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# Equine Disease Quarterly

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IN THIS ISSUE



University of Kentucky
College of Agriculture
Department of Veterinary Science

LLOYD'S

## Commentary

The emergence of new cases during late April and early May 2002 of Mare Reproductive Loss Syndrome (MRLS) is a cause of considerable concern to the equine industry. For those involved, whether horse owners, farm owners and their managers, equine veterinarians, or scientists striving to solve the problem, the continuation of the syndrome in 2002 serves to stiffen the resolve to elucidate the cause and identify methods to reduce the losses.

At the outset, it is important to emphasize that the number of cases is considerably reduced compared to the same period last year. This is based on daily disease surveillance information including the number of accessions to the University of Kentucky's Livestock Disease Diagnostic Center (LDDC), the number of sick foals referred to two local veterinary hospitals, and reports from veterinarians in the field undertaking regular reproductive examinations of mares. The combined findings provide an extremely accurate incidence of MRLS in 2002 as compared to 2001. This and other information concerning MRLS is constantly updated on the Department of Veterinary Science MRLS Web site that can be accessed at www.ca.uky.edu.

What has emerged is a different pattern of disease distribution compared to last year. Cases are less widespread, and to date no cases have been reported on farm pastures where there is a complete absence of the eastern tent caterpillar. That this observation remains in place to the end of the breeding season is critical to developing a sound and absolute understanding of the origin of MRLS. In support of this field observation are results derived from an experimental study undertaken as a collaborative project by the Departments of Entomology and Veterinary Science within the University of Kentucky's College of Agriculture. This is one of several projects on MRLS currently under way in the College, funded from federal sources and contributions from the local equine industry.

For the first time, it has been possible to reproduce MRLS under experimental conditions suggesting a role of the eastern tent caterpillar. Two further studies completed in June, supported by the Grayson-Jockey Club Research Foundation and the College of Agriculture, confirm this important observation.

Information derived from field and experimental observations does provide evidence as to the source of MRLS. It does not at this stage indicate cause but does narrow the field of investigation considerably, allowing, for example, the development of a laboratory animal model to study MRLS. Additionally, other areas of investigation can be more critically analyzed, including the influence of weather and the pathological changes associated with MRLS, both of which are discussed in separate articles in this issue.

The practical consequence is that, if these observations are confirmed, a means of reducing the incidence of MRLS becomes available by controlling the presence of the eastern tent caterpillar on horse farms and adjacent properties. Recommendations to horse owners and farm managers to reduce the incidence of the disease prior to the commencement of the breeding season also become simplified.

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International

National

## First Quarter 2002

The International Collating Center, Newmarket, reported the following disease outbreaks.

Cases of botulism occurring in 2001 and 2002 were reported from Switzerland. There were at least six outbreaks with 23 horses affected, of which 13 were euthanized. All cases were associated with the feeding of silage or haylage. The toxin has not been typed.

The respiratory and abortion forms of equine herpes virus (EHV) were reported from France. EHV-1 abortion was diagnosed in Germany, and in Italy major losses were reported among unvaccinated mares. Japan, Sweden, Switzerland, and the United Kingdom also reported cases. Eighteen cases of EHV-1 abortion were confirmed among Thoroughbred mares in Central Kentucky between October 2001 and March 2002. The majority were single cases on individual farms except two farms with two cases each. The paralytic form of EHV was reported among a group of unvaccinated non-Thoroughbred mares in the United Kingdom.

Equine arteritis virus (EAV) was isolated from the semen of six stallions of unspecified breed in Sweden prior to their use for artificial insemination. Switzerland is planning to vaccinate its population of Thoroughbred stallions with the inactivated EVA vaccine.

Influenza was diagnosed among non-Thoroughbreds in France, and an outbreak occurred at racetracks in Rome involving Standardbreds and Thoroughbreds. Type 2 influenza was isolated from horses with acute respiratory disease at the University of Kentucky farm in December 2001. Strangles was reported from Sweden and Switzerland and from the states of Victoria and Queensland in Australia. ■

## West Nile Virus Update

The USDA has reported 738 clinical equine cases of West Nile virus (WNV) infection in the United States during 2001 distributed over 20 states as illustrated in **Figure 1**. Of the reported cases, 651 were verified by tests conducted at the National Veterinary Services Laboratory in Ames, Iowa, of which 640 were confirmed and 11 considered probable. Mortality occurred in 156 (33.2%) of 470 horses for which an outcome was reported. During 2001, there were 66 human cases of severe WNV infection with nine associated deaths.

