

One Year Later— MRLS Still a Conundrum

BY MARK LLEWELLYN

Mother Nature often seduces scores of Kentuckians into believing spring has sprung well before its time. As rays of sunshine melt winter doldrums, thoughts of longer days elicit heady anticipation among horsemen. But all too often, Mother Nature reels in the eager souls with a dash of wintry weather. And such is the way of life in central Kentucky and neighboring lands where meteorological misfires are a simple truth. So, nary a thought was given to the erratic temperatures that occurred in mid-April last year, an explosion of warmth in early April, a hard freeze on April 17-18, and subsequent warming thereafter. Certainly, no one suspected that this one climatic hiccup would set into motion an unimaginable cavalcade of events.

Within two weeks, the famed Thoroughbred industry catapulted into a state of calamity and confusion when a storm of early- and late-term abortions pulverized dreams. Ironically, the storm reached its zenith on May 5, the day of the 127th running of the Kentucky Derby, when 73 stillborn or aborted fetuses were delivered to the University of Kentucky Livestock Disease Diagnostic Center in Lexington. In a matter of weeks, over 500 foals of 2001 and nearly 3,000 foals of 2002 were nothing more than biological artifacts, waiting their turn to be examined by veterinary pathologists.

A constellation of the finest scientists—veterinarians, agronomists, toxicologists, arborists, nutritionists, entomologists, meteorologists, and epidemiologists from all over the world—remain baffled a year after the onset of the crippling economic and emotional war waged in central Kentucky and its surrounding lands, the mecca of Thoroughbred breeding. With the fastidiousness of forensic criminologists, scientists leaped into action to determine the cause of the malady, coined mare reproductive loss syndrome (MRLS), that was gripping breeding establishments. Each offered his breadth of knowledge, cautiously substantiating some hypotheses and flatly dispelling others, but all labored towards a common goal: uncovering a definitive cause.

Investigators quickly tossed out contagious diseases and nutritional imbalances as precipitating factors and formulated a roster of pasture contaminants to inspect more closely. Included in this list were endophyte-riddled fescue, ergot alkaloids (fungal derivatives that cause smooth muscle contraction), phytoestrogens (plant hormones), and estrogenic mycotoxins (fungal poisons).



Levels of nitrite and nitrate, compounds that can concentrate in plants subjected to adverse weather conditions, were also measured.

One by one, suspected culprits were ticked off the list until a single contaminant, mycotoxins, remained. In particular, scientists focused on the mycotoxin zearalenone. Consumption of zearalenone-laden plants induces abortion in pigs and other livestock. Mycotoxins reproduce aggressively on compromised vegetation, and the unusual spring weather offered prime conditions for proliferation of mycotoxin-producing molds. Laboratory results squelched the enthusiasm of the mycotoxin-theory proponents, though, when hundreds of forage samples revealed no or inconsequential levels of zearalenone and other noxious fungal or mold by-products.

By mid-May, a second theory crept into the forefront of scrutiny. With Hercule Poirot-like deduction, scientists pieced together a plausible theory with an unlikely cast of characters. Individually, the players seemed harmless enough, but in concert, they may have proven indomitable and deadly. Wild black cherry trees, Eastern



tent caterpillars, and peculiar spring weather played critical roles in the theory.

Wild black cherry trees liberally dot the central Kentucky landscape, no doubt due to their propensity to thrive in various climatic conditions and soil types. Trees are distributed in rich forests, old fields, roadside thickets, and fencerows. They have proliferated and flourished undeterred on even the most immaculately managed horse breeding establishments in central Kentucky for years without a hint of reproach.



Lurking in the leaves, seeds, twigs, and bark of wild black cherry trees is amygdalin, a substance that remains dormant and innocuous until bruising, wilting, or frost damage transforms it to prussic acid or cyanide. Ingestion of compromised cherry tree structures, particularly wilted leaves, may trigger cyanide toxicity and death in animals. Ruminants, such as cattle and sheep, appear to be more sensitive than horses to cyanide toxicity. Despite the font of knowledge regarding their cyanide-generating capabilities, the trees continued to prosper on horse farms throughout Kentucky in the spring of 2001, usually not accessible to horses, but nevertheless on the property.

