HIGHLIGHTING RESEARCH
AND OUTREACH EFFORTS AT
THE UNIVERSITY OF KENTUCKY

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ESR

Equine Science Review is a monthly College of Agriculture, Food and Environment newsletter that highlights important equine work happening at the University of Kentucky.

Photo courtesy Jimmy Henning, PhD, extension professor, Plant and Soil Sciences

STUDYING ROTATIONAL FALLS TO FIND SOLUTIONS AND IMPROVE EVENTING SAFETY

Rotational falls are the leading cause of death and serious injury in the equestrian sport of eventing.

Wanting to make a sport she loves safer, University of Kentucky College of Engineering 2020 graduate Shannon Wood, MS, recently published the culmination of four years of research for her master's thesis - a series of statistical models that better predict the likelihood of a rotational fall. She completed the work under Suzanne Weaver Smith, PhD, professor of mechanical engineering at UK.

The results of her research can be used to help course designers determine the appropriate safety devices for the fences on a cross country course. The information can also be used by those who design safety devices to better optimize their effectiveness.

"Horses have always been my passion and increasing horse and rider safety through data-validated means is what motivated me to work on the rotational fall problem," Wood said.

According to her thesis abstract, the overall objective of the research was to create a statistical ensemble method for evaluating the physics of potential rotational fall situations, providing an alternative to physical testing dummies for determining indicators of rotation. She was motivated to find solutions because of the continued occurrence of rotational falls, even after the sport implemented safety devices into cross country eventing jumps. She also wanted to rectify the lack of evidence-based methods for safety device testing criteria.

TRAILBLAZING RESEARCH

Wood began her research in 2016, recognizing that it was important to capture the variety of horses, riders, jump positions and speeds approaching the jumps to better understand the nature of rotational falls in eventing. Prior to her research, physical dummies based on a horse cadaver were used to simulate the effect of the horse hitting the jump.

Based on that existing research, frangible devices currently in place were developed to break under hard contact, resulting in the jump falling, in order to lessen the effects of - or even eliminate - a rotational fall.

Providing design options for course builders and designers is important, as there are only three types of frangible devices in use but over 40 varieties of cross country jumps combined into different 'questions' for the horse and rider pair.

Shannon Wood

"The big thing for my research, instead of using information from just one horse and the physical dummies based on that horse, was being able to use a statistical model that can generate 10,000 horses and riders. There is so much variety in horses, riders and positions, especially in eventing," she said. "Additionally, current information used to create frangible pins didn't account for the rider."

Wood said she set out to incorporate the variability of these combinations, as well as the situations those horse and rider pairs would face on course, to ultimately create guidelines for the development of more frangible devices.

HERE, A COMPETITOR CONTACTED THE FENCE IN THE CRITICAL FOREARM REGION, BUT DID NOT ROTATE. SITUATIONS LIKE THIS ARE MODELED IN THE SIMULATION. PHOTO COURTESY SHANNON WOOD.

The type of statistical model Wood set out to create is similar in concept to the solutions for weather prediction.

"Previous studies to develop safety devices used physical models representing one, or at most several, physical situations leading to different designs with limited common understanding," she said.

"Providing design options for course builders and designers is important, as there are only three types of frangible devices in use but over 40 varieties of cross country jumps combined into different 'questions' for the horse and rider pair," she said.

According to Wood's research, reducing risk to competitors is a multi-faceted process with numerous fronts for possible improvement.

Her thesis refers to a "Swiss Cheese Model," or system failure model that has been applied to many high reliability settings such as medicine, nuclear power and aerospace systems. As illustrated

by the corresponding figure, the model is adapted to represent the layers of safety prevention and mitigation in eventing. A severe injury from a rotational fall only occurs if a number of unusual conditions line up.

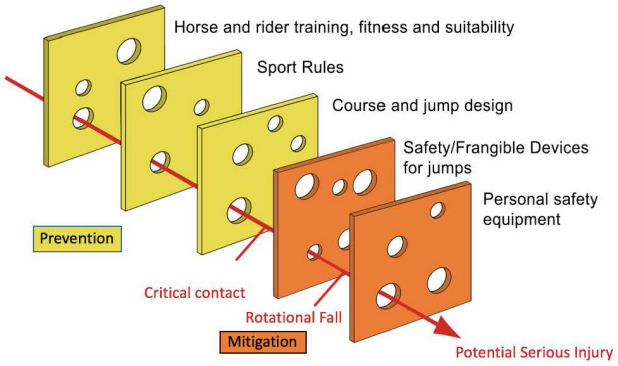
According to the model, such an injury is prevented by layers of safety, including training, qualifications, sport rules, course and jump design, among others, to prevent what could lead to the horse and rider ending up in a situation where they make contact with the fence in the critical foreleg region, or the ante brachium range of the horse's foreleg, associated with rotational falls. If critical contact with the jump does occur, the mitigation layers reduce the risk of a rotational fall through the action of fence safety devices. Finally, if that fails, individual safety technology such as inflatable vests and helmets react to minimize the consequences of a rotational fall.

Wood points out that her study is meant to help with mitigation rather than prevention. This means that safety devices lessen the consequences of horses and riders in dangerous situations rather than completely keeping competitors from problems.

At the outset of her research, Wood said there was very limited information about the physics

WOOD AND SMITH FILMING FOR THE PROJECT. PHOTO COURTESY WOOD.

of rotational falls and their contributing factors. For instance, there was no known center of gravity (CG) and inertia models for a horse and rider jumping.



AN ADAPTED "SWISS CHEESE MODEL" ILLUSTRATING THE PREVENTATIVE AND MITIGATIVE MEASURES TO PREVENT SERIOUS INJURY TO COMPETITORS IN CROSS COUNTRY.

Wood and Robles Vega, MS, developed those. There were two published epidemiological studies to provide context to root causes of rotational falls for Wood to reference.

