Parasite Management Plans, a New Reality for Sustainable Agriculture

November 24, 2018

Dr. Marie Noel, DVM

Management plan?

Outline of the presentation

- Parasites and grazing performance
- Parasite resistance and trip to NZ
- Why worry about resistance?
- How to delay onset of resistance
- Important concepts to consider before implementing a parasite management plan
- Charlevoix Parasite Project

Parasitology

Skills and areas of expertise

Veterinary doctor with a multi-species practice and a long-standing interest in parasitology, especially its application in pastures.

Internal parasite: Nematode; *Osteragia*; pathogen

What is a parasite?

A parasite is an organism that lives on or in another living organism (host). Parasites get food and shelter from the host and reproduce there. Their presence is not normally harmful or fatal to the host.

How an internal parasite affects its host!

For example, a **growing animal will**:

- Eat less food
- Absorb fewer nutrients
- Have lower food conversion
- Have a lower daily weight gain
- Have a weaker immune system and be vulnerable to other diseases: pneumonia, diarrhea, etc.

Internal parasites can also affect:

- Carcass quality
- Reproductive performance
- Dairy production

Effect on average daily weight gain

For animals at pasture, parasitism is one of the leading causes of reduced production

Average daily weight gain can drop by 50% in grass-fed calves with no clinical symptoms.

In Canada and the United States: Studies have shown that treating calves at pasture can improve weight gain by 25 to 55 kg.

Certain conditions foster parasite development to the detriment of the host:

- Excessive parasite burden on the pasture
- Weakened host: Diseases, nutritional deficiencies, start of lactation, etc.
- Low immunity: Physiological stage, age (young), nutritional deficiencies (selenium).
- Grazing conditions: Animal density, heat, humidity, etc.

Since 1980, underperformance on pasture has been on the rise

(especially in countries with year-round grazing)

- **Intensive production methods**: Higher animal density.
- **Discontinuation** of all other control methods.
- Onset of **parasite resistance** to anthelmintic treatments after arbitrary and sometimes excessive use of products.

International Sheep Congress New Zealand 2013

Definition of parasite resistance

A parasite is considered resistant when it **survives** a properly administered anthelmintic treatment at the correct dose.

In addition to surviving, the resistant parasite will pass its ability to resist anthelmintics down to all future generations.

Scope of resistance

- Countries with year-round grazing are more affected by parasite resistance. The top three are:

  South Africa, the United Kingdom, and Australia.

- In North America, recent studies mention cases of parasite resistance in the United States, Alberta, Ontario, and in a number of regions in Québec.

How resistance has developed

- Appeared in the late 1960s
- Development from 1980 to 2000
  - Repeated and arbitrary use of treatments
  - Poor administration
  - Discontinuation of prevention practices for grazing
- Since the 2000s
  - Pharmacology and resistance

Disappointing global findings

International Sheep Congress in 2013

Sheep producers from a number of countries noted that the use of new anthelmintics or even simultaneously administered combinations of products from different treatment families **doesn't prevent some parasites from becoming resistant.**

Pastures in New Zealand!

Some of the features used in pastures

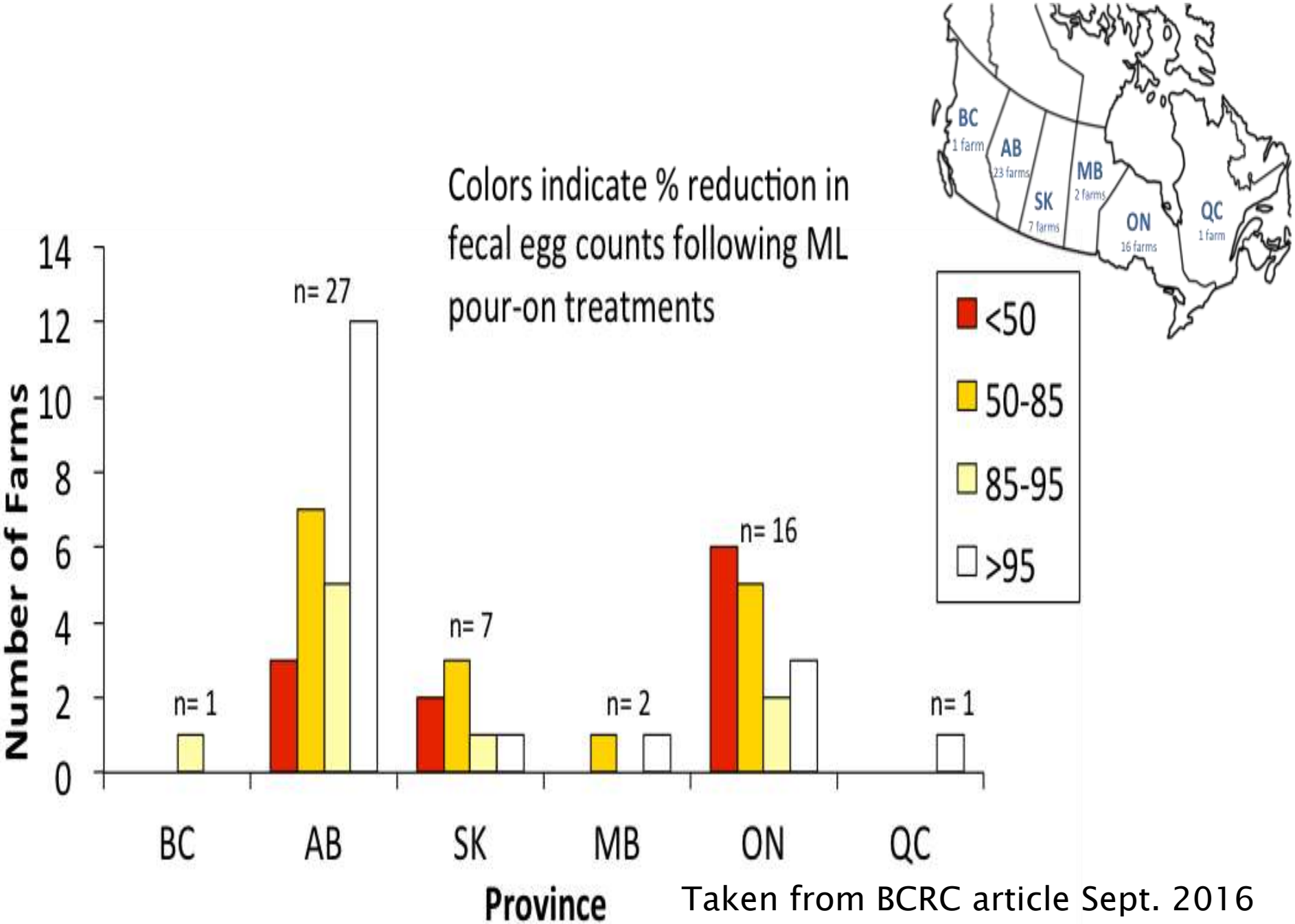
The entire country is “fenced in”

Back at home!

What about CANADA?

- Ontario: Dr. Peregrine: Sheep in Ontario and Québec
- Alberta: Dr. Gilleard: Cattle
- Québec: Dr. Alain Villeneuve: Cattle

Study of 40 steers (2011), treated with Ivermectin Pour-On: Average efficacy of 75.8%. To prevent resistance, efficacy should be 95%.



Taken from BCRC article Sept. 2016

What about my region, Charlevoix?

Four cases of resistance confirmed:

- Resistance to Ivermectin in two goat herds
- Resistance to fenbendazole in one goat herd
- Resistance to permethrin: Kills lice in a goat herd
- Resistance to Ivermectin in a group of horses

The situation closer to home

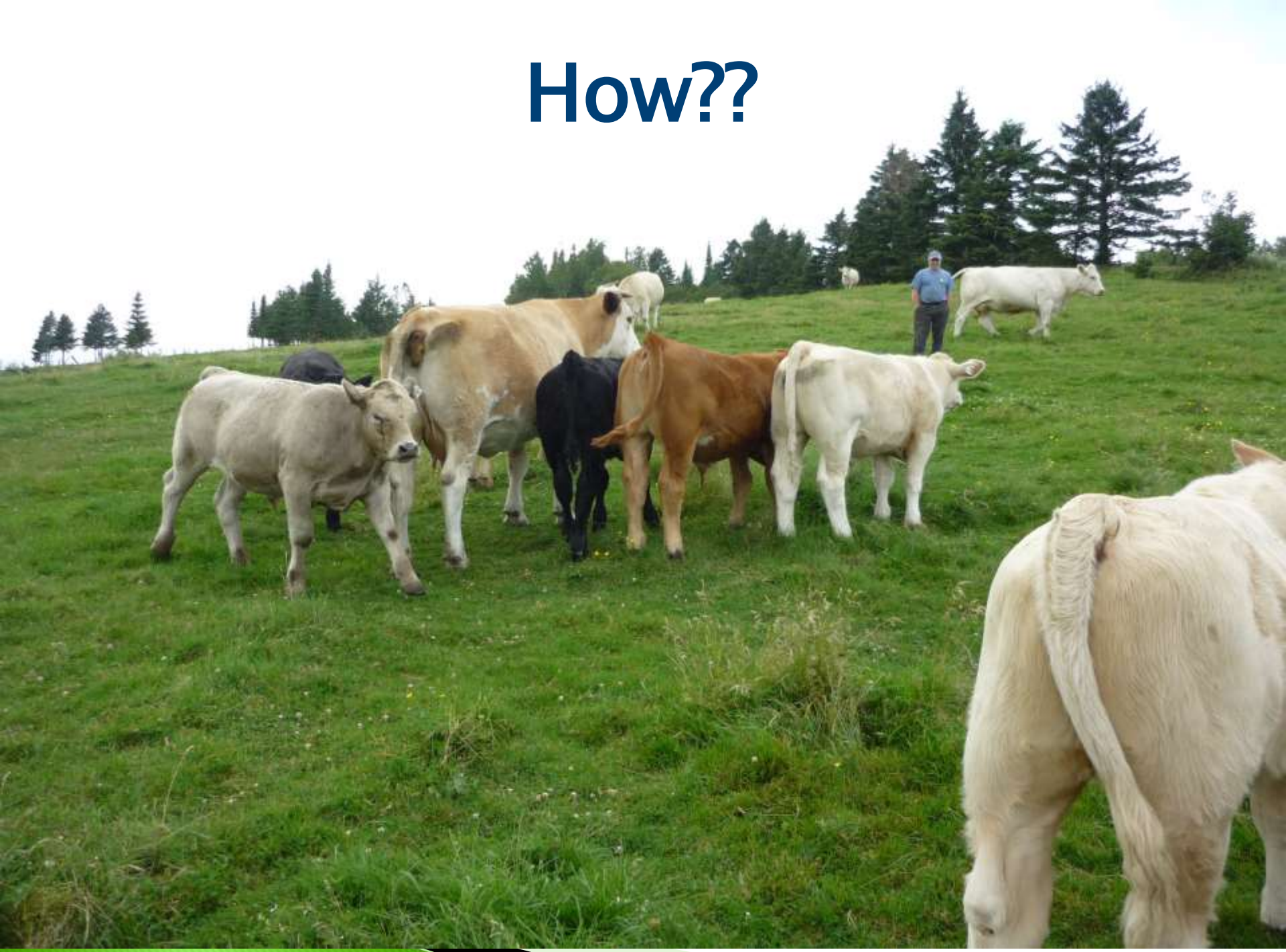
- The development of resistance to treatment cannot be stopped in certain parasites
- We must aim to delay the onset of resistance and/or slow its development
- Each anthelmintic treatment brings us **one step closer to resistance.**

