Cattle Grub (warble) Control for Feedlot Cattle

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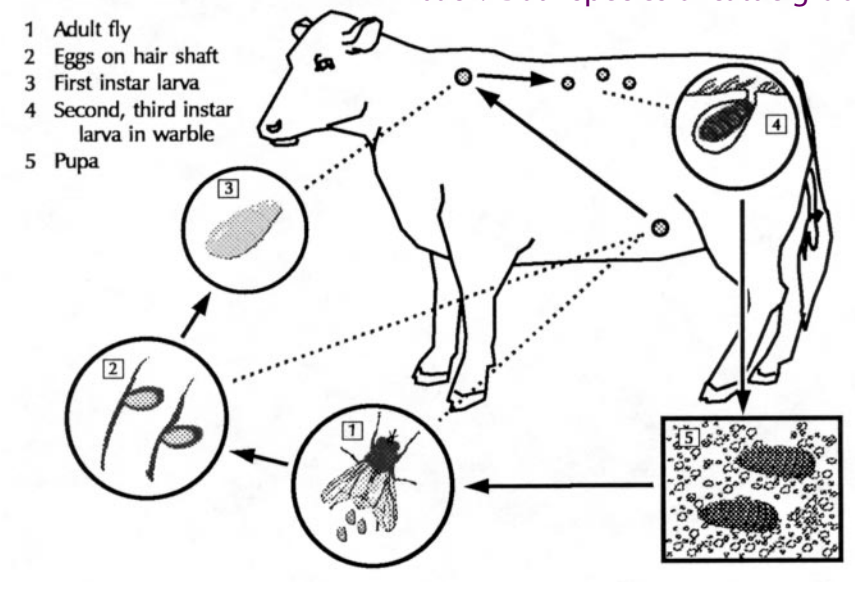
Take Home Message

- ✓ Cattle grubs, though not the scourge to cattlemen that they were in the past, remain a persistent danger to efficient cattle production. In some areas the percentage of infested calves exceeds 90%.
- ✓ Migrating grubs, in the tissue, result in lowered efficiency and increased susceptibility to disease.
- ✓ Grubs in the warbles on the back adversely affect efficiency and appearance as well as reducing value of the hide and carcass, estimated at $45/infested carcass.
- ✓ Strategic treatment programs for all age classes of cattle in the feedlot are crucial to prevent the economic losses that result from migrating cattle grubs. The cattle industry receives a benefit of $11 for each dollar spent on control.

Introduction

Cattle grubs, or warble flies, are unique among the insect pests of cattle in that both larval and adult stages cause economic losses to cattlemen. Two species, the common cattle grub (*Hypoderma lineatum (de Vill.)*) and the northern cattle grub (*H. bovis (L.)*), occur in Canada where cattle are raised. Economic losses to the Canadian cattle industry have been substantial, but effective products and aggressive treatment campaigns have reduced the damage to very low levels. Unfortunately, these insects are resilient and the reservoir population that exists is a continuing threat. Should treatment programs become less consistent and the level of control be reduced there is potential for a dramatic increase in infestation levels and a return to the levels of damage that were common in previous years. The absence of an organized surveillance program, based on rapid, field-ready diagnostics, limits the potential for predicting the development of possible outbreaks.

Figure 1. Life Cycle of the Catlle Grub *H. bovis*.



Cattle grubs have four developmental stages: egg, larva (or grub), pupa, and adult (Figure 1). The egg, pupa, and adult stages occur outside the host. The parasitic larvae (grubs) develop in three distinct stages: the first is deep within the host tissues, the second and third are within the tissue cyst or 'warble' formed as a host response under the skin on the host's back. Both species of cattle grub in Canada have similar life cycles, although there are differences in behaviour of the female flies, seasonal occurrence of each species, and the migration route within the host.

Adults are moderately large, hairy flies with black bodies and broad, distinctive yellow or gold bands. They resemble bumblebees and are very active, rapid fliers on warm sunny days. Adults of the common cattle grub are about 13 mm long and are active in April and May. Northern cattle grub adults are larger (20 mm long) and are active later in the year, in June and July.

Shortly after emerging from the pupa, male flies move to specific sites known as aggregation sites. These sites are generally located in small narrow valleys with little tree or brush cover and where a small body of water is present. Male flies rest on prominent objects at these aggregation sites and will fly up to meet passing females and other small insects (or even pebbles tossed by entomologists). The males and females meet in flight but quickly fall to the ground to complete mating. Females apparently only mate once before they begin searching for a host on which to lay eggs.