The speeds and jumping positions of competitors at various cross country jumps were also unknown. Wood video recorded 218 total competitors approaching 10 different jumps on cross country courses in competitions ranging from Preliminary to CCI5*, yielding horse and rider jump configuration angles for different fence types. Through this process, she created a statistical ensemble tool using impulse momentum methods to identify rotating conditions and design evaluation. This information can help in the design of future jumps and safety devices.

The force-time contact between the competitor, in other words, the horse's leg and the fence for rotational falls, is also unknown, although there was an instrumented fence British Eventing study by Competitive Measure that measured force-time histories of incidental hoof strikes and other fence contacts. This creates a baseline for the contacts that should not activate a frangible device.

In addition, before her study, it was unknown what force, in actuality force-time impulses, the jump safety equipment should activate for. It was unknown if the device would activate when it "should" and, if by activating, it prevented rotational falls. Wood aimed to answer these questions as part of her research.

For an accurate statistical representation of the horse and rider inertia distributions, Wood's research began with measurements of 429 training or competing horses for inertia distributions, which included riders' heights and weights, recognizing that the variety of sizes of the horse and rider combo was important to account for.

In planning her research, Wood took an alternate approach from using the physical dummies based on a horse cadaver that had been done in previous existing studies. Instead, a statistical ensemble model was developed and applied to generate and evaluate 10,000 different situations with horse and rider that might potentially lead to rotational falls.

Combining information for these, among 26 total variables, a statistical ensemble simulation

using impulse momentum physics identified conditions for rotation and defined design criteria for future general and situation-specific jumps and safety devices.

A Jump Safety Quality Index was also devised by Wood to represent the benefit of incorporating a safety or frangible fence design for mitigating rotational falls, compared to a regular fixed-fence, as opposed to the detriment and competition penalties of false activation.

All of the situations modeled represented horses contacting the jump with their forelegs. That is a "very bad day" type situation and didn't include clear jumps or incidental hoof strikes.

KEY RESULTS

According to Wood, results of the model created in her study tell the percentage of no-rotation competitors in critical foreleg contact with a fixed fence and for a fence with a prescribed safety device. It is a tool to evaluate the likelihood of a rotational fall and to determine an appropriate safety device and its effectiveness.

This can be applied to a particular fence.

"For instance, using body positions and speeds from fence 4A, a vertical at the 2018 Land Rover Kentucky Three Day Event, for simulated situations of foreleg contact, the model predicts that 64.9% of horses contacting the fence with their upper foreleg will not rotate. After adding a device that would activate and limit the impulse to 900 N*s within a -10 to 25 degree activation range, 96.4% of competitors would not have a rotational fall," she said.

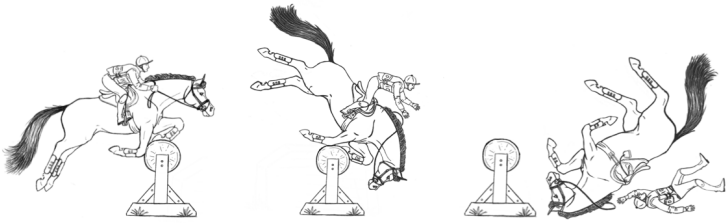
"The model also estimates false activations, or when the safety device would activate but no rotational fall would occur. This is important for the culture of the sport and competitors since an 11-point penalty is applied in FEI competitions. These predictions can be done for particular fences or for attempts to group similar jumps together, like with post and rail oxers on similar terrain," she said.

It was determined that if the center of gravity of the combined horse and rider (approximately near the rider's knee) crosses the vertical plane above the contact point, a rotational fall will occur.

ROTATIONAL FALLS ILLUSTRATION

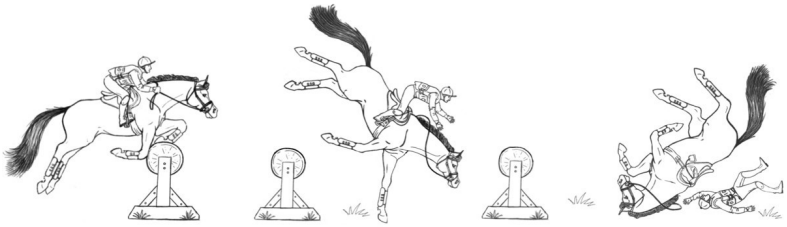
It was determined that if the center of gravity of the combined horse and rider (approximately near the rider's knee) crosses the vertical plane above the contact point, a rotational fall will occur. Thegeometry can be used to understand the results of the physics-based simulations.

The physical characteristics of rotational falls can actually be very different. See three main types, plus hind legs pushing, as illustrated below. Illustrations were drawn for Wood by Hayley Mojica, a Northern Illinois based licensed professional

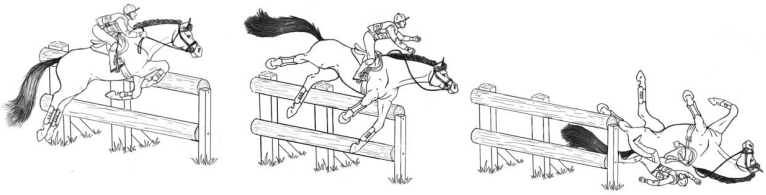


ONE-CONTACT ROTATIONAL FALL.

ONE-CONTACT ROTATIONAL FALL WITH HIND LEGS PUSHING OFF THE GROUND.



TWO-CONTACT ROTATIONAL FALL.



TORSIONAL FALL. ALL ILLUSTRATIONS COURTESY DR. HAYLEY MOJICA.

with a doctor of chiropractic who is also certified in veterinary spinal manipulative therapy.

EXPECTED IMPROVEMENT AND MODEL RELEVANCY IN SPORT

As excerpted from Wood's thesis:

To provide insight and results for policy decisions and design guidance, each physics-based simulation looks at 10,000 cases of competitors with critical contacts, which is the equivalent of more than 62.5 years of "very bad days." Reducing the 165 occurrences of rotational falls to 19 per year or less is achievable without changing the culture of the sport. This represents one in 1,048 starters (0.095%), half the rate of 2015.