What can be done???

Draw up a global strategy to control parasitism in order to **slow** the onset of parasite resistance by developing complementary **management tools** and using anthelmintics more **wisely**.

Parasite management plan adapted to the needs of <u>each producer</u>

How??



Ideal work team

Producer: Takes the lead and puts actions in place

Cattle consultant: Management advice, action monitoring, results assessment, motivator.

Agronomist: Pasture management: Rotation, animal density, grazing height. Risk factor assessment: Climate, drainage, cycle. Genetics and race in relation to immunity.

Veterinarian: Assessment of the herd's parasite status: Fecal analyses, results analysis, selection of refuge groups, optimum and judicious use of anthelmintics.

Prerequisites

- Good knowledge of the herd: Grazing conditions for the animals, rotation, density, race, etc.

Familiarity with the parasites we are trying to control

Parasites present on cattle farms in Québec

- **NEMATODES** Strongyles, *Nematodirus*, *Trichuris*, Strongyloides, *Capillaria*
- **CESTODES**: *Moniezia*
- **PROTOZOA**: *Coccidies* (*Eimeria*), *Giardia*

Sample parasite

The main topic of the conference:

Ostertagia

Nematode from the Strongyles family.
Parasite in the abomasum, very pathogenic, resistant to winter, moderately prolific.

Essential concepts to consider before drawing up a parasite management plan.

Essential concepts

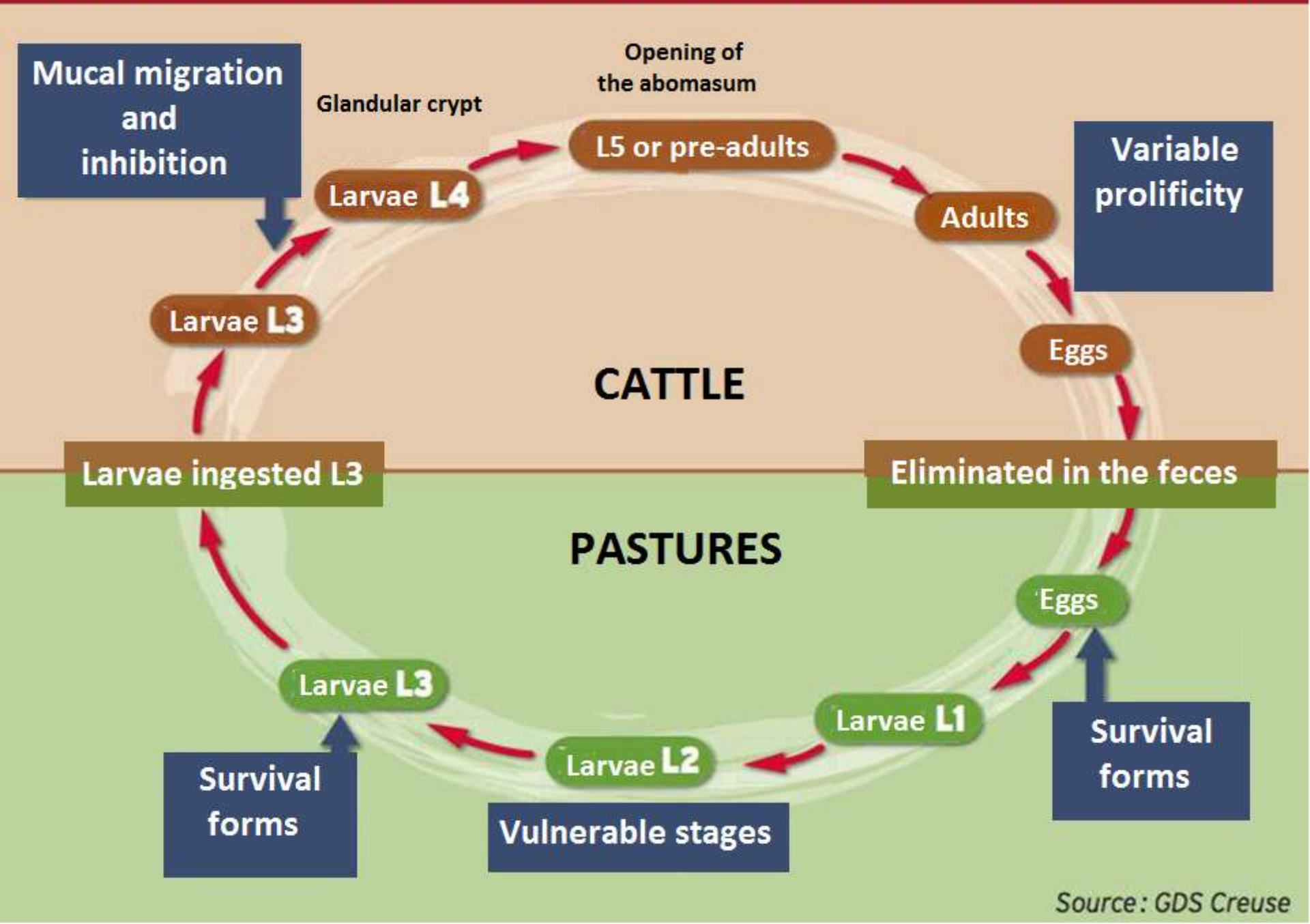
- ....Life cycle of the targeted parasite
- Parasite burden: Animals, pastures
- Judicious use of anthelmintics
- Refuge

- Resistance vs. resilience
- Risk factors that favor parasitism
- Clean pastures and contaminated pastures

THE LIFE CYCLE OF THE PARASITE Ostertagia

- Adult worms, present in the host, lay eggs that are found in in dung.
- Eggs develop into larvae: L1 becomes L2 becomes L3: the infective larva.
- L3 migrates to blades of grass in the pasture and is ingested by a host (cattle, sheep, horse). That larva will become L4, L5, and eventually an adult parasite that will live in the host and reproduce.

DEVELOPMENT CYCLE OF GASTROINTESTINAL STRONGYLES (OSTERTAGIA)



Source : GDS Creuse

- **Ostertagiosis type 1**: The infective L3 larvae are ingested, settle in the mucous membrane of the abomasum, and transform into L4 and L5 (egg-laying adults). Affects digestion and can cause significant financial losses, especially towards late summer/fall.
- **Ostertagiosis type 2**: Infective larvae ingested in fall that undergo hypobiosis. In late winter or spring the larvae make a mass exodus at a time of stress: Birthing, dietary issues, etc. Can be fatal.

Essential concepts (cont.)

- ....Life cycle of the targeted parasite
- Parasite burden: Animals, pastures
- Judicious use of anthelmintics
- Refuge

- Resistance vs. resilience
- Risk factors that favor parasitism
- Clean pastures and contaminated pastures

Parasite burden

- **Animals**: Easier to manage if there is no resistance

Goal: Reduce the parasite burden in animals, taking the unavoidable onset of resistance into account