The adults have no functional mouthparts and thus are not able to feed and do not bite. They must complete all of their adult activities on nutrient reserves built up during their development in the host. These factors contribute to the short life-span of the adults, which may range from a few days to 2 weeks. Female flies are most active on sunny, warm days when the winds are light. Activity occurs mostly during midday when temperatures exceed 18°C. Egg-laying behaviour of the females differs between the two species.

Females of the common cattle grub approach resting animals, circle the target animal once or twice, and then land either on the shady side of the host or on the ground nearby. After landing on the ground, they back up to the host and, thrusting with their ovipositor, lay eggs in strings of up to 25 - 30 on the hair of the lower leg or other available parts. Those landing on the animal lay eggs on hairs near where they land. Females of the northern cattle grub hover low near the rear of their target and dart toward the host to lay eggs. The flies dart in and out to lay several eggs, one at a time. This behaviour disturbs the cattle, which run away, exhibiting the classic gadding posture with the fly pursuing. Occasionally, flies will dart in to lay an egg and then will drop to the ground for a few seconds before resuming pursuit of a host. Eggs of both species are laid on the underside of the hair near the base of the shaft, where they are somewhat protected from removal by grooming or by being accidentally brushed off.

Eggs are laid by the female flies on the hairs of cattle, usually on the lower and hind regions. The eggs hatch within 3 - 7 days, and the small, newly hatched grubs (about 1 mm long) migrate down the hair shafts to the skin. These grubs penetrate directly through the skin using both mechanical means and enzymatic digestion. They enter underlying layers of connective tissue, using digestive enzymes that break down the tissue in front of them, and begin migrating throughout the body via the connective tissue. The exact route of migration is unknown but larvae of the common cattle grub congregate in connective tissue of the esophagus whereas those of the northern cattle grub generally congregate in the fat surrounding the spinal cord and major nerves where they enter the spinal column. First-stage grubs complete their migration by moving to the back of the animal where they digest a small hole through the skin. Shortly after grubs arrive on the back, the host responds by surrounding the parasite in a cyst usually called a 'warble'. The warble isolates the parasite from the host and provides the grubs with a rich source of nutrient. Grubs grow substantially during their migration in the host, increasing from I mm in length at the time of entry to 15 mm in length by December (at 8 months of age).

The first grubs appear on the back between 32 and 34 weeks after eggs are laid, and they continue to arrive at the back for another 6 weeks. Common cattle grubs first appear on the back between mid December and mid January. Northern cattle grubs appear between mid February and the first week of May. Their numbers build slowly reaching a peak in mid February (common cattle grub) and late March (northern cattle grub).

Shortly after they complete the hole the grubs moult to the second stage. The entire second and third stages are spent within the warble where the grubs grow rapidly and store energy reserves necessary to complete the pupal and adult stages. When the grubs reach maturity they crawl out of the warble through the breathing hole, fall to the ground, and bury themselves under surface litter or soil. The entire larval period takes from 7 to 9 months. Common cattle grubs may begin to drop from the host during mid March, northern grubs in mid to late April. On the ground, grubs harden to form the pupa within which they will undergo the change to the adult fly. Development of the fly within a pupa depends on temperature and may require 4 to 12 weeks.

Cattle that have been exposed to infestation with grubs develop at least partial immunity to further infestations. The number of larvae that survive in previously infested cattle is greatly reduced. Following several infestations, most cattle become completely resistant to cattle grubs. A few cattle appear to have an innate immunity and will kill all the grubs from a primary infestation.

Recognition that cattle acquire immunity to grubs and that the immune response is directed, in part, against secretions from the grubs has led to the development of techniques for early diagnosis of infestation and to efforts to develop a protective vaccine. Grub-infested cattle produce antibodies to the excretory and secretary products (e.g., digestive enzymes) released by the grubs. These antibodies can be detected in the blood as early as 6 weeks after infestation, which enables identification of grub-infested cattle. A test for antibodies in the blood, used in combination with mathematical modelling techniques, now allows producers to estimate the size of cattle grub populations in an area by determining the proportion of calves testing negative for antibodies. In general, as the percentage of calves positive for antibodies in a herd increases, so does the mean number of grubs per animal in that herd. This approach can be useful in evaluating control campaigns and in planning follow-up treatments.

Economic Losses

Cattle grubs have caused huge economic losses to the beef industry. In 1979 it was estimated that cattle grub infestations cost the Canadian industry in excess of $14 million dollars annually. That estimate did not include the cost of insecticide now used commonly countrywide, the effects of adult fly activity, or overall reductions in animal health that result from infestation. Effective control programs based on the use of

systemic insecticides and broad-spectrum parasiticides have reduced the number of infested cattle and the damage they inflict. However, it has been estimated that the cattle industry receives a benefit of $11.00 for each dollar spent on cattle grub control.