Not all rotational falls can be eliminated, though, even with safety device/designs for irrecoverable contacts and low impulse magnitude contacts that would change the culture of the sport and eliminate all effects of jump contact on horse motion. Simulation results show 2.2% of the critical-contact situations for one-size-fits all cases can't be mitigated by jump safety devices or designs. Prevention of rider injury in these cases would rely on personal safety protection for three to four per year.

Data from different sport organizations differ as to what is included, so comparisons are more challenging for rotational fall statistics.

A LOOK TO THE FUTURE

According to Wood, there are several avenues that should be pursued in future research. One of those should include looking at the hind legs pushing off the ground while jumping and incorporate that with the existing model.

In addition, Wood said an important future step toward safety would be the implementation of widespread, static (non-panning) video recordings of fences on course for review purposes. Follow-up incident reports should also be completed by riders to add information to safety and accident conditions for future epidemiological studies.

"Over 700,000 fences are attempted in FEI classes, but there's not a static video camera at the fences. So when something happens, there's limited reviewable information. Having that record of how each jump was navigated could be beneficial to course designers and other professionals interested in eventing safety," she said.

"It wouldn't be terribly expensive. Consider 45 GoPro cameras outfitted, then 'record' pressed on remotes by jump judges and turned off when there's no activity. I estimate it would cost about $15,000 for equipment. However, data processing would be cost more. But, so many are calling for transparency on the 15-penalty flag rule and using the cameras to evaluate the rules and safety could be dual purpose," she said.

Wood also recommended conducting follow-up e-mail "fall" or accident report forms for riders after they are injured to learn more. One relevant industry interested in this type of information could be helmet designers.

As for the safety device testing and design, Wood recommended a focus on how to test using impulse measurements that account for the specific reaction of the fence, rather than conservation of energy methods, and how to adapt that testing to "garage" or workshop testing possibilities.

Additionally, the rotational fall problem should continue to be addressed from a course designer and builder's perspective as far as jump arc design, ground lines and decorations to increase horse perception and understanding

TERMINOLOGY USED

Safety device and frangible device are used interchangeably. MiM Clips, Frangible Pins, Reverse Pins are examples.

Activation: safety device allows fence to fall down, usually by breaking fuse type device

Prevention: doing something preemptively to keep a dangerous situation from happening

Mitigation: reducing or eliminating the consequences of a dangerous situation

CG: Center of gravity, envisioning horse and rider combined CG at the rider's knee

Inertia: a physical property that describes the size, shape and weight of something (in this case a horse and rider) which "resists rotation"

Impulse: force-time contact, the horse hitting the fence is an impulse

of the ”question,” as well as placement on terrain and proper footing.

“Now that we have a validated statistical ensemble framework for understanding the complexity of rotational fall situations that occur with fence contact, we are well positioned to bring in the jumping and landing ground interactions,” Smith said. “Besides the video studies that Shannon mentioned, advanced jumping and landing force research would provide valuable information for modeling these contributing aspects.”

NEXT UP FOR WOOD HERSELF

Wood gradated in May with her master’s and is currently seeking employment. She is interested in sports safety and using data to improve safety outcomes, particularly in the equine industry if possible.

ACCESS THE ENTIRE STUDY

Wood’s master’s thesis is provided free via open access by the Mechanical Engineering at UKnowledge. It has been accepted for inclusion in Theses and Dissertations--Mechanical Engineering by an authorized administrator of UKnowledge. For more information, please contact UKnowledge@lsv.uky.edu. To read the thesis in its entirety, go here.

| Holly Wiemers, MA, APR, is the communications and managing director of UK Ag Equine Programs.

FUNDING AND STUDY SUPPORT ACKNOWLEDGEMENTS

Wood’s expressions of appreciation: “Hayley Mojica for the illustrations of the different types of rotational falls and for being one of my first eventer friends. UK graduate Gregorio Robles Vega, MS, led the way for validating horse and rider inertia approximations, an important component to the rotational fall statistical ensemble. The eventing community has been impressive in the support for the project and efforts. Thank you especially to Vanessa Coleman and Anthony Trollope for the support and wealth of knowledge about the sport and willingness to share it with me. Thank you to Dan Michaels, Derek Di Grazia, Mick Costello, Rob Burke, Jon Holling and the Safety Committee and many others in the USEA for your insight and encouragement. Thank you to all who submitted responses to the Safety Survey and allowed me to measure their horses. Thank you to Lauren Gash, Ellen Sadler, Lisa Everett, Ashley Kehoe and all those at Antebellum Farm for teaching me the sport of eventing. Thank you to the Kentucky Three-Day Event and Equestrian Events, Inc, Chattahoochee Hills and The Event at Rebecca Farm and Sarah Broussard. Ashley Ede and Meriel Moore-Colyer (Directors, Equine Management Program, Royal Agricultural University) and Jamie MacLeod, VMD, PhD and director of UK Ag Equine Programs. Thank you to the United States Eventing Association (2017-2018), especially the private donors, and the UK Department of Mechanical Engineering (2018-2020) for supporting this work.”

UK DEPT OF VET SCIENCE HOSTS FREE ZOOM CE

The University of Kentucky Department of Veterinary Science hosted a free Zoom Continuing Education opportunity May 28, “Nipping disease in the bud, preventing treatment errors - unleash the power of the microchip.” The event featured Kevin Corley, BVM&S, PhD, DACVIM, DACVECCS, MRCVS, internal medicine specialist, and Alan Dorton, DVM, a renowned central Kentucky practitioner.

Dorton shared his experiences with the Equitrace app and bio-thermo microchips, describing how he uses these ID chips to read body temperature without using a thermometer, with vastly reduced risk to personnel, and with social distancing. He also described how frequent temperature monitoring facilitates picking up signs of disease earlier, as well as chip use assisting with the GPS locations of horses.

Corley, one of the app developers, discussed further uses of this technology and the scope for medical record keeping, integration into management practices and more.

