Pesky Pathogen

Summertime pests are principal vectors for anaplasmosis.

by ***Shelby Mettlen,*** *assistant editor*

'Anaplasmosis has been known in cattle for at least half a century," began Ram Raghavan, assistant professor with Kansas State University's (K-State) College of Veterinary Medicine at the Anaplasmosis Symposium hosted at K-State Polytechnic's campus in Salina, Kan., May 11.

The disease that has become one of the leading killers of cattle across the country has been known by a number of names and has been associated with various symptoms, but it remains a common disease in the tropics and subtropical regions of the world, Raghavan explained. Enzootic, or endemic, regions lie in the South, along the Atlantic Gulf Coast, the Atlantic states, many Midwestern states and into the West. The disease, caused by the pathogen *Anaplasma marginale*, is a problem for cattle producers across the United States, and it's only getting bigger.

"Even in the places where the disease is not considered established, the states in those regions have consistently reported anaplasmosis in their cattle herds," Raghavan, who specializes in Geographic Information Systems (GIS) and spatial epidemiology, said. Carrier cattle from endemic regions are continually transported to regions where the disease has not been established, allowing the disease to spread. The subsequent mechanical or biological transmission of the disease from infected animals to noninfected animals then results via tools, flies and ticks.

"The distribution of the disease we know of in the U.S. is expected to change, largely because of the changing weather patterns … and the anthropogenic influences on disease systems overall," Raghavan explained, adding that this is true not only for the United States, but for all of North America. He added that there will be shifts in the distribution of anaplasmosis across the country.

The transmission of *A. marginale* from an infected animal to a noninfected animal can happen in one of three different ways: Mechanically, from biting flies or blood-contaminated fomites (surgical instruments); transplacentally, from cow to fetus; or biologically, from ticks.

Mechanical transmission can occur when biting flies feed upon an infected host, then carry the bacteria with them and pass it on to a noninfected animal. Fomites that have been exposed to the pathogen, like syringes or other surgical tools, can also spread the disease if used subsequently on a noninfected animal.

Transplacental transmission occurs in endemic areas where contaminated blood is passed through the placenta from the uterus of the cow to the unborn calf.

"It is a significant part of the anaplasmosis epidemiology in endemic regions," Raghavan said.

The third and, according to Raghavan, most important way by which anaplasmosis is transmitted is by biological transmission involving ticks. Ticks attach themselves to an infected host and ingest contaminated blood, where the bacteria multiply in their gut and salivary glands. The tick then falls off, attaches to another host, and the chain continues.

It's important to note that replication of the *A. marginale* bacteria only occurs through biological transmission via ticks.

"It's only with ticks that you can start with very few bacteria and by the time the ticks bite other animals, you have multiple bacteria," Raghavan said. "It really bio-magnifies the whole situation."

Mechanical transmission

Stable flies are the primary cause for mechanical transmission of anaplasmosis bacteria. The housefly's ugly stepsister, the stable fly, is fairly common in Kansas, but is more prevalent in Missouri and the southeastern part of the country, Raghavan said. The stable fly is similar to the housefly but a bit smaller at just 5-7 millimeters (mm) long. The greatest difference between the two flies is the most important: Stable flies are obligate blood feeders.

Houseflies don't consume blood. The buzzing pests feed only on mucous and salivary secretions on an animal's face, making them prime suspects in the spread of pinkeye, but houseflies play no role in the spread of anaplasmosis. Stable flies have blood-sucking mouthparts, something houseflies lack. A stable fly must consume blood to reproduce and complete its life cycle.

The lifespan of an adult female stable fly lasts only nine to 12 days, during which she can consume a blood meal a day. Each time she feeds on an animal, she can lay between 600 and 800 eggs, laid in batches of anywhere from 50 to 100 eggs at a time, he said. From egg to adult, the stable fly's life cycle takes about three weeks, so in Kansas conditions, ranchers can expect to endure at least four to five generations of stable flies mid-spring through early fall.

"When you start seeing stable flies in your pasture, on your cattle, that is usually an indication that the problem is already there," Raghavan warned. "Whether or not you're

interested in controlling anaplasmosis, or any other blood-borne parasite that these flies are transmitting, it is advised that you keep count of the number of flies that are out there so you can start doing some management."

Count the number of flies on the front two legs of an animal, Raghavan said, and if the number is anywhere from three to 10, depending on your location, it's time to incorporate a management program to control the stable fly. Otherwise, you'll start seeing economic damage.

"Stable flies are notoriously hard to control, because … the only life stage we see of stable flies are the adults. Everything else is somewhere else in the environment," Raghavan explained. "Any control that you plan should consider the fact that the eggs, the larvae and the pupae are somewhere else."