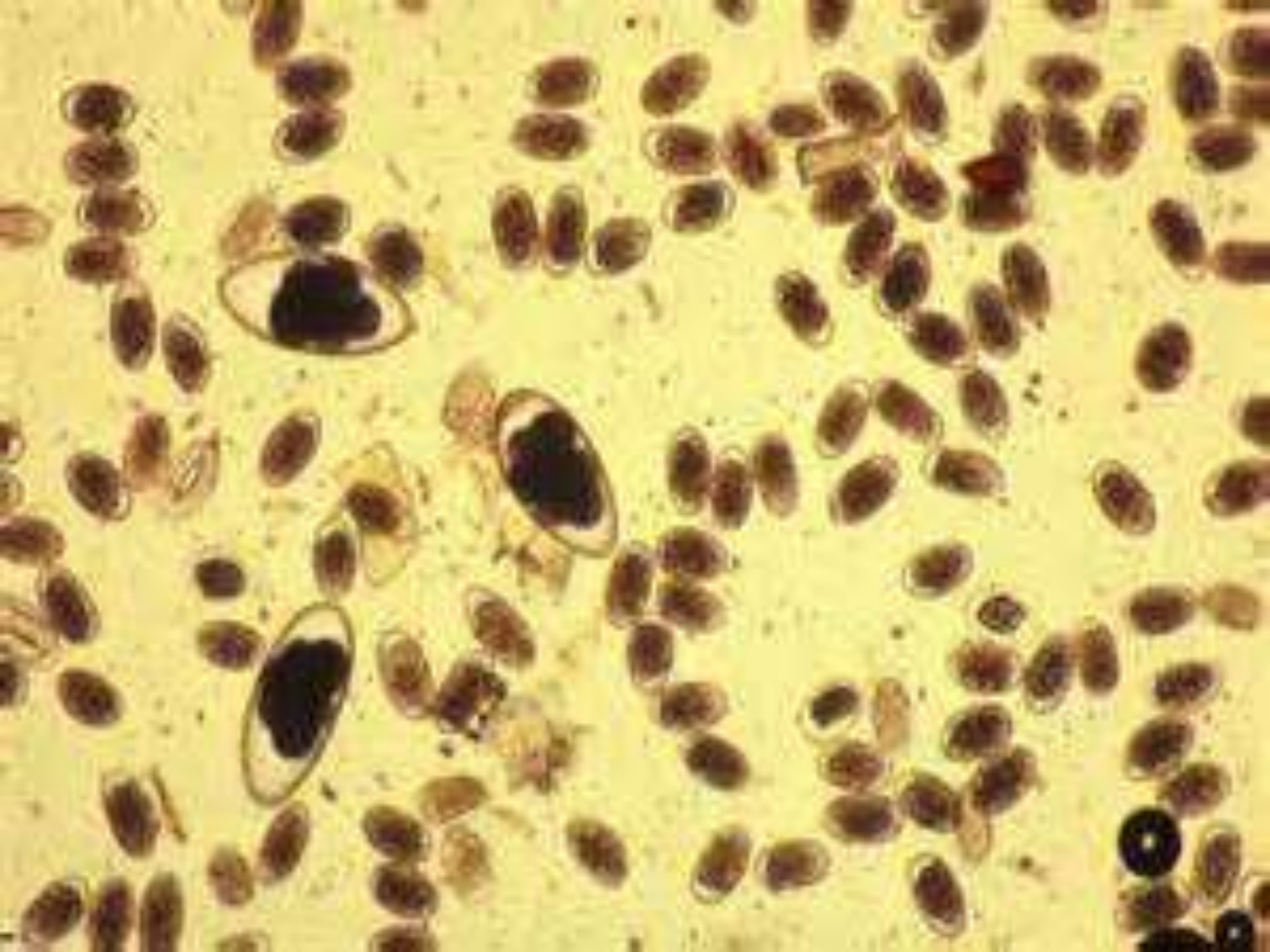
- **Pasture**: Assessment and control are more difficult

Goal: Reduce the total parasite burden and the number of parasites unexposed to treatment: refuge

Assessing the parasite burden

Fecal analysis

- Parasite egg count as eggs per gram of dung
- Limitations of this technique: egg laying by females



Fecal analyses:

- Can be done for a single animal
- Can be done for a target group: pool

- Sampling: Rectal or from the field

- Samples are kept refrigerated for dispatch to the laboratory

How are samples pooled?

1. Collect dung from a group of **homogenous subjects** (6 to 10)
2. Each sample goes in a separate bag
3. Put all the samples in one bag labeled for the group. The laboratory will pool the samples by weighing out an equal amount from each subject to produce a group average.

When should the analyses be done?

- Before treatment if the goal is to determine the parasite burden before animals are treated

or

- Before and after treatment if the goal is to verify efficacy or if the parasite burden is high and there is a suspicion that parasites will be resistant to the treatment

Testing for a reduction of eggs in feces

Steps:

- Do a fecal analysis and egg count per gram (eggs/g) using fresh samples collected at time of treatment of 10 to 15 animals: Identify each animal
- Give the appropriate treatment: According to industry standards
- Repeat the egg count 10 to 14 days later: **Same animals** (no. of days depends on the product used)

Percentage reduction in egg laying

Formula:

$$\frac{\text{Eggs/g before Tx} - \text{Eggs/g after Tx}}{\text{Eggs/g before Tx}} \times 100 = \text{Result}$$

Example: $\frac{50 - 2}{50} \times 100 =$ 96% fewer eggs excreted

Interpreting the results

A properly administered treatment at the right dose should reduce egg laying by:

90% for the benzimidazole family

95% for the macrocyclic lactone family

Currently the only way to know if our cattle herds are affected by resistance is to test for a reduction in eggs excreted in feces.

Studies being conducted at the moment will help us more easily identify parasite larvae and their resistance capability.

Interpreting the results

Results from the laboratory are given as:

eggs per gram

eggs per 3 grams

eggs per 5 grams

To make it easier to interpret the results, they shoul
all be expressed as eggs per 1 gram **(eggs/g)**

Interpreting the results

Example for strongyles: Ostertagia

	Low eggs/g	Moderate eggs/g	High eggs/g
Cattle	0-10	10-40	40 and +

Ref: Dr. Alain Villeneuve, DVM

Different interpretation of results for cattle in the USA

	Low eggs/g	Moderate eggs/g	High eggs/g
Adult cows	5 and –	5–20	20 and +
Heifers and bulls	10 and –	10–30	30 and +
Calves	10 and –	10–50	50 and +

Interpreting the results

Example: *Haemonchus* in goats

	Low eggs/g	Moderate eggs/g	High eggs/g
Goats	0-300	300-500	500 and +

Essemtoa; concepts (cont.)

- ....Life cycle of the targeted parasite
- Parasite burden: Animals, pastures
- **Judicious use of anthelmintics**
- Refuge

- Resistance vs. resilience
- Risk factors that favor parasitism
- Clean pastures and contaminated pastures

Judicious use of anthelmintics

- Accurate assessment of the animals' **weight**
- **Product administration**: Oral: On top of and behind the tongue
- **Calibration** of the applicator: Before and during treatment
- **Treat** as infrequently as possible, at the right time, with the right product. E.g., Biting lice with mectins
- If possible, do not treat all the animals. Create a **REFUGE**

What do we treat with?

Families available in Canada: Only two (cattle)

Benzimidazole: Bz

Fenbendazole: Safe-Guard: Feed, oral solution
Panacur: Oral solution

Albendazole: Valbazen: Oral solution

Macrocyclic lactone: Mectins (ml)

Ivermectin: Bimectin, Ivomec, Noromectin: Pour-on and injectable.

Moxidectin: Cydectin: Pour-on

Doramectin: Dectomax: Injectable and pour-on

Differences between products:

Form:

Injectable, oral, pour-on

Duration of action:

Short acting and long acting

Spectrum of activity:

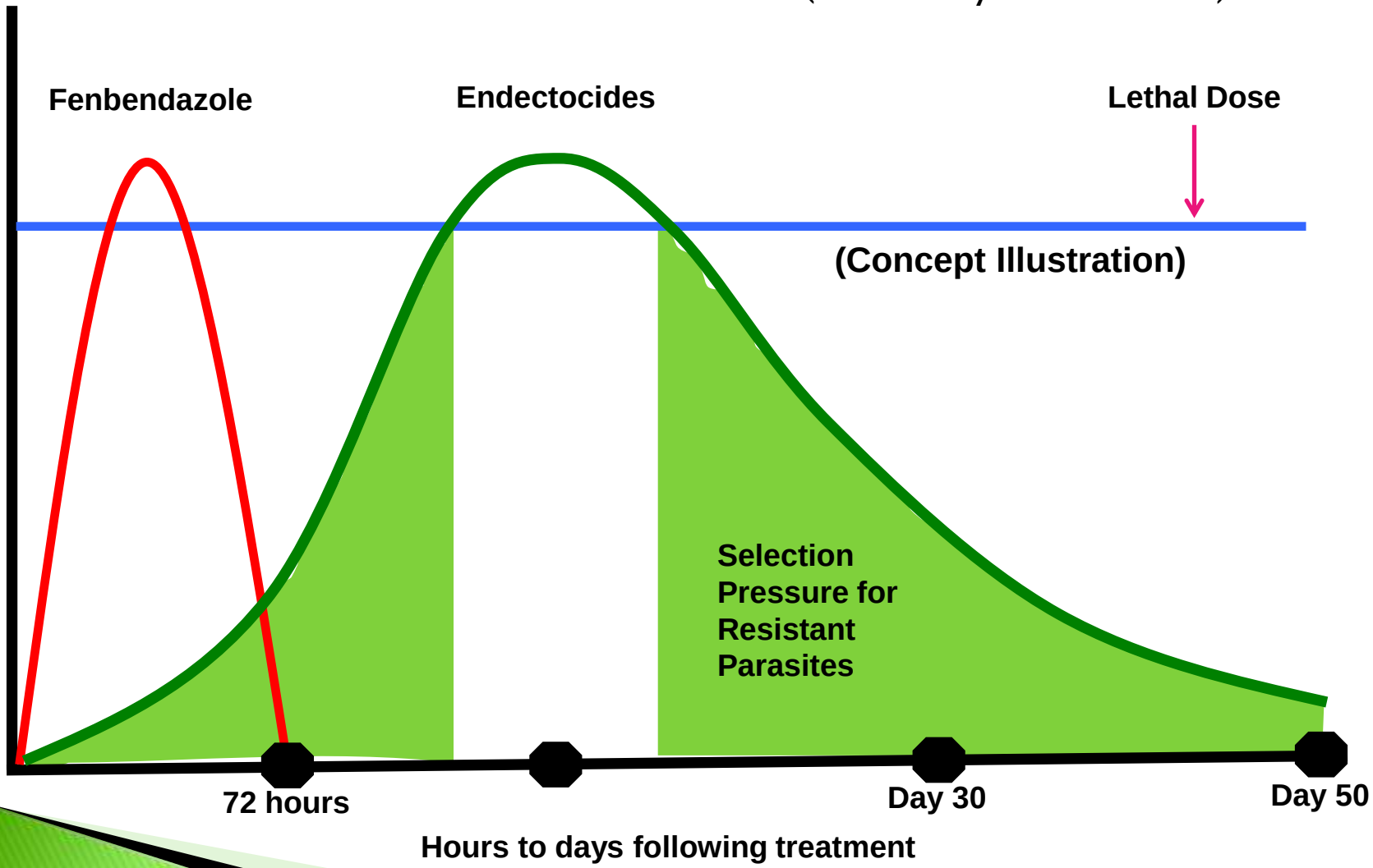
Internal parasites, external parasites, both, larvicide, acts on larvae undergoing hypobiosis

Waiting period for meat:

Highly variable: between 7 and 40 days.