As of June 12, 2002, seven equine cases have been reported in Florida and three in Louisiana. Based on surveillance of dead birds and mosquito pools, WNV has been detected in Ontario, Canada, and in 12 states (Connecticut, Florida, Georgia, Illinois, Louisiana, New Jersey, New York, Massachusetts, Michigan, Pennsylvania, Tennessee, and Virginia) and the District of Columbia during April and May. ■

## Drug-Resistant Parasites in Horses

Horses can harbor more than 100 species of internal parasites. About one-half of these species are in the strongyle group. They are separated into two categories—small and large strongyles. These parasites live in the large intestine of the horse and lay eggs that are voided in the feces.

In the environment, the eggs embryonate to the first stage larvae, hatch, and then develop to the second and third stage larvae. Third stage larvae are the infective stages that crawl up on pasture vegetation and are then accidentally ingested by the horse. Inside the horse they develop to the fourth and then fifth (adult) stage. Typically the large strongyles are composed of three species in the genus *Strongylus*; these are the most pathogenic of the strongyles because they can cause colic and even death of horses.

Equine Disease Quarterly

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Detrimental effects of these parasites usually are most evident during migration of immature stages in organs outside the gastrointestinal tract. A few other species have been assigned to the large strongyle group, but they are less important than *Strongylus* spp. because they do not migrate outside the intestinal tract.

The small strongyle group includes about 50 species worldwide. Virtually 100% of horses are infected with at least some species of small strongyles. Numbers of these worms are usually lower in older horses that have had time to develop some immunity. They are much less harmful than *Strongylus* spp. because the infective third stages migrate only into the lining of the large intestine, where they encyst. Here they develop to the fourth and sometimes young fifth (adult) stage and then usually trickle out to the intestinal lumen and mature. Under poorly understood circumstances, massive numbers of larval stages can encyst and emerge, causing severe damage to the intestinal lining and resulting in extensive fluid and protein loss. This occurrence can be related seasonally, especially in late winter or early spring, and also after deworming. The condition is called larval cyathostomiasis and has been reported more commonly in Europe than in the United States. Death can occur from this disease situation. Overall, the small strongyles are not considered very pathogenic except under certain conditions, but they should not be overlooked as disease entities.

Control of internal parasites in horses has been attempted for several centuries. Most of the early medications had tremendous toxic side effects in the horse and were ineffective or effective only on a low number of species of parasites. The first broad-spectrum anthelmintic (dewormer) was thiabendazole, a benzimidazole, marketed in 1963; it was effective on most species of nematode worms. However, soon after its commercial use, small strongyles were observed to be resistant to it. Other similar benzimidazole products came on the market, but cross-resistance by the small strongyles was evident also. Various other classes of dewormers were developed and marketed. Initially, small strongyles were quite susceptible to most of them, but later resistance occurred with such compounds as pyrantel pamoate. The organic phosphate, dichlorvos, was highly active on small strongyles resistant to other products; however, this compound is no longer on the market.

In this country, only four chemical antiparasitic classes are currently on the market. They are the macrocyclic lactones (ivermectin and moxidectin), benzimidazoles (fenbendazole, oxfendazole, and oxibendazole), piperazine (piperazine), and pyrimidines (pyrantel pamoate and pyrantel tartrate). Resistance of small strongyles has been documented for all of the benzimidazoles, piperazine, and pyrantel pamoate. There has been no indication of resistance of these parasites to ivermectin and moxidectin. It should be mentioned that there have been no reports of drug resistance of the large strongyles or species of nematodes other than small strongyles.

Opinions vary as to frequency of treatment and usage of compounds. Rotation of different classes of compounds is advocated. Fast rotation is alternation of classes of drugs for each treatment. Slow rotation is using the same compound or class for several consecutive treatments.

Various treatment schedules are used, including every six to eight weeks, strategic times such as spring and fall when parasites are usually present in greatest numbers or only when fecal worm egg counts (EPGs) are above a certain number. Even though there is resistance of small strongyles to all but ivermectin and moxidectin, it seems prudent not to use them exclusively because resistance has occurred after a period of time of usage with most other products. Therefore, it is suggested that ivermectin or moxidectin be used sparingly, for instance in the spring and fall. In between, the other commercially available compounds that are still active on nonsmall strongyle nematodes can be given.