Speakers were invited to discuss this seminar on the National Equine Conference Call, which is a national communication network for the horse industry.

UK is developing more online VetCE using Zoom. We hope to have further opportunities in July and thereafter every month. We will keep you posted and offerings will also be posted on the Gluck website. For further questions, please contact Emma Adam, DVM, PhD, DACVIM, DACVS, assistant professor, research and industry liaison at the Gluck Equine Research Center.

| Holly Wiemers, MA, APR, is the communications and managing director of UK Ag Equine Programs.

THE TENACITY OF THE BUTTERCUP

Kentucky pastures have exploded with the signature yellow buttercup flower. Buttercup is the common name for a group of species from the genus Ranunculus. Buttercups are sometimes classified as short-lived perennials, but often grow as winter annuals.

Four species of buttercups can be found in Kentucky: bulbous buttercup (Ranunculus bulbosus), creeping buttercup (Ranunculus repens), tall buttercup (Ranunculus acris) and small flower buttercup (Ranunculus arbortivus). Each of these species have somewhat similar flower heads but differ in their leaf characteristics. New seeds are produced during the time petals are showy. Waiting until after flowers appear can be too late to implement control tactics. This is one reason buttercups can survive year to year.

Buttercups are more than an unsightly weed. They can also be toxic. Grazing or mowing will release a powerful vesicant, or blistering agent, which causes blistering of the skin, mouth and digestive system on contact. The blistering agent is detoxified rapidly by drying, and thus it is not generally a problem in hay.

Less is known about whether ensiling, or conversion into silage, has a similar detoxification effect. Death of horses due to buttercup is rare. A review of University of Kentucky Veterinary Diagnostic Laboratory records over the last 13 years found no cases of horse deaths attributable to buttercup ingestion. If other forage is available, grazing horses will usually avoid buttercup because the leaves, flowers and stems have a sharp, acrid taste.

Most buttercup plants emerge from seed during the fall or late winter months. Therefore, pasture management that maintains thick stands and promotes growth of more desirable plants during these months is one of the best methods to help compete against the emergence and growth of this plant. Mowing fields or clipping plants close to the ground in the early spring before buttercup plants can produce flowers may help reduce the amount of new seed produced, but mowing alone will not totally eliminate seed production.

CHEMICAL OPTIONS

Herbicides registered for use on grass pastures will effectively control buttercup, including those that include 2,4-D. For optimum results, apply herbicide in the early spring (February-March) before flowers are observed and when buttercup plants are still small and actively growing. For best herbicide activity, wait until daytime air temperatures are greater than 50o F for two or three consecutive days. Consult the herbicide label for further information on grazing restrictions, precautions or other possible limitations.

Applying broadleaf herbicides like 2,4-D will damage clover. However, buttercup is able to germinate and grow because of insufficient ground cover of desirable forage species. In these cases, clover stands are likely not that thick or need rejuvenating.

BUTTERCUP IN FULL BLOOM. PHOTO BY JIMMY HENNING.

MANAGEMENT OPTIONS

To prevent or inhibit buttercup germination in the fall, manage grass pastures to retain residual heights of three or four inches. Realistically speaking, pastures used for overwintering, or hay feeding will always be overgrazed and therefore will be prime spots for buttercup and other winter weed encroachment. Overseeding these pastures in early spring with forages that establish aggressively (like red clover or ryegrasses) will add some desirable forage species to the spring flush of growth even though they will not eliminate buttercup emerging at the same time. Follow up with an early spring mowing to clip the buttercup and release the desirable species.

Cover up bare ground. Fall applications of nitrogen will produce taller grass (shading the ground) and will stimulate existing grasses to thicken up or tiller out the following spring. Timely mowing in the spring followed by nitrogen application can reduce buttercup seed production and will stimulate spring forage growth that helps shade the lower growing buttercup.

No matter how you go about it, controlling buttercup is not a "once and done" project. Nor will one method work alone. Chemical control alone will leave bare ground unless there is a strategy to replant or fill in that area. However, you can manage pastures to reduce buttercup incidence and improve your pasture productivity at the same time.

Happy foraging.

| Jimmy Henning, PhD, extension professor, provided this information, with support from Bill Witt, PhD, professor emeritus. Both are in the Department of Plant and Soil Sciences.

PETERSON HIGHLIGHTS RECENT ADVANCES IN TRACK SAFETY RESEARCH AND IMPLEMENTATION

Michael "Mick" Peterson, director of the Racetrack Safety Program and a professor in the Biosystems and Agricultural Engineering Department at the University of Kentucky, also serves as executive director of the Racing Surfaces Laboratory. He gave his ninth presentation on racetrack surface safety at the 2020 Jockey Club Welfare and Safety of the Racehorse Summit. Presented remotely due to the COVID-19 pandemic, his webinar covered recent advances in track safety research and implementation. The presentation covered three main topics, with Peterson speaking to pertinent researchers and racetrack leadership to illustrate current safety initiatives, best practices and future plans.

ORONO BIOMECHANICAL SURFACE TESTER BEING READIED. PHOTO COURTESY MICK PETERSON.

DATA COLLECTION: MSQ/OBST

Fourteen racetracks participate in Peterson's Maintenance Quality System (MQS), a research-based data collection service he provides to improve understanding of racetrack surfaces, which then drives increased safety. Some of the data points collected include weather, the track composition banking and track geometry.

Peterson's "culture of data" supports documentation of a track's design, inspection outcomes and daily maintenance, but it does not prescribe maintenance procedures. Rather, it is designed to track the maintenance decisions track superintendents make for their tracks and provides aggregate, cumulative data that racetracks can learn from and use to improve their surfaces.

Peterson and Glen Kozak, senior vice president, operations and capital projects at the New York Racing Association, discussed the important switch to electronic data collection, and how, by monitoring maintenance and weather data, track superintendents are able to swiftly adjust their practices at each track in real time.

After a while, you can judge the weather patterns by looking at the maintenance records, Kozak said. He also lauded the ability to differentiate turf and dirt data to detect patterns, and how the electronic data allows for safety and continuous improvement.