Anthelmintic Comparison

Fenbendazole vs. Endectocides (Macro Cylic Lactones)



Study in 55 veterinary clinics in 19 U.S. states

Treatment with anthelmintics, with eggs/g before and after treatment. Gives the % success rate of treatment, which should be above 95%.

Average for **injectable "mectins"**: **72.5%**

Ivomec 76.2% , Ivermectin 50%, Cydectin 98%, Dectomax 89.9%

Average for **pour-on "mectins"**: **66.1%**

Ivomec 72.3% , Ivermectin 59.7%, Dectomax 78.9%

Average for Panacur **by mouth**: **99.4%**

Essential concepts (cont.)

- ....Life cycle of the targeted parasite
- Parasite burden: Animals, pastures
- Judicious use of anthelmintics
- **Refuge**

- Resistance vs. resilience
- Risk factors that favor parasitism
- Clean pastures and contaminated pastures

Concept of REFUGE

The number of parasites not exposed to anthelmintic treatments

These parasites can be in the animals or in pastures

How is a REFUGE created?

When some of the animals are not treated with anthelmintics, they may possibly excrete non-resistant parasites

Caution

1. It is important to know the parasite status of the animal or group of animals selected for the refuge.

2. If the herd has a high parasite level, the refuge should be put in place later.

3. Never risk creating a refuge that puts the health of a group of animals in jeopardy.

Which animals can be used as a refuge?

For example, in a herd of cows and calves:

Adult cow:

- Age 5 and up and at least 3 years of grazing (*Ostertagia* 18 months)
- With good flesh, in good health, and from a herd with a known parasite burden
- In a physiological condition conducive to immunity: Gestating, in mid-lactation, or ending lactation

Not to be used for refuge

- Young animals in their first or second year of grazing (**low immunity**)
- Females in an at-risk **physiological stage** Close to giving birth or starting to lactate
- Animals **born after the ban**: purchased bulls, heifers, or cows that have never been at pasture (low or non-existent immunity)

Refuge and hypobiosis

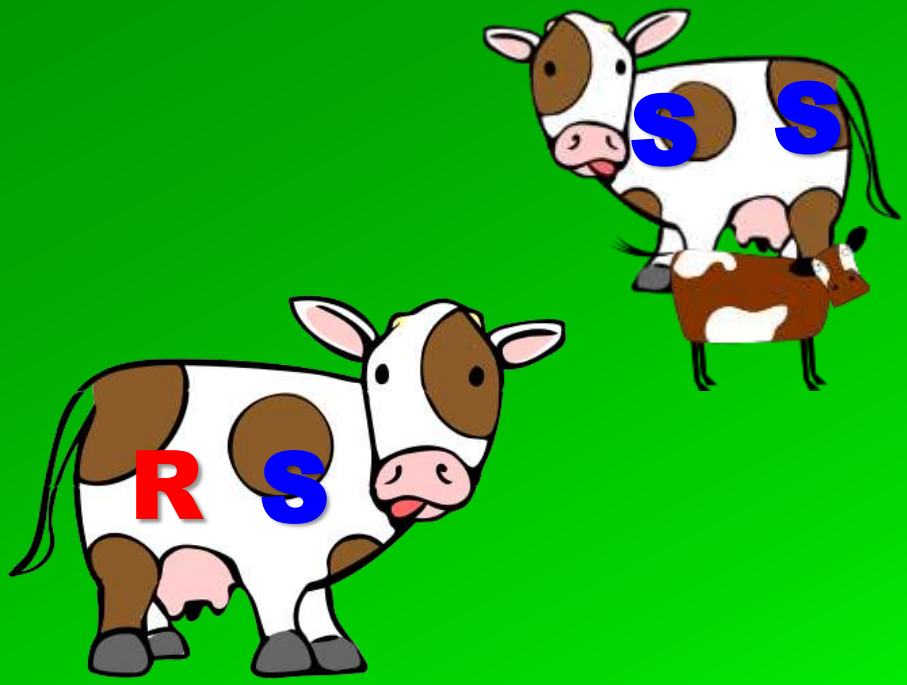
Certain parasites: *Ostertagia* and *haemonchus* undergo **hypobiosis** from October to March.

The larvae are "encysted" in the abomasum wall.

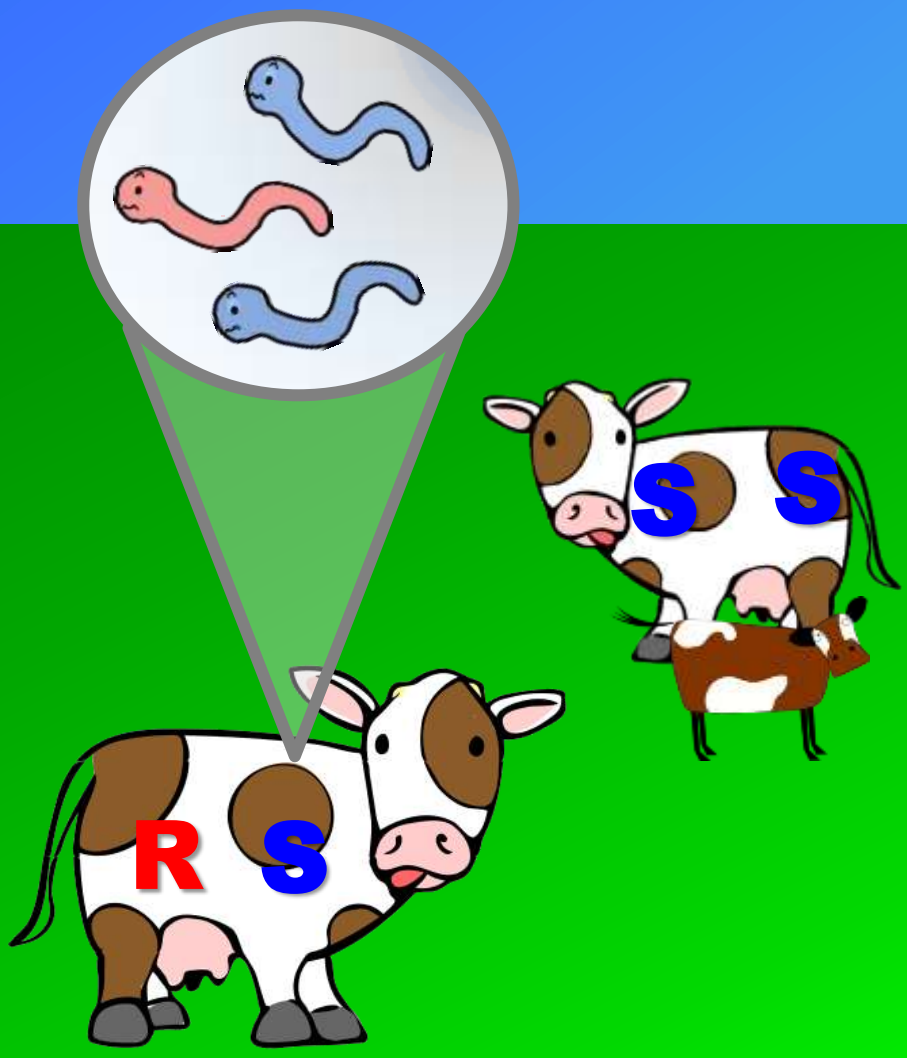
Fecal analyses at this time will not be significant and will not necessarily provide an accurate indication of the animals' parasite status.

Stress (birthing, dietary deficiency) can cause larvae in hypobiosis to be released during the winter.

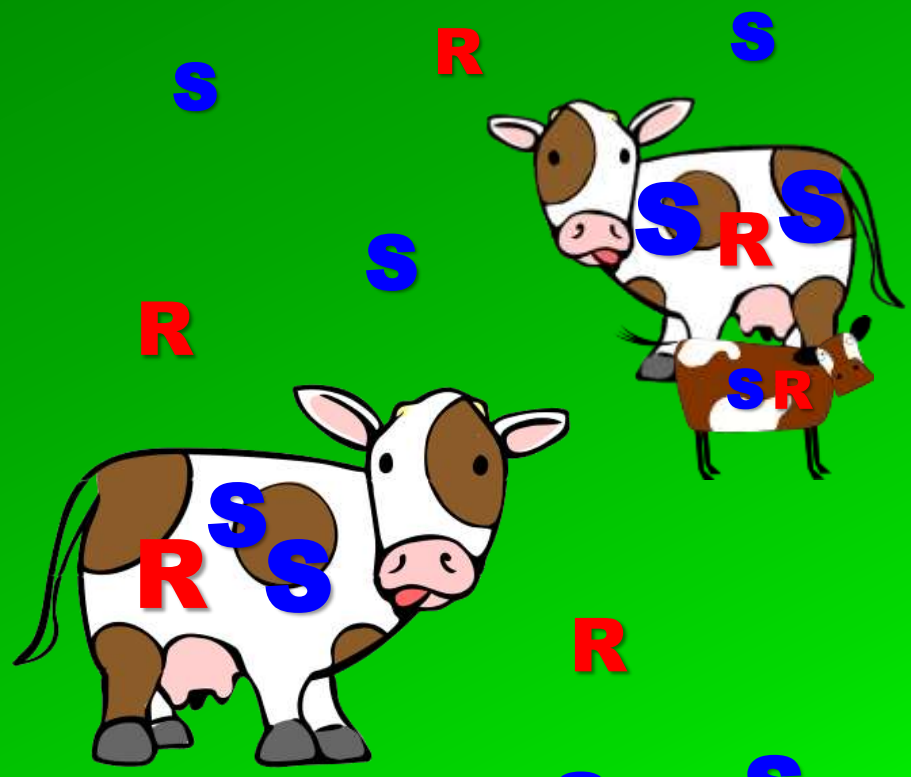
Should all cows be treated during calving?



Should all cows be treated during calving?

