced. However, mean worm burden and inhibited worm burden are considerably reduced. Fecal egg counts, the only diagnostic tool for estimating burdens of active egg laying adults, are reduced after treatment. However, fecal egg counts do not evaluate actual parasite loads which include adults and inhibited worm burdens.

<table>
<thead>
<tr>
<th>Client’s Name EXAMPLE 3</th>
<th>Date of Turnout: May 1, 1999</th>
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<tbody>
<tr>
<td>Operation Weaned Calf</td>
<td>Stocking Rate: 0.5/acre</td>
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<tr>
<td>Parasite: <em>Ostertagia ostertagi</em></td>
<td>Initial Pasture Contamination: 200/lb</td>
</tr>
<tr>
<td>Location: Kansas-North</td>
<td>Worm Burdens Monitored (mo): 12</td>
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<tr>
<td>Date of Removal from Pasture: Oct. 1, 1999</td>
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</tbody>
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<table>
<thead>
<tr>
<th>Pasture Contamination</th>
<th>Fecal Egg Count</th>
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</thead>
<tbody>
<tr>
<td>Pasture Contamination</td>
<td>Fecal Egg Count</td>
</tr>
<tr>
<td>Mean Worm Burden</td>
<td>Mean Worm Burden</td>
</tr>
<tr>
<td>Total EPG</td>
<td>Total EPG</td>
</tr>
</tbody>
</table>

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**Client’s Name EXAMPLE 3**

**Operation Weaned Calf**

**Parasite:** *Ostertagia ostertagi*

**Location:** Kansas-North

**Date of Removal from Pasture:** Oct. 1, 1999

**Date of Turnout:** May 1, 1999

**Stocking Rate:** 0.5/acre

**Initial Pasture Contamination:** 200/lb

**Worm Burdens Monitored (mo):** 12

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**Pasture Contamination**

**Fecal Egg Count**

**Mean Worm Burden**

**Arrested Worm Burden**

**Total EPG**

**Total EPG**
In Example 6, the IVOMEC SR Bolus was used in the same Louisiana location. This formulation of IVOMEC provides season-long control of pasture contamination, mean worm burdens, fecal eggs, and inhibited worm burdens. Processing cattle with the IVOMEC SR Bolus at turnout will provide broad-spectrum parasite control for about 135 days. In studies conducted across the country with grazing cattle, the IVOMEC SR Bolus provided weight gain advantages ranging from 41 to 111 lb, compared to untreated controls. (3)

Example 7 includes northern Kansas geography. IVOMEC Pour-On was used at turnout. In the example, pasture contamination, mean worm burdens and fecal egg counts were slightly affected. However as was seen in Examples 4 and 5, inhibited worm burdens showed a sharp decline.
Conclusions
Strategic deworming maximizes resources spent on controlling internal and external parasites in cattle on grass. PARABAN can be a tool for a producer to understand the timing of strategic deworming, in conjunction with his/her area of the country.

References


3. Jacobsen JA. Productivity of cattle treated with the IVOMEC SR
Bolus, in *Proceedings*. 41st Annu Meet AAVP 1996; Abstr. #75.

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