According to Peterson, even more data is needed to understand safety, but one conclusion is that track surface consistency appears to be a big factor. Weather, and especially water/moisture, are critical factors for track consistency.

"Conditions can change very quickly, especially in places like California, where dry winds can dry the track in a few hours," Peterson said.

To measure surface consistency and response, Peterson developed the Orono Biomechanical Surface Tester (OBST). The influence of maintenance and weather changes in composition can be understood by using this device to test the surface. Data collection for maintenance, weather, track design and usage rates can help provide guidance for decisions related to the maintenance and optimal design for a surface. Future research projects include water truck design, new track materials and the automation of data acquisition for racetrack maintenance and daily measurements.

MICK PETERSON ON TRACK. PHOTO COURTESY MICK PETERSON.

ASTM STANDARDS AND THE RISE OF TURF

In the second section of Peterson's presentation, he discussed progress that he and his research collaborators have made in establishing international standards for racetrack surfaces.

Stephanie Bonin, Ph.D., PE, a biomechanical engineer at MEA Forensic, explained how standards such as those being developed with ASTM International, can be used in regulations and to ensure that testing is done in a consistent manner. Peterson has been working with an international team to publish consensus-based standards that can be used by regulatory bodies. Peterson and Bonin have multiple ASTM standards, and even more are in process.

According to Bonin, the standards are not limited to racing; the surface recommendations apply to and support all equestrian activities.

Peterson said that, at this point, racing has some of the best protocols and standards of any sport.

One factor influencing the need for standards is the rise in popularity of turf racing in the U.S.

Jim Pendergest, director of racing surfaces at Keeneland, noted that additional focus is needed for turf tracks. The new safety protocols being developed by the racing industry will use methods described in the ASTM standards. Pendergest also discussed extending the current surface testing to document standard turf maintenance practices, including watering, aeration, divot/sod repair and repair for heavy use areas, such as the surface area underneath the starting gate.

AUTOMATION OF DATA COLLECTION NEEDED

In the final section of Peterson's presentation, he discussed the trade-offs of the MQS system with Dennis Moore, track superintendent at Santa Anita Park.

Maintenance Quality System tracks are recording data and using it to make day-to-day decisions. Peterson acknowledged how labor-intensive data collection is—track staff have to measure moisture and cushion every day and manually enter those data points.

"We need automated measurements," Peterson said. This will not only help improve the quality of data acquired at the top tracks but should also help tracks with more limited staffing to be able to participate in the Maintenance Quality System.

However, several additional areas of research are needed. One important area is how different surfaces—dirt, synthetic and turf—provide support during breakover, the phase of the gait when the hoof rotates and grabs the surface to propel the horse forward. Understanding the different response of the three types of surfaces may make it possible to develop a surface that is biomechanically more like turf or dirt but has some of the unique attributes of synthetic surfaces.

Peterson concluded with three recommendations: increased record keeping, ongoing investment in turf projects and equipment and the use of data to develop automation and new surfaces.

"We need a culture of data to improve horse and jockey safety," Peterson said.

A link to the talk can be found here.

| Karin Pekarchik, MS, senior extension associate for distance learning and founder of the UK Female Equestrian Health and Wellness Community of Practice, provided this information.

GRADUATE STUDENT PROFILE: PETER SCHMITT

FOCUS: IMPROVING TURF RACING SURFACES IN U.S.

As a member of Peterson's research team, first-year PhD student Peter Schmitt is using his engineering education and 10 years of industry experience to improve understanding of turf racing surfaces in the U.S.

After receiving Bachelor's and Master's of Science degrees in agricultural and biological engineering from Purdue University, Schmitt spent a decade in industry, specializing in diesel engine drivetrains at Cummins and Linkbelt. When he decided to get a PhD, he knew he wanted to do something that would make a difference.

"Horse racing matters to Kentucky. It matters a lot to the people in the state. It affects the economy, the traditions, the past times," he said.

He reached out to faculty at the University of Kentucky to gauge the existing research opportunities and was fortuitously introduced to Peterson, who is a professor in the Biosystems and Agricultural Engineering Department.

Turf racing is experiencing a renaissance of sorts in the U.S., with demand for increased starts. Peter's focus is to examine turf surfaces and establish some understanding of turf qualities from an engineering perspective.

He has started by analyzing soil media and particle size distribution of turf tracks around the country, and he will eventually try to codify the mechanical properties and conditions that make turf racing

so popular with owners and racing fans while ensuring that it is the safest possible surface.

"There is very little systematic engineering analysis of turf surfaces, so we are basically starting from scratch. We don't know the composition—sand, silt, clay—and we need to understand what we are dealing with," Peter said. "The goal is to make racing safer for the horse and jockey, and the best way to keep the jockey safe is to keep the horse from falling."

| *Karin Pekarchik, MS, senior extension associate for distance learning and founder of the UK Female Equestrian Health and Wellness Community of Practice, provided this information.*

Forage Timely Tips:

- Line up hay supplies now - there may be shortages again next winter.
- Continue hay harvests. Minimize storage losses by storing hay under cover.
- Clip pastures for weeds and seedheads as needed.
- Slow rotation, allowing for a longer recovery period.
- Use portable fencing to decrease paddock size and increase paddock number.
- Do NOT graze below the minimum desired height
- When managed, volunteer crabgrass can provide high quality summer forage, but these pastures should be overseeded in the fall since crabgrass dies after frost. (More information on crabgrass and its management can be found here.

Source: University of Kentucky Forage News, May 31, 2020

NATIONAL ALFALFA & FORAGE ALLIANCE RELEASES ALFALFA: HIGH QUALITY HAY FOR HORSES

Known as the "Queen of Forages," alfalfa has long been accepted as one of the highest quality hays fed to horses. It is a widely adapted, perennial forage legume which produces more protein per acre than any other crop.