As with most deciduous plant life, wild black cherry trees have natural enemies. Their archnemesis is the Eastern tent caterpillar, a destructive, defoliating insect that can retard growth. If leaf loss is extensive year after year, immature trees often die. Caterpillar populations in Kentucky were elevated in 1999 and 2000, but a virtual explosion occurred in 2001. Because of the population density, the caterpillars were more mobile than usual, marching purposefully in search of cherry trees to plunder. During the exodus of the caterpillars from one stand of cherry trees to the next, scientists hypothecate that cater-

pillars deposited cyanide-rich frass, or excrement, across pastures grazed by mares. Horses are close grazers, ripping forage near the ground, and in doing this consumed cyanide-laced frass. In support of this theory, toxicology tests recovered cyanide in fetal heart tissue samples.

Naysayers, however, find the caterpillar component of the theory debatable but concede that cyanide may have been integral to the rash of abortions. Entomologists opine that caterpillars are a dead-end reservoir for cyanide, as the poison is thought to be denatured in the gut of the insect. Further, and perhaps more damaging to the theory, entomologists have concluded that mares must have eaten substantial quantities of frass to be affected, as excretions contain only 10% of the cyanide found in the intestinal tract of the caterpillar. If indeed mares were unable to ingest enough cyanide in frass to induce reproductive distress, the route of cyanide ingestion remains elusive.

Even as the theory implicating cyanide and caterpillars loses momentum, another is gaining publicity. Recent research at Clemson University points to poison hemlock as the probable culprit in the onslaught of abortions. The plant commonly grows in moist areas such as creek banks, hedgerows, and fence lines. Coupled with its omnipresence and innate hardiness, hemlock manufactures an abortifacient, an abortion-causing compound, known to affect livestock. Hemlock exposed to extreme temperature variations, such as those in mid-April, would be ripe with the toxicant, according to researchers. The hemlock theory is being considered by Kentucky-based epidemiologists as perhaps contributing to the syndrome, but acceptance of the theory as definitive is not widespread among researchers and veterinary practitioners.

Despite almost a year of intensive and collaborative research efforts, no explanation for the syndrome has been found. Continuing investigations involve attempts to re-create probable scenarios in laboratory settings. As time passes, the investigative team moves further from the initial insult. Like so many criminal investigations, as time passes, trails run cold.

Epidemiological Survey

Epidemiology is the branch of medical science that investigates the incidence, distribution, and control of disease. Surveys have historically been instrumental tools in epidemiological studies. To assess the enormity of the problem facing central Kentucky and to ascertain the extent of early fetal losses, a short, five-question survey was sent to members of the Kentucky Thoroughbred Farm Managers' Club on May 7. By the morning of May 10, 159 responses had been returned. Using only mares that were at least 42 days pregnant, 122 farms confirmed early fetal losses. Seventeen farms reported that over one-half of the mares in this stage of pregnancy aborted.

A more complex two-part survey was designed to pinpoint potentially multiple risks on farm, pasture, and individual animal bases. In addition to University of Kentucky researchers, the USDA Centers for Epidemiology and Animal Health was asked to help formulate the survey. During the week of May 30-June 8, more than 100 farms were surveyed to identify the factors associated with early- and late-term abortions in central Kentucky. Questions focused on potential risk factors, protective factors which may have prevented mares from being affected, and other factors that merited further investigation.

Responses from 133 farms substantiated the early preliminary theories maintained by the bevy of researchers. Four factors were associated with increased susceptibility to MRLS: breeding date in February; moderate to high concentration of caterpillars in areas near the mares; presence of cherry trees around the pastures; and presence of more than 50 mares on the farm.

Many factors deemed to have no association with incidence of MRLS were also extracted from the survey: plant composition in pastures; mowing, fertilizing, harrowing, liming, or spreading manure on fields; source of drinking water; grain type or amount; bedding type; deworming schedule; and contact with other farm animals.