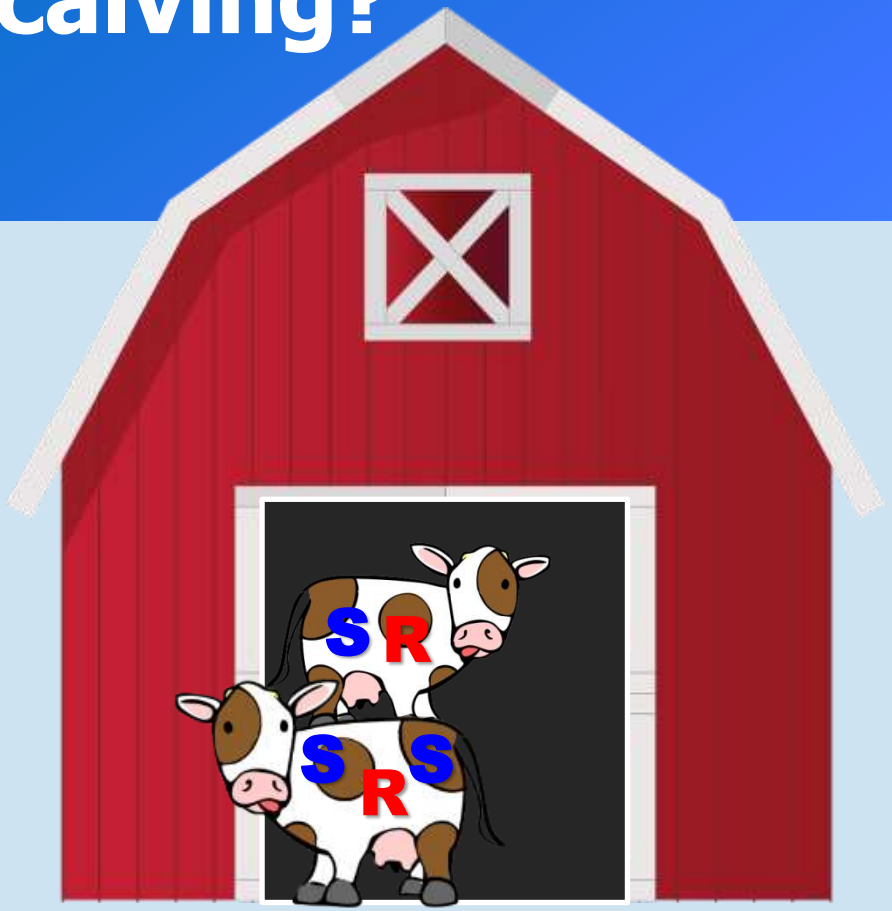


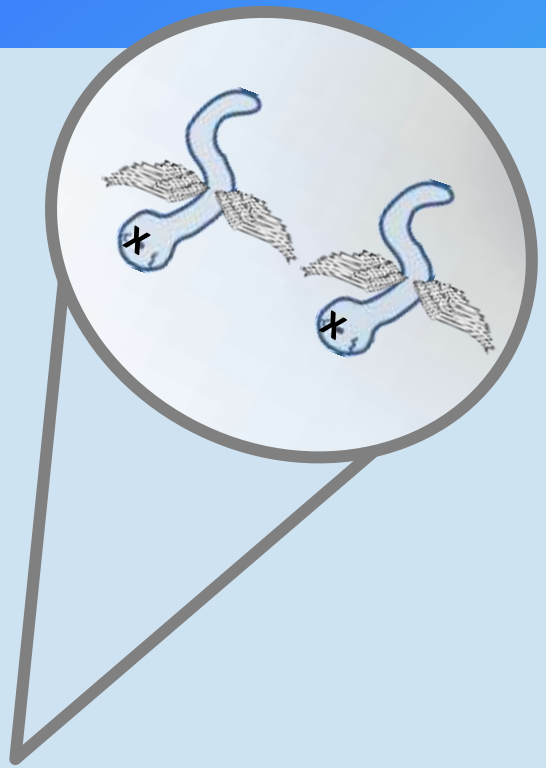
Should all cows be treated during calving?



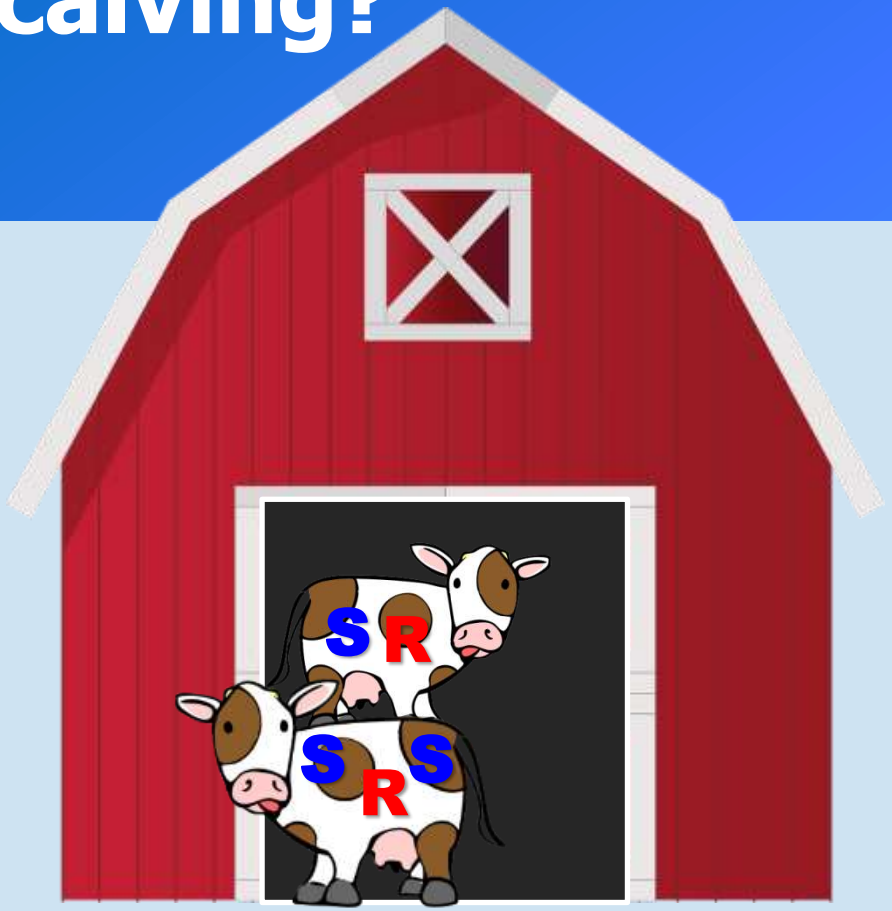
Should all cows be treated during calving?

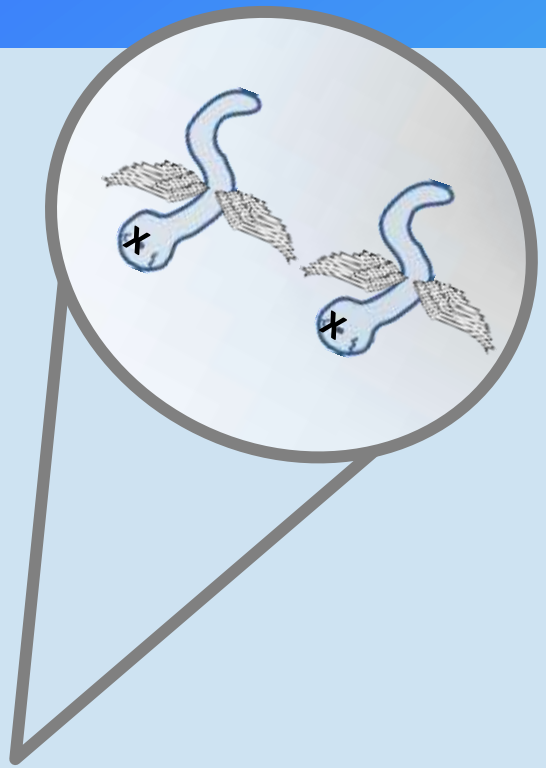
Should all cows be treated during calving?





Should all cows be treated during calving?





Should all cows be treated during calving?

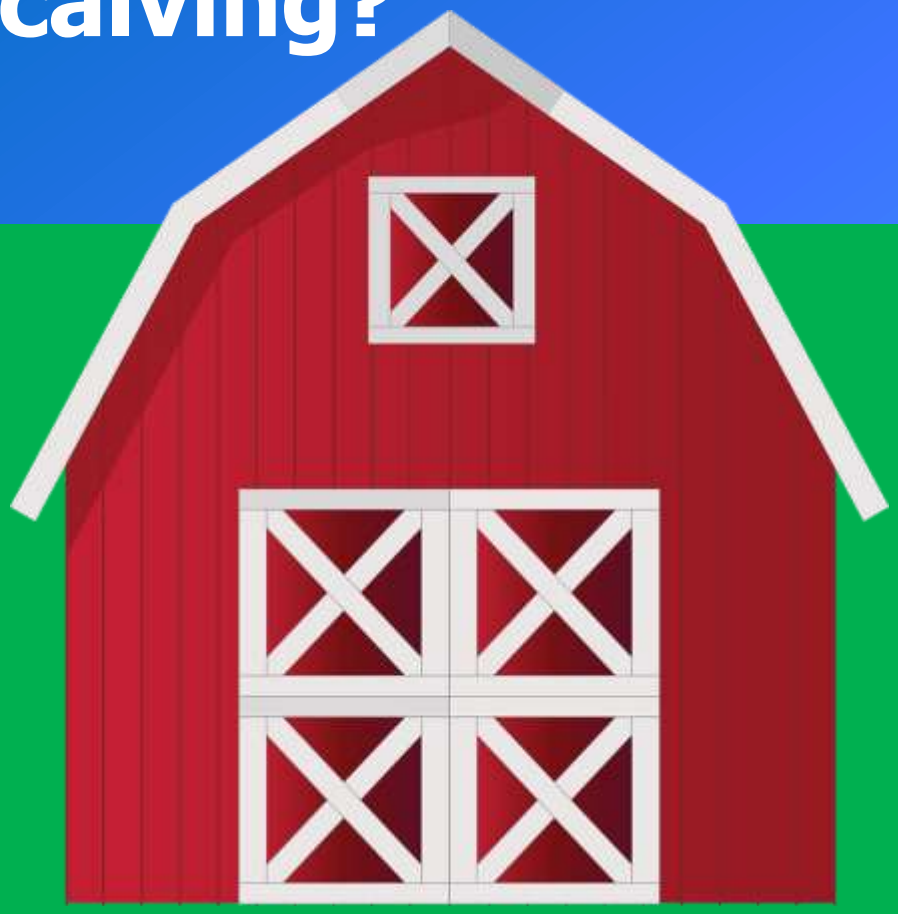
Should all cows be treated during calving?