To provide a comprehensive overview of the advantages of feeding alfalfa hay to horses, the National Alfalfa & Forage Alliance (NAFA) has recently updated and released Alfalfa: High Quality Hay for Horses, serving as a quick and handy guide to everything horse enthusiasts should know about feeding alfalfa to horses.

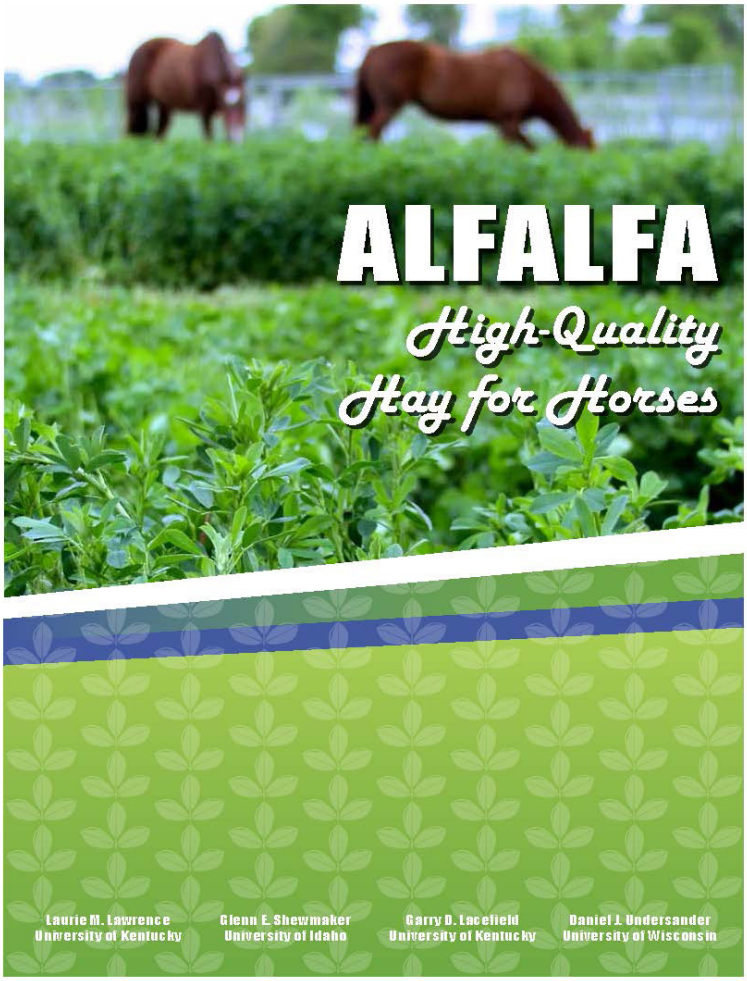
Several University of Kentucky nutrition and forage specialists have contributed to the publication in this and past iterations, including Laurie Lawrence, PhD, professor in the Department of Animal and Food Sciences, Garry Lacefield, PhD, professor emeritus in the Department of Plant and Soil Sciences.

Some of the publication's highlights include:

- Physical characteristics of high-quality alfalfa hay
- Equine digestion of forages
- How growth stage affects forage quality
- Nutritional needs of horses
- Storing and feeding hay

"When we think of feeding alfalfa hay, the first thing that comes to mind is its common use in dairy and beef cow operations," said Beth Nelson, NAFA president. "But alfalfa is often overlooked as an integral part of a well-managed, nutrient-dense equine diet."

In addition to discussing the use of alfalfa for mature horses on a maintenance diet, horses used for sport and competition, broodmares and growing horses, Alfalfa: High Quality Hay for Horses also covers multiple options of bale size, how to assess quality through hay testing and visual inspection and how the time of the year alfalfa is harvested can influence quality.



The new publication concludes with a valuable "myth vs fact" section which addresses many of the common misconceptions about feeding alfalfa to horses, such as the myth that excess protein in alfalfa hay will damage a horse's kidneys. In fact, normal healthy horses have no issues metabolizing and excreting extra protein, whether it is consumed from alfalfa hay or lush pasture.

This publication is intended as a resource for both horse owners and hay farmers as a useful educational tool to provide valuable information to their regular customers and to potential buyers.

Alfalfa: High Quality Hay for Horses is available to order for $2 per copy in print form or may be downloaded for free here.

| Source: edited NAFA news release published June 8.

Myth versus Fact

Debunking 5 Common Alfalfa Myths

Myth	Fact
Excess protein in alfalfa hay will damage the horse's kidneys.	Normal healthy horses can metabolize and excrete the extra protein in alfalfa hay without damaging their kidneys. However, horses consuming high-protein diets may consume more water and produce more urine as part of the normal excretion process. All horses should have access to clean water at all times.
Alfalfa is too rich for horses.	As with any feed, the nutrient content of hay should be matched to the nutrient needs of the horse. Early maturity alfalfa hay is very nutrient-dense and is suitable for mares and growing horses. If fed to recreational horses, the intake of early maturity alfalfa hay must be restricted. Late-maturity alfalfa hay or alfalfa-grass mix hay would be less nutrient-dense and more suitable for horses with lower nutrient requirements.
Calcium content of alfalfa is too high, especially for young growing horses.	Calcium has been fed at more than five times the requirement without detrimental effects, provided the phosphorus level is adequate.
Alfalfa makes horses cough.	Any hay (alfalfa or grass) that contains dust or mold may make a horse cough. Horses should only receive hay that is free of dust and mold. Ventilation in the feeding area can greatly reduce the effect of dust in hay on horses. If dust-free hay is not available, the hay can be soaked in water prior to feeding to reduce airborne particles.
Preservative-treated hay isn't safe for horses.	Most preservatives applied to horse hay contain organic acids that are the same as those found in the horse's gastrointestinal tract. Application of preservative helps produce mold-free hay. Initially some horses may prefer hay without any preservative, but if they are not given a choice, horses will consume the same amount of preservative-treated and non-treated hay.

EXCERPT FROM ALFALFA: HIGH QUALITY HAY FOR HORSES.