The economic effects of cattle grubs can be divided into two interrelated categories: (1) direct effects, that include reductions in weight gain and milk production, result from the activity of adult flies and grubs within the host and; (2) indirect effects that result from the activities of migrating grubs and grubs present in the back.

Direct effects

Oviposition by adult females causes cattle to gad (a wild running behaviour characterized by the tail being pointed upward) and seek shelter in water or in shaded areas. This behaviour reduces weight gain and milk production (up to 10% during fly activity periods) by interrupting grazing patterns. It also may result in local degradation of pasture quality where cattle seek protection from flies.

The presence of grubs within the deeper tissues and in the warbles induces irritation in affected cattle. This host response to the larvae is reflected in decreased weight gains in cattle harbouring grubs. Reduced weight gain may result in longer feeding periods in finishing cattle and in longer periods needed to reach critical breeding weights in replacement beef and dairy heifers.

Penetration of newly hatched grubs through the skin produces a rash that can be intense in previously exposed cattle. This rash irritates and leads to scratching and rubbing that increases the skin damage. Affected regions are prone to secondary infections by bacteria. High numbers of migrating larvae in the esophagus can result in swelling, which may interfere with swallowing and cud regurgitation and lead to bloat. Similarly, high numbers of northern cattle grubs in the spinal canal may injure the spinal cord and cause paralysis.

Enzymes secreted by the migrating grubs are known to have general debilitating effects on the cattle when grub numbers are high. The enzymes secreted by grubs have deleterious effects on the inflammatory and immune systems, which may render cattle more susceptible to other infections. This susceptibility can be extremely important in calves both at weaning and at feedlot entry, when the combination of stress and exposure to high concentrations of cattle influences the development of respiratory diseases.

Indirect effects

Damage to the carcass and hide of cattle results from the presence of grubs and from the associated host response that forms the warbles. Grub-infested carcasses require trimming to remove both the jelly-like material formed around the warbles and the discoloured fat resulting from inflammation that surrounds the warble. Trimming requires extra time at the packers, reduces the weight, and devalues the carcass. Net losses range from $25 to $45 for each grub-infested carcass, depending on the number of grubs present. Hide damage from grub infestations can be extensive. Holes in the hide and weak spots result from scar tissue formed over healed warbles. Hides are generally discounted when more than five holes are present. The economic damage varies dramatically with the state of the leather market.

Control

Most products available for grub control are systemic insecticides or broad-spectrum parasiticides. There are a few contact insecticides that remain available, but these products are effective only against the larval stages in the back of the animals and must be applied several times in a season to give effective control.

Table 1. Cattle Grub Control Products.

Product	Active Ingredient	Administration
Macrocyclic lactone parasiticides		
Cydectin®	moxidectin	Pour-on Injectable
Ivomec®	ivermectin	Pour-on Injectable Bolus
Ivomec Eprinex®	eprinomectin	Pour-on
Dectomax®	doramectin	Pour-on Injectable
Organophosphate systemic insecticides		
Co-Ral®	coumaphos	Spray
Lysoff®	fenthion	Pour-on
Spotton®	fenthion	Spot-on
Tiguvon®	fenthion	Pour-on
Neguvon®	tricholofon	Pour-on
Botanicals		
Warble Fly Wash®	rotenone	Spray
Warble Powder®	rotenone	Spray Wash

The systemic products available for grub control (Table 1) fall into two major groups:

Organophosphate insecticides that are predominantly available in pour-on formulations, but are also available in spray, and dust formulations.

Macrocyclic lactone parasiticides (avermectins or milbemycins) are active against a broad spectrum of insect/mite and roundworm parasites and are available in pour-on, injectable and bolus formulations.

Systemic insecticides and broad-spectrum parasiticides may be applied after the end of fly activity, generally after September 15. Products containing avermectins are known to have activity against migrating cattle grubs for at least 4 weeks after application. This activity

allows their use prior to the end of fly activity if that practice is required as part of an overall parasite management program. Treatment as early as possible limits the damage to tissue from migrating larvae and reduces negative effects on the immune system. Several systemic products should not be applied for grub control after December 1. This limitation is applied to reduce the possibility of adverse host reactions such as bloat and hindquarter paralysis following death of larvae. Adverse host reactions occur when the most larvae, at nearly their maximum size, are killed in sensitive locations such as the esophagus or the spinal canal. The number of adverse reactions has declined over the last few years because the intensity of grub infestations has declined. However, it is imperative that producers follow label recommendations specified by the manufacturers.

References

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