The other common fly species in Kansas that are categorized as a mechanical vector for anaplasmosis are the *Tabanidae*. There are more than 200 species of *Tabanidae* in North America, but only the horsefly has been recognized as a significant vector for spreading anaplasmosis in Kansas and the Midwest. Horseflies emerge in late spring, and females can lay between 850 and 1,000 eggs at a time. Producers can expect to see three to four generations of horseflies in a season.

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Biological transmission

While flies can carry *A. marginale* from animal to animal, they don't cause replication of the disease pathogen. Ticks, on the other hand, cause biological multiplication of the bacteria. Although that's cause enough for concern, of the 20 different species of ticks that have been implicated as vectors for anaplasmosis, only four of them are present in North America, and of those four species, only two species — *Dermacentor variabilis* (American dog tick) and *Dermacentor andersoni* (Rocky Mountain wood tick) — are recognized as vectors of anaplasmosis in Kansas. The dog tick is found in eastern and southeastern Kansas and the southeastern states, while the Rocky Mountain wood tick is found in the western and northwestern parts of Kansas, western parts of Nebraska and into Wyoming.

After a long day in the field this time of year, you may find a tick or two crawling on you or your dog. Generally, those are not the anaplasmosis-carrying dog tick, Raghavan said. Those are Lone Star ticks.

"They're not the tick that I'm talking about. Lone Star ticks have this conspicuous white marking on the back; it's very easy to spot. That's most likely the tick you will encounter in Kansas. They have nothing to do with anaplasmosis. It's the American dog tick that transmits anaplasmosis and acts as a biological vector for anaplasmosis in cattle in Kansas."

Raghavan and his research team have collected ticks in Kansas for the past two to three years. In the southeastern part of the state, he said, his research has found that for every 10 Lone Star ticks caught, there are one or two dog ticks.

"As you keep going west, around [Manhattan], the ratio becomes more balanced," he notes. "For every five Lone Star ticks you collect, you collect five dog ticks. As you keep going west, the ratio kind of flips, and you get more dog ticks and less Lone Star ticks."

The American dog tick has a distinct teardrop shape and a white or silver-gray marking on its back. The tick is usually just 5 mm long; females are slightly larger. A fully engorged female that has been feeding on an animal can grow to 15 mm wide and 10 mm long.

D. variabilis is a three-host tick, Raghavan said. The female lays several thousand eggs at once, and once an egg hatches, it becomes a larva. The larva becomes a nymph, and the nymph grows into an adult. During each of the tick's life stages, it must feed on an individual host. Once the tick reaches the nymph stage, it has a choice: Based on weather conditions, the tick may choose to become an adult when conditions are suitable, or it may choose to stay a nymph, overwinter, and become an adult in the next season.

"With mechanical transmission, the pathogen is taken from one infected animal to another purely by mechanical means. The flies that are biting have the pathogen in their mouthparts and are giving it to the animal purely in a mechanical way," Raghavan explained. "The process where the ticks are involved, the ticks are biting, they get the pathogen, it multiplies in their gut and salivary glands, and the ticks can go from one host to another host."

Male dog ticks are typically considered the reservoir host for *A. marginale*. They can mate with multiple females on the same animal, he said, or they can drop off an animal, mate and move onto another animal, making them the primary spreaders of the disease.

Determining presence of the pathogen

"We've known anaplasmosis for a few years at the K-State Veterinary Diagnostic Lab (KSVDL)," Raghavan said. "We know this is a problem, that it's an ongoing problem and that's it's going to get bigger."

To determine the prevalence of *A. marginale* among ticks in the area, Raghavan and his team went tick-collecting in Kansas, south of I-70 and east of I-35, each year for the last three to four years. The team's studies revealed that about one-third of the ticks collected were positive for *A. marginale*.

Raghavan's team had a few other questions to answer using data received at KSVDL: Has the disease increased over time in Kansas, has it spread to new places, and are there any disease clusters in Kansas?

Between 2009 and 2015, just more than 4,000 cases of anaplasmosis were submitted to KSVDL. That data determined that yes, more and more cases are being submitted to KSVDL, he said, and those cases are coming from newer areas.

"The disease is spreading, and the intensity of the disease is increasing," he said, emphasizing that if cattle in a neighboring county have anaplasmosis, the disease is likely to spread to your county soon.

Horseflies, stable flies and ticks all contribute to the spread of anaplasmosis in Kansas and surrounding states.

"We have the ticks that have the pathogen; it's not like you're always getting infected cattle from elsewhere. … We have the ticks, and we have the flies that can keep the disease going for some time," Raghavan said.

As more and more cases of anaplasmosis are reported, he believes the trend will continue. Fly- and tick-control strategies can help keep the disease in check, but producers need to be on the lookout for signs of anaplasmosis now and in the future.