INBREEDING AND GENOMICS

Inbreeding has played a key role in the improvement of livestock breeds, resulting in more uniform populations with highly specialized performance traits. Selection for desirable traits entails identifying individuals with superior performance and often mating them to relatives (inbreeding) who possess the same superior traits. The goal of this practice is to increase the frequency of the desired characteristics and thus of the beneficial genes in the offspring. At the same time, negative consequences of inbreeding are well known. In small populations such as captive bred species, the loss of diversity associated with inbreeding is a major concern, and significant losses of diversity may lead to extinction. The increased expression of recessive deleterious genotypes can also lead to embryonic loss or other defects, some of which can be fatal. Furthermore, inbreeding can lead to a phenomenon called inbreeding depression.

Inbreeding depression is commonly manifest in poor performance of traits that are complex (due to contributions of many different genes), such as fertility and athleticism. Mindful of the dangers inherent with inbreeding, breeders traditionally balance the benefits and dangers of inbreeding by monitoring their breeding stock, culling poor performers and avoiding matings of closely related individuals.

Recently, genetic tools have become available that provide an alternative approach to unambiguously quantify and manage inbreeding relative to the traditional use of pedigrees. Today, a genomic survey of a horse's DNA may cost $70 to $180. A comprehensive whole genome sequence, including analyses, may cost $1,000 to $2,500. So far, over 1,000 horses have had their entire DNA sequenced in connection with research projects. Those genome sequences have been used to identify the genetic bases of diseases, coat colors and even some performance traits. Nevertheless, the overall performance of horses is complex, involving over 20,000 genes and probably millions of other functional elements. Studying genes one at a time is unlikely to be effective to significantly improve performance. Genomic tools, however, make it possible to identify associations between the genome and traits that contribute to success or which may cause problems.

PHOTO CREDIT: UK COLLEGE OF AGRICULTURE, FOOD AND ENVIRONMENT.

The overall performance of horses is complex, involving over 20,000 genes and probably millions of other functional elements.

One of the areas in which genomics excels is in determining levels of inbreeding. An animal's inbreeding coefficient is the likelihood that both parents transmitted the same piece of DNA to their offspring that they each inherited from a common ancestor. Traditionally, we measured inbreeding by identifying all common ancestors – those that appear in the paternal and maternal sides of an individual's pedigree. After common ancestors are identified, the relationship between the parents of the individual in question can be calculated. Using this method, on average, pedigree-based inbreeding coefficients for Thoroughbred horses are reported to be between 12.5%-13.5%, however individual horses may have values that range from less than 5% to over 20%. When genomic measures have been made in other species, geneticists discovered that inbreeding levels calculated from pedigrees are poorly correlated (50%-80%) with genomic measures of inbreeding. This is not surprising since pedigrees inaccurately assume a random and equal transmission of genes each generation.

Which variant of each gene

is inherited, however, is not predictable. For example, full-siblings share, on average, 50% of their genes; however, at any particular part of the genome they may share 0, 50 or 100%. Further, genes are not randomly distributed in a breed since selection practices are applied in mating horses. If we are good breeders, the genetic constitution of our current generation is not a random representation of the ancestors, but rather, a selection of the genes contributing to their success.

There are other ways to apply genomics to horse breeding. As noted above, both the genome and the traits we value are complex. Our genomic tools are powerful, and we can begin to seek genetic patterns correlated with measures valued by horse owners. The limitation for such studies is the quality and availability of data for traits related to fertility, conformation, durability and athleticism. Collecting these data and using genomics to identify genes associated with these complex traits would be a more sensible way to improve performance rather than simply seeking to limit inbreeding.

| Ernest Bailey, PhD, professor, and Ted Kalbfleisch, PhD, associate professor, both in the Department of Veterinary Science at the Gluck Equine Research Center, and Jessica Peterson, PhD, University of Nebraska-Lincoln, provided this information.

Source: January 2020 Equine Disease Quarterly.
The Equine Disease Quarterly is published in January, April, July, and October each year by the Department of Veterinary Science. It is funded by Underwriters at Lloyd's, London. Material published in the Equine Disease Quarterly *is not subject to copyright. Permission is therefore granted to reproduce articles, although acknowledgement of the source and author is requested.*

PARASITOLOGY VIDEO SERIES WRAPS UP

Martin Nielsen, DVM, PhD, Dipl. ACVM, Schlaikjer professor of Equine Infectious Disease at the University of Kentucky Gluck Equine Research Center, just wrapped up a new lesson-style video series on equine parasitology. The series was released with weekly episodes during the global COVID pandemic lock-down.

"I wanted to try a new format of science communication," Nielsen said. "I tried to make the videos informative and educational, but also entertaining and light-hearted."

The videos have been well received on Facebook with 50-200 shares per video and more than 60,000 views. The Gluck Equine Research Center Facebook page even gained a couple thousand followers during the campaign.

"The videos are quick to shoot with a smartphone and subsequently edit, and I think I found a good format. I definitely feel encouraged to create another series at a later stage," Nielsen said.

The series consisted of approximately 15-30 minute videos dedicated to one equine parasite each. The series covered threadworms, ascarids, small strongyles, bloodworms, tapeworms, bots and pinworms.

- Episode 1, Strongyloides westeri
- Episode 2, Ascarids
- Episode 3, Small Strongyles
- Episode 4, Bloodworms
- Episode 5, Tapeworms:
- Episode 6, Bots
- Episode 7, Pinworms

You can also find these and future videos on the Gluck Center's Facebook page.

| Holly Wiemers, MA, APR, is communications and managing director of UK Ag Equine Programs.

THREE UK COLLEGE OF AGRICULTURE, FOOD AND ENVIRONMENT STUDENTS RECEIVE USDA PREDOCTORAL FELLOWSHIPS

Three graduate students in the University of Kentucky College of Agriculture, Food and Environment have received a predoctoral fellowship from the U.S. Department of Agriculture.