Economic Impact

The economic damage caused by MRLS to the horse industry, on the state and national levels, is staggering. In a study prompted by the governor of Kentucky and carried out by professors at the University of Louisville, total losses through 2003 were estimated to be over \$300 million. According to the study, the greatest losses will occur in 2003, when the almost 3,000 aborted early-term fetuses would have been yearlings. This figure takes into account unrecoverable stud fees, barren mare upkeep costs (board, veterinary, and farrier expenses, for instance), and potential revenue from the preparation and sale of weanlings and yearlings. Others affected by MRLS, albeit less obviously, are farriers, veterinarians, and dentists that will have fewer horses to care for, hay growers and feed manufacturers that will sell less inventory, and countless full-time farm workers that may have their hours cut due to the shortage of horses to maintain.

What Now?

With foaling and breeding season in full swing, horsemen feel confident that the medley of factors that coincided to cause MRLS in 2001 will not materialize this year. Based on the information collected from researchers by late October 2001, the University of Kentucky College of Agriculture released four primary measures that may prevent a recurrence of MRLS, including: minimizing or eliminating exposure of mares to Eastern tent caterpillars;

keeping pregnant mares out of proximity to wild cherry trees; frequently mowing pastures grazed by mares; and providing hay to horses on pasture.

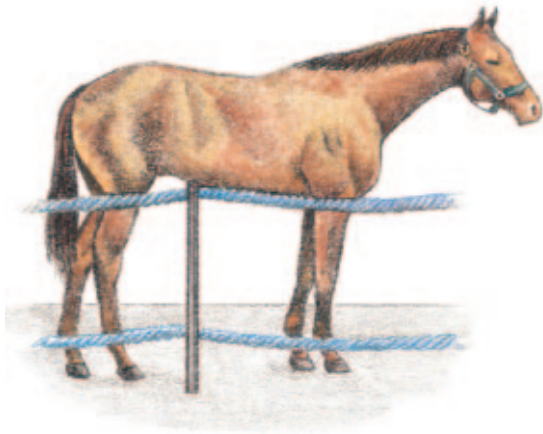
The population of barren mares left in the wake of the MRLS insult kept veterinary practitioners bogged down at the onset of breeding season. Horsemen traditionally begin breeding mares in mid-February in an attempt to have foals born as close to January 1 as possible. In 2002, however, some breeding sheds opened early because managers anticipated larger books to popular stallions. On the flip side, some horsemen chose to breed mares later in the season so they will be out of harm's way should the syndrome recur.

Despite well-intentioned optimism by experts, horsemen are being proactive in their fight against the possibility of another episode of MRLS. As a precautionary measure, farm managers are purchasing feeds containing mycotoxin binders, additives that cling to ingested mycotoxins and prevent their absorption into the bloodstream. A veritable arsenal has been amassed to limit Eastern tent caterpillar populations this spring. In addition to chemical and biological pesticides, predatory insects, and adhesive bands that prevent caterpillars from crawling up tree trunks, egg masses and young caterpillars are being destroyed. Complete removal of cherry trees from farms has been widespread. Other farms are pruning branches or building fences to keep horses from reaching cherry trees. Horsemen that cite tall fescue toxicity as a factor in MRLS are dosing pregnant mares with domperidone 15 days prior to foaling. While some preventive tactics are more costly than others, breeders have employed everything in their power to preclude a reappearance of the syndrome.

Some of the professionals that have delivered invaluable information to the research effort over the past year continue to monitor the environment for any inkling of a repeat performance. Agronomists, for instance, began harvesting grass and soil samples from pastures in February, and weather experts are on the lookout for precipitous temperature dips. As the number of risk factors elevates, the degree of vigilance will be heightened. Veterinarians and pathologists are taking little for granted, giving all abortions and stillbirths, even the presumably routine ones, utmost attention.

Day in and day out researchers expand their knowledge of equine reproductive physiology, propelling the art and science of breeding horses into places that were unimaginable just years ago. But no degree of hormone therapy, no tampering of photoperiod, and no modern-day prophylactic could forfend the rash of abortions that shook the breeding industry to its core in 2001. As is often the case with head-on warfare with Mother Nature, she claimed victory, successfully allaying all notions that humans can masterfully manipulate the horse breeding industry. ☹☹

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