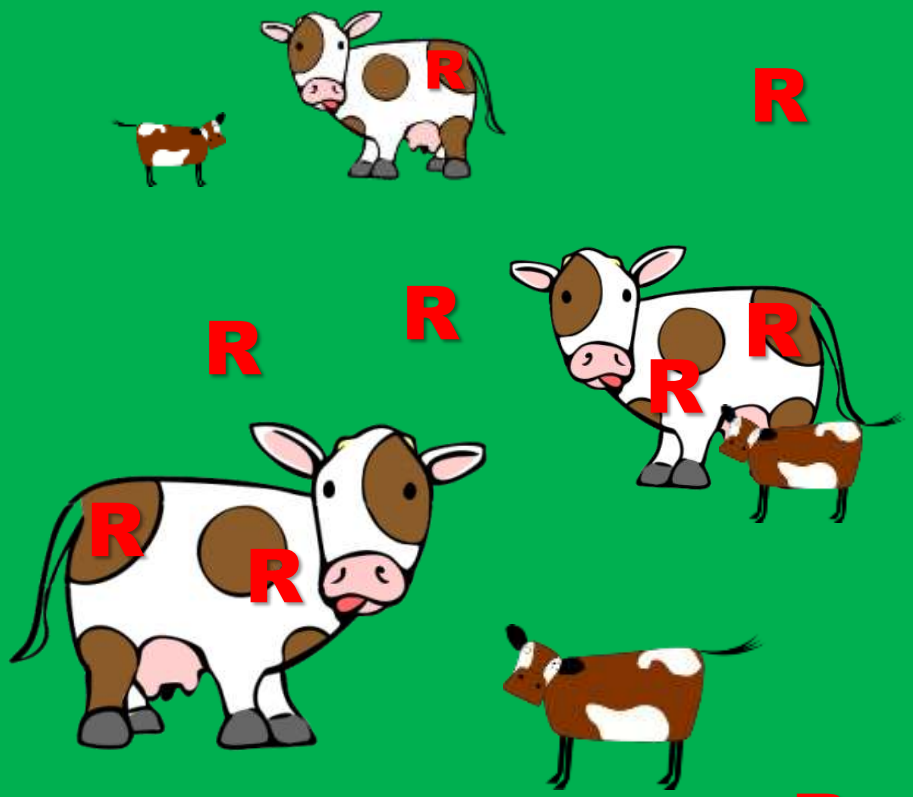
Should all cows be treated during calving?

Should all cows be treated during calving?

Should all cows be treated during calving?

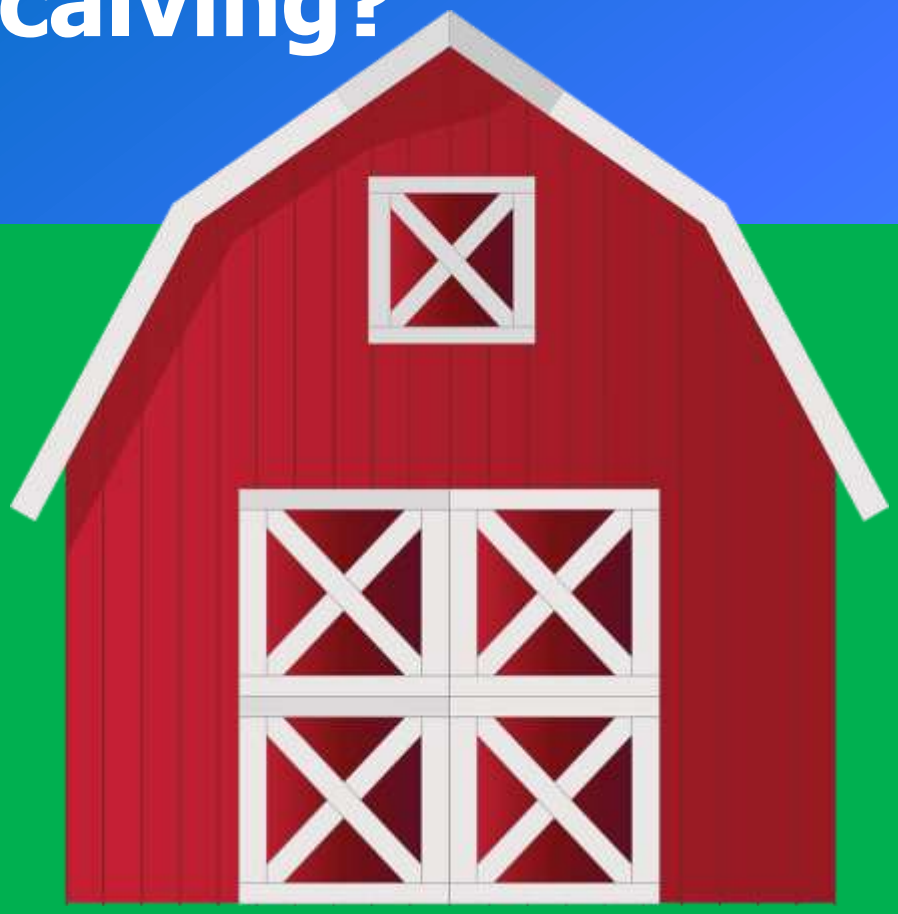
Should all cows be treated during calving?

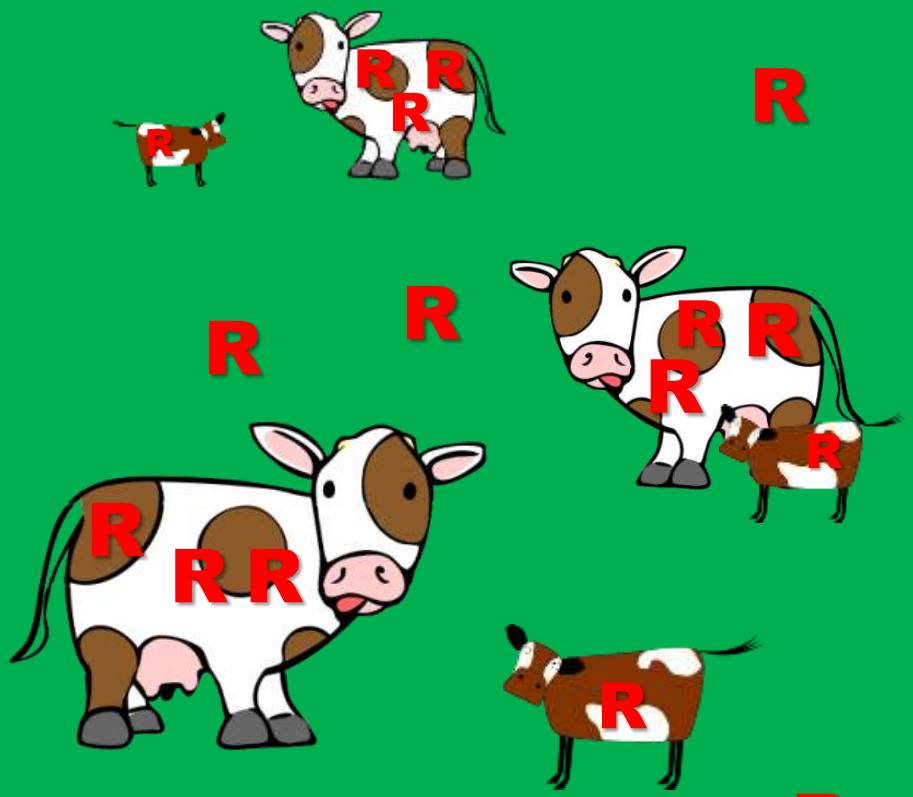




R R R R R R R R R R R R

Should all cows be treated during calving?





Essential concepts (cont.)

- ....Life cycle of the targeted parasite
- Parasite burden: Animals, pastures
- Judicious use of anthelmintics
- Refuge

Agronomic concerns:

- **Resistance vs. resilience**
- Risk factors that favor parasitism
- Clean pastures and contaminated pastures

Agronomic concerns

Diagram credit: Diane Allard, agronomist

Resistance vs. resilience:

- **Host** resistance: Contact immunity (1-18 months)

  Resistant host: Adult excrement and low eggs/g

  Favorable factors for the host: Genetics, diet, etc.

- **Resilience**: Animal that lives in equilibrium with the parasite: Flesh in good condition, good yield

  Note: Resilient animals can excrete a large number of eggs: Source of pasture contamination.

