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Environmental Factors Influencing the Risk of Bovine Anaplasmosis

Project Title:

Seasonal activity of wood ticks, Dermacentor andersoni, a vector of bovine anaplasmosis.

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Background

The Rocky Mountain Wood Tick (Dermacentor andersoni) is one of several ticks that can transmit the bacterium that causes bovine anaplasmosis. This tick is common in the western U.S., and is also found in interior B.C. and western Alberta. The wood tick has a three-stage life cycle. After tick larvae emerge from the egg, they feed on blood from small mammals like mice or rabbits. The engorged larvae then molt into nymph ticks that also feed on small mammals. The engorged nymphs molt into adults that feed on deer or cattle. If the adult ticks cannot find a host to feed on, the ticks may overwinter in the ground and emerge in spring. Once a suitable host is found, the adult ticks feed and mate. Male ticks may interrupt their feeding to look for female ticks to mate with. This questing behavior may lead the male to move from one host animal to another. The ticks drop to the ground after they have finished feeding and mating. After a few weeks, the engorged female lays several thousand eggs, dies, and the cycle continues. This life cycle can be completed in one year, but may take up to three years.

If a larval, nymph or adult tick has picked up the anaplasmosis bacterium from an infected host, the disease can be transmitted to cattle when the adult tick feeds. When mating, infected male ticks can also pass the infection to the female tick, which can then pass it to the animal it is feeding on, as well as to the next batch of tick eggs.

There has been strong interest by some sectors of the industry to remove bovine anaplasmosis from Canada's reportable disease list. This is because it is viewed as a very low risk disease that can be managed by producers and as a long standing trade irritant. Bovine anaplasmosis is rare in Canada, despite the facts that the Rocky Mountain Wood Tick is found in both the U.S. and Canada and wildlife cross the border freely. Currently, bovine anaplasmosis is a federally reportable disease in Canada and there are anaplasmosis-related restrictions imposed on U.S. feeder and breeding cattle imported into Canada. However, it is possible that climatic conditions in Canada limit the number of Rocky Mountain Wood Ticks that survive the winter to transmit the disease in the next grazing season. A better understanding of how environmental conditions affect tick development and survival will help to assess whether removing anaplasmosis from Canada's reportable disease list would present a high risk to Canada's beef industry.

Objectives

To develop a better understanding of how environmental factors affect Rocky Mountain Wood Tick survival, development, activity and reproduction.

What they did

A series of related lab and field experiments were carried out to determine when ticks become active and how host temperature, environmental temperature (ranging from 10 to 30oC) and humidity (ranging from 35 to 95% relative humidity) affect the questing behavior, survival, development and reproductive success of ticks.

What they learned

Ticks begin questing in April. The questing season was shorter in mountainous areas than in prairie areas. In mountain sites, ticks were most active in April and largely finished questing in May. In prairies sites, tick questing was highest in April and May, with less activity in June and July, and rare in August.

Most tick reproduction, development and survival parameters were harmed by low temperatures. At 10oC, egg laying was delayed, fewer eggs were laid, hatching was delayed, fewer hatched, fewer larvae molted, fewer nymphs molted, adult females engorged more slowly and adult survival rates decreased. Adult female ticks engorged faster, became larger, and survived better as air temperature increased. Warm cattle skin temperatures had a similar effect. Holstein and Angus cattle were used in this study; the Holstein had warmer skin temperatures than the Angus cattle, so ticks engorged and survived more successfully on the Holstein cattle.

Four main factors encouraged male ticks to move from one cow to another. Male ticks were most likely to move if (a) there were not very many female ticks on the original host animal, (b) there were a lot of female ticks on the recipient animal, (c) the female ticks on the new host were more mature, and/or (d) the temperature was low. The last two factors are likely related to pheromones, which insects use to attract mates. Mature females release more pheromones. Ticks mature more slowly at low temperatures, so the male ticks had to look harder for a mature mate. Male ticks survived longest when they were fed, when temperatures were moderate (15oC) and humidity was high (85%).

What it means

The results summarized above were used to develop models to predict the risk of anaplasmosis becoming established and spreading in the Canadian cattle population due to the importation of infected feedlot or breeding cattle.

Imported feeder cattle would be most likely to carry ticks if they had been on pasture or range during the spring and early summer before importation. Importing infected breeding stock could result in the spread of anaplasmosis when infected cattle grazed tick-infested pastures in spring and early summer.

Anaplasmosis could be transmitted in two ways. The first is by ticks that fed on an infected animal, dislodged, survive in the pasture, and then reattach on an uninfected animal. The risk of this occurring on rangeland would be greatest if humidity was high (which is rare in the Canadian prairies, particularly in summer). Anaplasmosis could also be transmitted by questing male ticks moving directly from an anaplasmosis-infected animal to an uninfected animal. The risk of this would depend very much on the size of the tick population, so practices that reduce tick density, such as the application of permethrin for tick control, would help to reduce the risk of anaplasmosis.

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