Several helpful management practices have been advocated for control of internal parasites of horses: exposing larval stages on pastures to detrimental factors such as sunlight by clipping and chain harrowing, composting feces, and rotating horses and cattle on pasture. This rotation is effective because when each eats the larval stages of the other's parasites, except for one species, the larva are killed. ■

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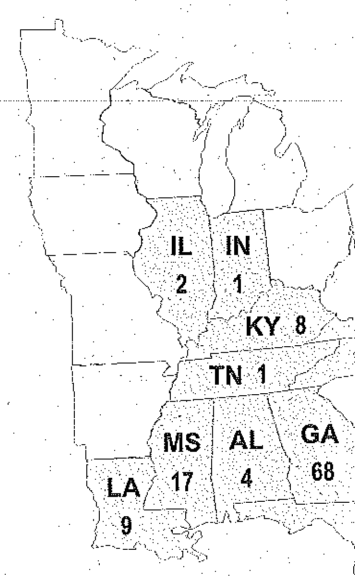
**Figure 1.**

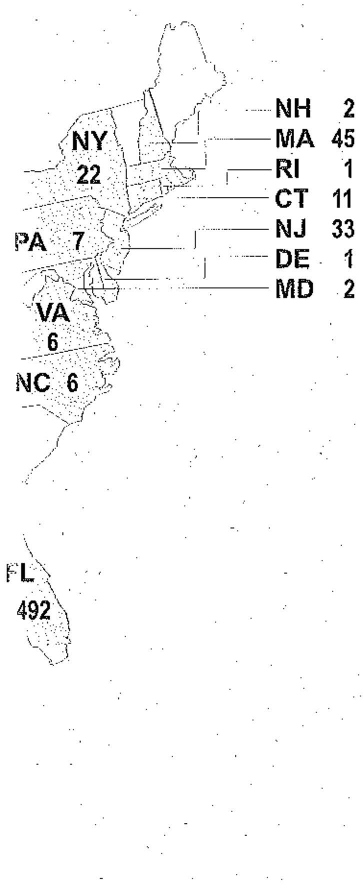
## West Nile Virus
Confirmed Equine Cases,



2001

**Total U.S. Cases—738**

156 fatal




*Kentucky*

# Mare Reproductive Loss Syndrome: Pathologic Findings

In the spring of 2001, Central Kentucky horse farms experienced epidemic losses of fetuses and foals as well as other equine health problems. This was repeated to a lesser degree in 2002. Although the cause has not been definitively proven, epidemiological investigations concluded that the losses were likely the result of a point-source exposure to the causal factor(s). This group of conditions has been referred to as Mare Reproductive Loss Syndrome (MRLS).

During the 2001 epidemic, approximately 550 late-term fetuses were presented to the Livestock Disease Diagnostic Center for examination. Necropsy examination and laboratory testing revealed a number of consistent findings in these fetuses. Multiple breeds and all ages of mares were affected. Most of the fetuses were delivered at term or were aborted several weeks prior to the due date with usually no premonitory signs in the mares. The delivery was characterized as "red bag" in many of the cases, indicating that the allantochorion was presented and passed concurrently with the fetus. Lesions were seen in both the fetus and placenta. The fetuses were of normal size and weight for the gestational age and typically were in a state of good postmortem preservation. Hyphema (blood in the eye) was occasionally present. The lungs had variable inflation from case to case, ranging from no aeration, to moderate aeration indicating respiratory efforts at the time of delivery. The lungs were sometimes slightly firm, suggesting pneumonia. Hemorrhages were often present on the pleura and heart. Some allantochorions were mildly edematous; however, most were of normal size and weight. Hemorrhages were commonly seen on the chorionic and allantoic surfaces. The most striking change occurred in the umbilical cord. A high percentage of the cases had roughening of the surface of the cord and enlargement due to stromal edema. There was discoloration of this area that was typically a dull grayish-yellow color, and there were stromal and surface hemorrhages. The umbilical cord changes were limited to the amnionic segment with the allantoic portion having the normal smooth, glistening appearance to the surface. The amnionic membranes had variable hemorrhage and edema.

Histopathologically, the lungs often contained numerous desquamated squames of amnionic fluid origin and low numbers of neutrophils and macrophages in the alveoli. Bacteria were often present in the alveoli. Other fetal tissues contained only variable congestion and acute hemorrhages. Microscopically, the umbilical cords had bacteria on the surface with loss of the epithelium and light to heavy infiltrates of neutrophils and macrophages that were concentrated near the surface of the cord. Hemorrhages and edema were present in the stroma. Similar changes were sometimes present in the amnionic membrane. Allantochorions occasionally had low numbers of neutrophils in the stroma and extraembryonic coelom.