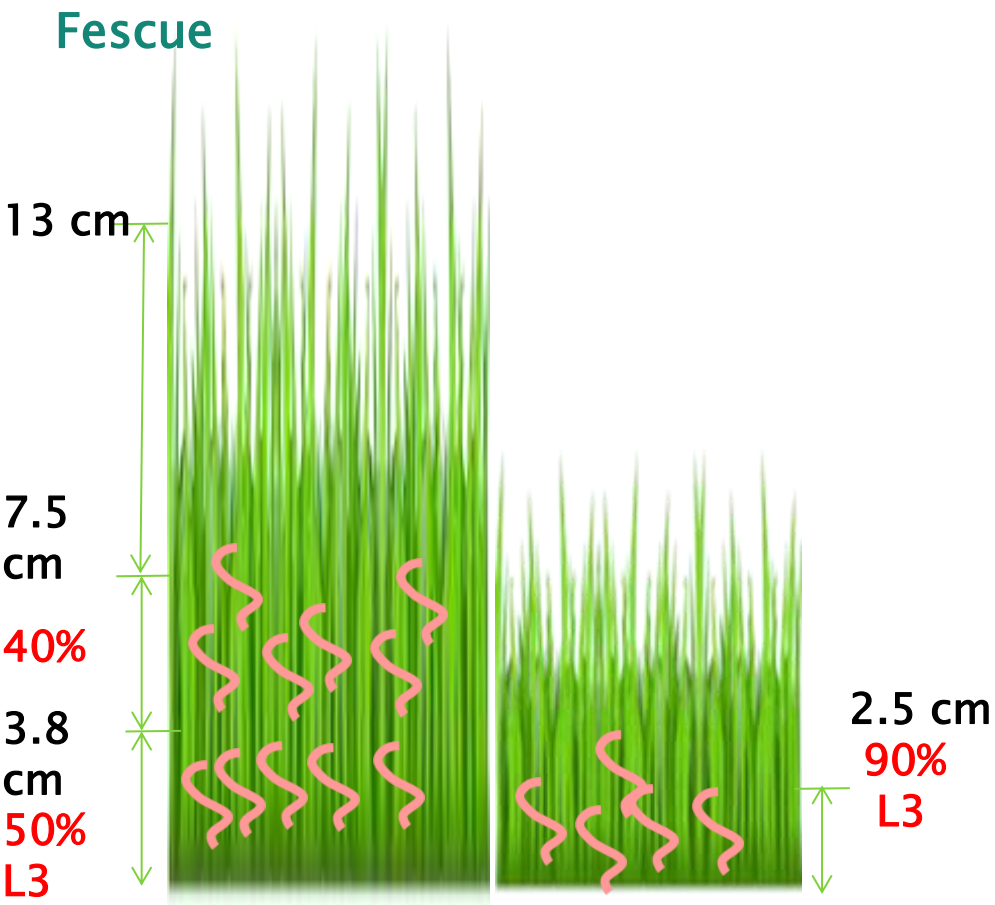
Risk factors

(for grazing, agronomic concerns)

- Variations in climate: Heat and humidity
- Animal density in the pasture
- Stagnant water: Drainage
- Physiological condition of the animal: Age, lactation, etc.
- Pasture rotation intervals
- Diet: Proteins, certain minerals, and oligo-elements in relation to immunity
- Grass height: 5-7 cm (for example, *ostertagia* and *haemonchus* infective L3)

Vertical location

Internal *Ostertagia* parasites



Crofton (1948), reported by: ADAS, Impact of grazing management on cattle and sheep parasites

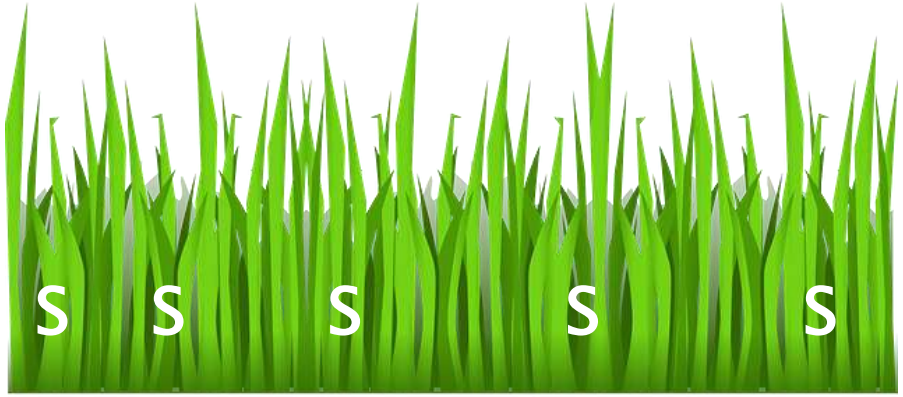
Varies by plant but always quite close to the ground so:

Remove animals when height is 7.5 cm or more.

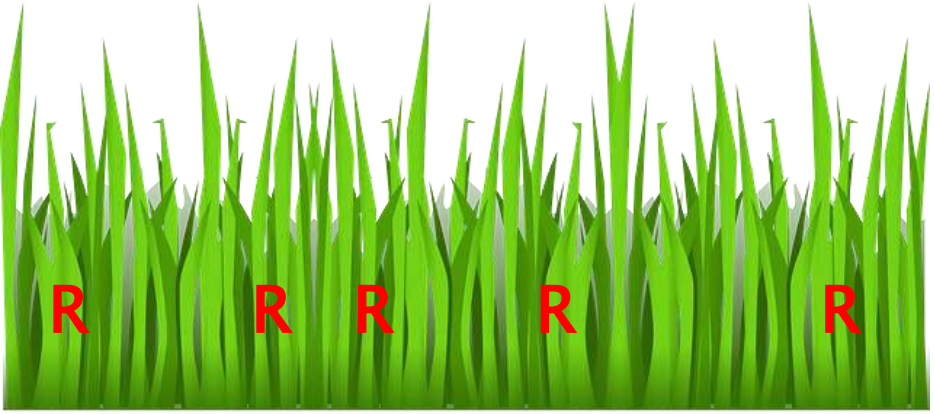
Pastures

- **Clean pastures**:
  - New or plowed pasture
  - Used by a different species for more than a year
  - Harvested as forage for more than a year
- **Pastures contaminated by:**
  - Non-resistant parasites: Refuge
  - Resistant parasites
  - A mixed population: Susceptible and resistant: Refuge

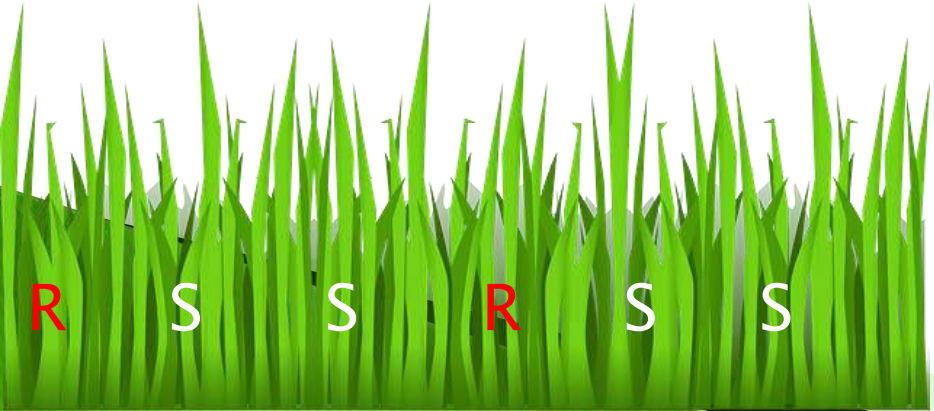
Contaminated pastures:



Susceptible to treatment



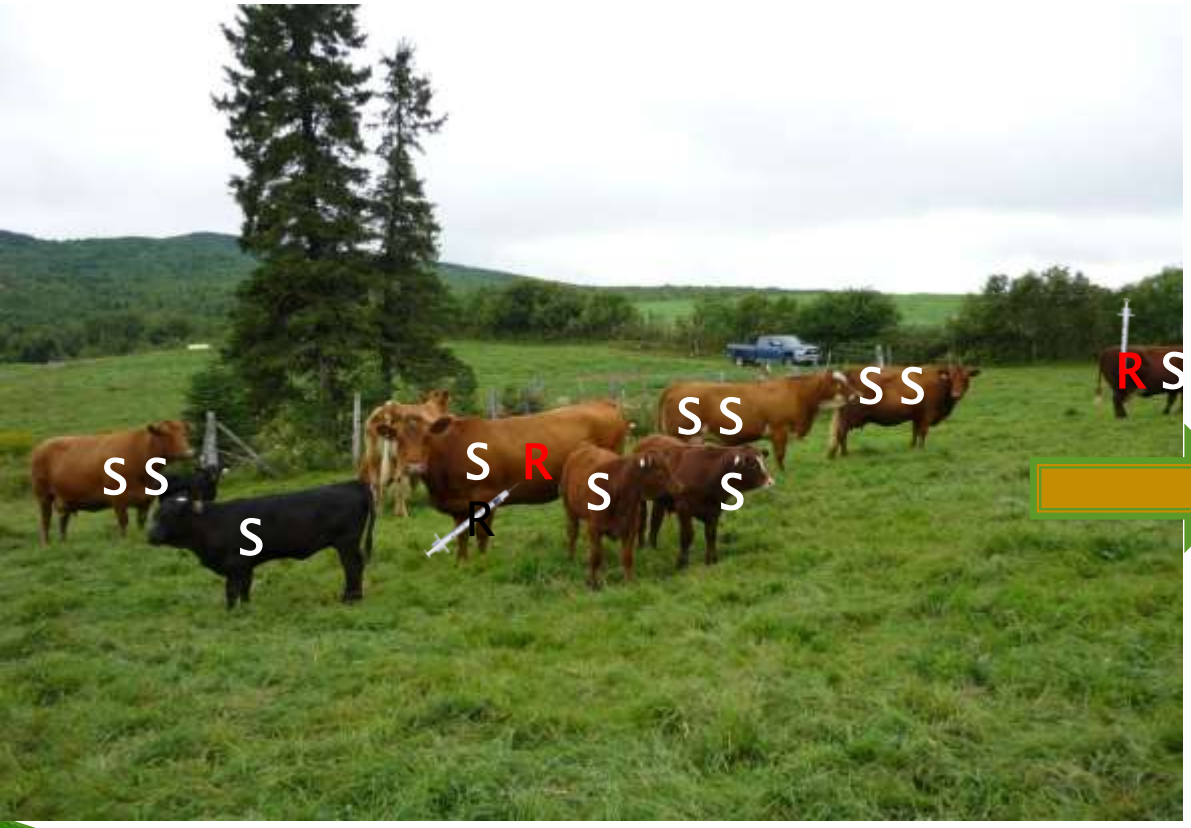
Resistant to treatment

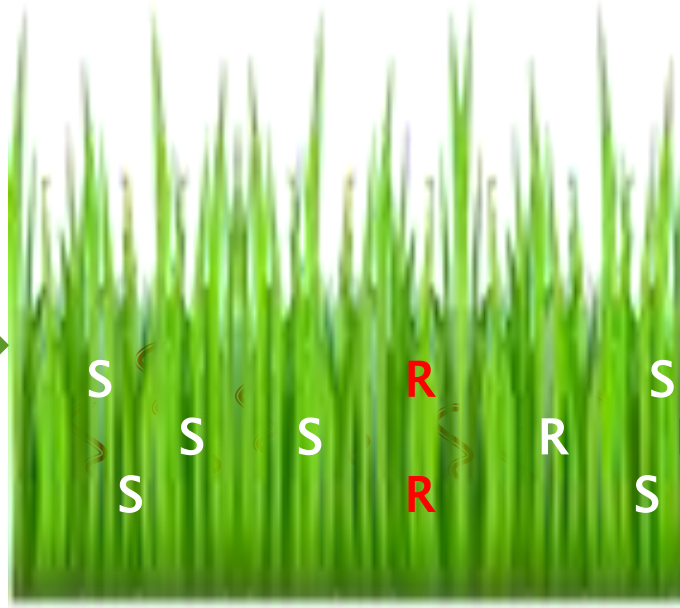


Mixed

A mixed pasture

Animals	Pasture

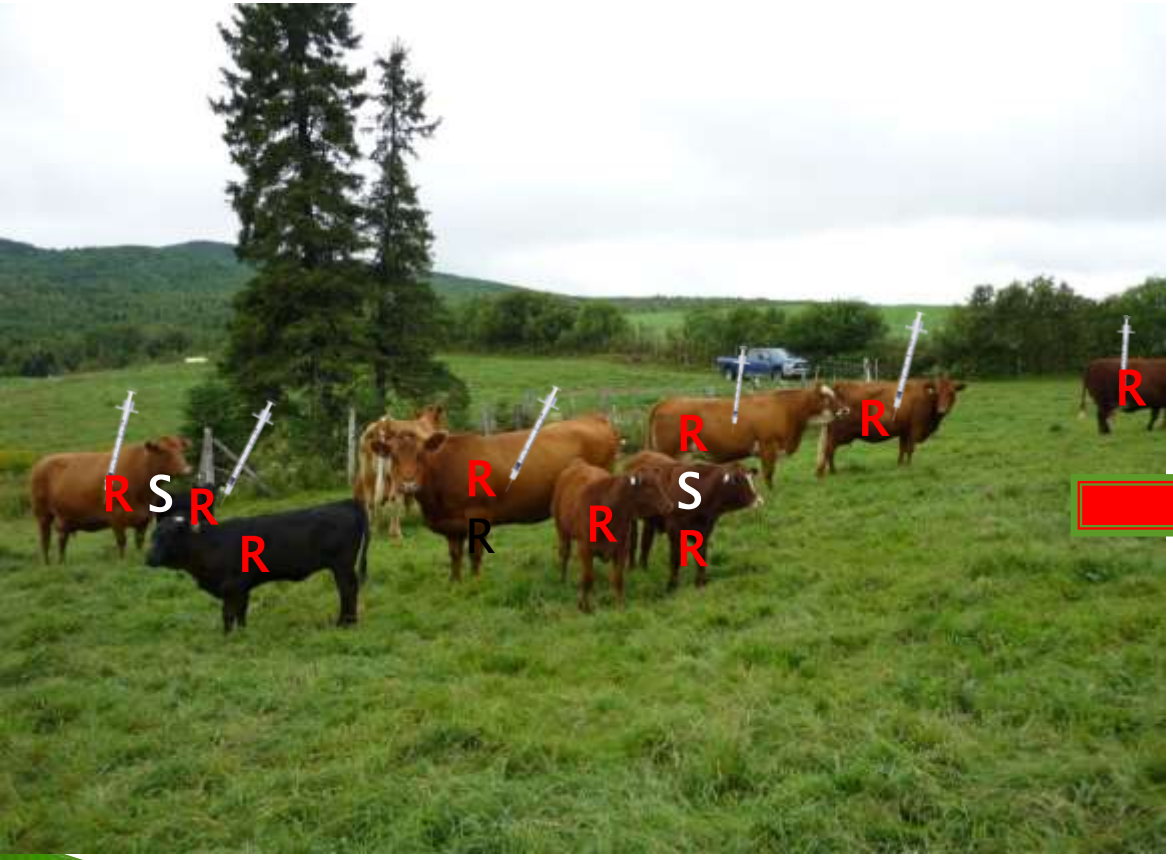


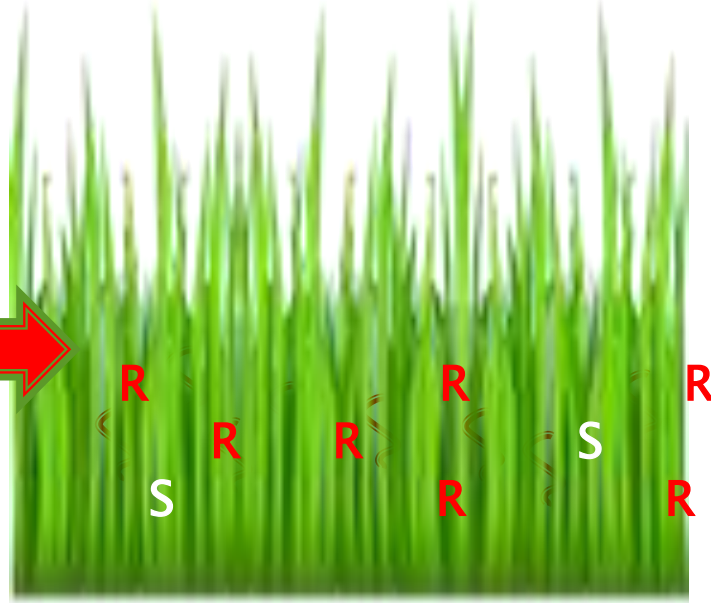


R Resistant parasite
S Susceptible parasite

Pastures we don't want

Hypothesis	Pasture





R Resistant parasite
S Susceptible parasite

Management plan???

What can we do???

We can choose one or several courses of action

Veterinarians:

- Assess the parasite burden in animals:
  Monitor all season long
- Use anthelmintics wisely: REFUGE
- Check treatment efficacy

Agronomists:

- Take concrete action on pasture, e.g., reduce animal density, rotation.
- Identify clean and contaminated pastures and use them for the appropriate groups
- Promote a diet rich in protein and minerals:
  selenium, cobalt, etc.

CHARLEVOIX PARASITE PROJECT 2014-2015-2016

The 24 farms in 2014

- Beef cattle: 11
- Dairy cattle (non-lactating cows and heifers): 6
- Sheep: 1
- Goats: 1
- Horses: 1
- Llamas and alpacas: 2

- 2015: 24
- 2016: 28

Project goals

1. Inform producers about **financial losses**
2. Raise awareness of gastrointestinal parasites in their herd
3. Document their treatment habits
4. Provide information about the parasites present

The way forward

1- Know which parasites are present in the herds (species and numbers)

- Fecal analyses and training

2 - Promote judicious use of anthelmintics and the concept of refuge

- Training and recommendations

3- Introduce new tools for managing animals at pasture

- Training and recommendations

Fecal analysis results

- Interpretation, results as eggs/g
- Veterinarian recommendations:
  - Species, numbers
- Agronomist recommendations
  - Rotation, length of time at pasture, etc.

Annual meeting with participating producers

- Training: parasite cycles, concepts of resistance, how to treat and with which product, how to prepare a management plan
- Sharing ideas on recommendations
- Discussion of results and trends

Key project statistics
(veterinarians' component)

- 82% of participants had never done a fecal analysis prior to the project

- 59% used treatments in a different way
- 64% performed a control fecal analysis after treatment
- 59% created a refuge

Key project statistics
(agronomists' component)

46% of participants started using new grazing practices during the three years of the project

Of these:

- 67% reduced time at pasture
- 56% improved rotation management
- 44% increased the grass height at which animals were removed
- 33% took action to clean up a pasture

Follow-up: 2018
Two years after the project ended

- **77%** of participants use the target treatments as needed (2016 = 59%)
- **66%** have implemented grazing practices suggested in the project (2016 = 46%)

Conclusion

All farms that use grazing can take action to prevent parasite resistance. A strategic management plan should take into account the target parasite, the parasite burden in the animals and fields, the judicious use of anthelmintics, etc. All of which brings us one step closer to sustainable agriculture.

Acknowledgments

The organizers of Cattle Day 2018
Fernand Turcotte, agronomist
Diane Allard, agronomist, instigator and collaborator
All the Charlevoix producers who helped us make this project happen
MAPAQ staff for the other projects

Thanks for listening!
Any questions?

References

- Eighth International Sheep Veterinary Congress, February 2013, New Zealand.
- Dr. Alain Villeneuve, DVM, Ph.D., speaking at the OMVQ Conference, November 2013, presentation on small ruminants, November 2013.
- Dr. Andrew Peregrine, DVM, Ph.D., University of Guelph, Ontario, OMVQ Conference, *La résistance des parasites aux anthelminthique*, Nov. 2015.
- Dr. Christopher Fernandez-Prada, Ph.D., *Agents infectieux animaux de Rente*, June 2017.
- Dr. Joan S. Bowen: OMVQ Conference, Novembre 2014.
- Dr. Paula Menzies ,University of Guelph, Ontario. Manual on controlling internal parasites in sheep and presentation at the International Sheep Congress, 2013.
- Dr. Paula Menzies: *Control of Gastrointestinal Parasites in Sheep and Goats*, 2013.
- *Parasite Control on Organic Sheep Farms in Ontario*, Dr. Laura C. Falzon, University of Guelph, Ontario, 2013.