Cultures of the fetus and placenta yielded non-beta hemolytic *streptococcus* spp. and/or *actinobacillus* spp. in more than 50% and approximately 20% of the cases, respectively. These bacteria were commonly cultured from lung, stomach content, and placental membranes. Other bacteria were not consistently isolated from the MRLS-associated cases. All other routine bacteriologic, virologic, serologic, and toxicologic testing failed to incriminate other causes.

In 2002, cases consistent with MRLS recurred. The timing was similar to the previous year, and the pathological and microbiological findings were identical to the 2001 epidemic. Although totals are still being compiled at the time of this writing, it appears that the 2002 occurrence is of a lesser magnitude.

The main pathological findings in MRLS fetuses are inflammation of the umbilical cord (funisitis) and amnion (amnionitis), pneumonia, fetal bacteremia, and sometimes placentitis. There was no single diagnostic test or finding that permitted diagnosis of MRLS. Diagnosis of MRLS-related abortion or stillbirth is based on a combination of history, time of year, bacteriologic results, and the above-described pathological findings. These pathological findings are suggestive of *in utero* fetal illness and distress but lack sufficient specificity to allow for diagnosis of the inciting cause. The role of bacteria in MRLS is still being elucidated. ■

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## MRLS Degree Days—What It Means

Although Kentucky usually experiences very pleasant weather during the start of the spring growing season of March through May, Mother Nature sometimes decides otherwise.

In nature, all biological organisms are affected by temperature. Van Hoff's Law states that for every 10 degrees (C) of increase in temperature, biological activity doubles. It was this simple law that led the Agricultural Weather Center at University of Kentucky (UKAWC) to believe that weather may play a role concerning Mare Reproductive Loss Syndrome (MRLS). Possible impacts concerning weather ranged from weather acting as a triggering mechanism to the impact of weather-related stress (i.e., wet, drought, hot, cold). Determining these weather variables that could be used as predictive tools for future weather events related to MRLS was undertaken.

It was necessary to quantify the explosive nature of spring warmth, which could be accomplished in several ways. One way was to determine the frequency of days on which the maximum temperature exceeded 80 degrees (F). April 2001 had 10 days and April 2002 had seven days on which the daily temperature equaled or exceeded 80 degrees (F). Normally, there are no days in the 80s during April. This allowed a comparison of the magnitude of heat during April but did not differentiate between days when the temperatures were in the low 80s versus upper 80s. Also, this method would not allow the determination of the "rate of change" of heat accumulation through the months of March and April.

A second, and better, method of quantifying heat accumulation is called "degree days" (DDs). The degree day is the daily average temperature (sum the daily high and low temperature, then divide by two) minus a threshold temperature.

Degree days are used in a number of applications such as insect growth and development (i.e., European corn borer degree days), crop growth and development (corn and rice growing degree days), and residential heating and cooling (heating and cooling degree days). The difference among each of these applications is the "threshold temperature" used to calculate the degree days. For example, one insect called alfalfa weevil develops at temperatures equal to or greater than 48 degrees (F), so the threshold temperature for alfalfa weevil degree days is 48. Corn growing degree days are calculated using a threshold temperature of 50 degrees (F), and heating and cooling degree days use a threshold temperature of 65 degrees (F).

For MRLS degree days, a threshold temperature of 50 degrees was selected. For a given day, if the daily high temperature was 80 and the daily low temperature was 60 degrees, the following calculation provided the MRLS degree days for that day:

[(high temp + low temp) divided by 2 ] - threshold temperature = daily MRLS DDs

*Example:* (80 degrees + 60 degrees) / 2 ) - 50 degrees = 20 MRLS DDs

The total accumulation of MRLS degree days during March and April for 2002 was 348; during 2001, it was 334; for 1981, it was 360. These figures were 194, 180, and 206 MRLS degree days, respectively, above normal. Normally during March and April 154 degree days are accumulated.

For March and April 2001, the maximum rate of change of MRLS degree days over a seven-day time period was 143; for the same time period during 2002, it was 132; during 1981, it was 96. The normal rate of change is 60 MRLS degree days.

For 2002, the degree day concept allowed UKAWC to accumulate heat units, differentiate between temperatures in the 70s and 80s, and determine the "rate of change" of heat accumulations to a much better degree than did "counting days with temperatures in the 80s." UKAWC was able to calculate, as a predictive tool, MRLS degree days on a daily basis and compare the results to those of previous years.

With weather models providing 10-day temperature forecasts on a daily basis, it will be possible to predict the MRLS degree days 10 days ahead and update the information daily. If Mother Nature decides to turn the heat on in 2003, UKAWC will be counting heat units using MRLS degree days. ■

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