Through the fellowship, Allyssa Kilanowski, Staci McGill and Tim Shull have received funds from the USDA's National Institute of Food and Agriculture to pursue a research project of their choice. The predoctoral fellowship program helps to develop new scientists and professionals to enter research, education and/or extension fields in the food and agricultural sciences within the private sector, government or academia.

"The aim of these fellowships is to cultivate future leaders who are able to solve emerging agricultural challenges of the 21st century," said Robert Houtz, UK associate dean for research and director of the Kentucky Agricultural Experiment Station. "This is a highly competitive program, and the fact that the college has three recipients is a testimony to the excellent research programs we have."

A student in the Department of Biosystems and Agricultural Engineering, McGill's research project will develop ways to improve the air quality of indoor arenas to make the facilities healthier for humans and horses. Under the advisement of UK assistant professor Morgan Hayes, PhD, McGill's research will explore designs that can aid in reducing the environmental concerns of indoor arenas such as dust, poor ventilation and excessive moisture. It will also explore the best footing materials and management.

UK STUDENTS ALLYSSA KILANOWSKI, TIM SHULL AND STACI MCGILL RECENTLY RECEIVED USDA PREDOCTORAL FELLOWSHIPS. PHOTOS PROVIDED..

"I love being able to go to farms and help them provide the best environments for their horses," she said. "Ideally, my career after graduate school will continue to focus on how to help the equine industry as an agricultural engineer whether that be in extension, as a consultant or in some way I haven't discovered yet."

From her findings, McGill will develop design guidelines and recommendations for engineers, project managers, construction companies and members of the equine industry on how to build better indoor arenas. She also plans to create extension publications, presentations and materials for the equine industry and curriculum focused on indoor arenas. She is originally from Chesapeake, Virginia.

A student in the departments of Entomology and Biology, Kilanowski will study aspects of insect dispersal, which is how insects spread to other crops and areas, as part of her fellowship.

A student in the Department of Plant and Soil Sciences, Shull's research will explore ways to suppress weeds using allelopathy techniques. Allelopathy is an evolutionary mechanism that allows plants to produce and release chemicals that negatively affect the growth of surrounding plants.

| Katie Pratt is an agricultural communications specialist in UK's College of Agriculture, Food and Environment.

THINK ABOUT HORSE HAY NEEDS NOW

A 1,200-POUND HORSE NEEDS ABOUT 24 POUNDS OF HAY PER DAY. PHOTO CREDIT: UK COLLEGE OF AGRICULTURE, FOOD AND ENVIRONMENT.

In the midst of a bountiful first cutting of hay, a University of Kentucky equine specialist reminds horse owners to start thinking about how much hay they need in the future.

"The photos I'm seeing look great," said Bob Coleman, PhD, extension equine specialist with the UK College of Agriculture, Food and Environment. "There is some good-looking hay out there, but growing conditions and weather could change things up here at home or across the country and that will move hay either across the state, to a neighboring state or wherever the need may be at the time."

Feeding horses is expensive. Coleman encourages producers to plan for how much hay they may need this winter, while growing conditions are ideal.

"Do the math and figure out how much your horses need," Coleman said. "When planning your hay budget, consider your horse's weight and plan for feeding 2% of their weight per day in hay."

For example, a 1,200-pound horse will need 24 pounds of hay per day.

"How many days do you think you will need to feed at that rate?" Coleman asked. "Will you have pasture to use, thereby reducing your hay needs, or will you have horses in the barn that get hay each day?"

For example, if owners will need to feed for 180 days, then they will need to multiply 24 pounds by 180 to get the total amount of hay they need. The more horses they are feeding, the more hay they will need.

Another thing to consider is how owners plan to feed hay. Using a feeder may help reduce wasted feed.

"Feeders can reduce waste, but they won't eliminate it," Coleman said. "Make sure you figure in an amount for wasted, perhaps about 10%. Not using a feeder can cause a hay waste of up to 50%."

Storage is an important consideration. Store hay in a covered, well-drained area to reduce waste.

"Thinking back to our example of a 1,200-pound horse and figuring in all potential waste considerations, that horse will need approximately 2.6 tons of hay or 104 50-pound bales of hay in a year," he said.

Many owners have more than one horse, with different weights. For those scenarios, Coleman suggests either doing individual calculations for each horse or using an average body weight for all horses.

Equine managers should have a nutrient analysis done on their hay. That will help horse owners know whether or not they need to supplement the forage to meet their horses' needs. The Kentucky Department of Agriculture offers a Forage Testing Program. Producers can find more information about sample submission, which has recently changed, and program costs here.

UK Cooperative Extension Service has an office in each Kentucky county, with agents who can help with equine-related questions and much more. To find a local office, visit the directory online.

| Aimee Nielson is an agricultural communications specialist in UK's College of Agriculture, Food and Environment.

NEW UKVDL TEST FEES GO INTO EFFECT JULY 1

Below are fee increases for 80 diagnostic tests performed by the University of Kentucky Veterinary Diagnostic Laboratory that will become effective July 1.

Increased fees are in response to a recurring state budget cut to the lab as well as increased costs in tissue and disposal fees and operating costs.

Please see the UKVDL fee schedule for out-of-state pricing here (usually, but not always, about one and one-half times the in-state fee).

| Source: UK VDL email announcement May 27.

UKVDL In-State Fee Increases for fy2021	
TestName	**fy2021 Fee**
Albumin	8.00
Alkaline Phosphatase	8.00
Amylase	8.00
Avian Influenza	3.00
Babesia caballi (equine piroplasmosis)	18.00
Biopsy	60.00
Blastomycosis	8.00
Bovine Viral Diarrhea Virus	5.00
BUN	8.00
Calcium	8.00
CBC	22.00
Chemistry Panel	22.00
Chemistry Panel, Canine	22.00
Chemistry Panel, Equine	22.00
Chemistry Panel, Feline	22.00
Chemistry Panel, Porcine	22.00
Chemistry Panel, Ruminant	22.00
Chloride	8.00
Cholesterol	8.00
Chronic Wasting Disease	65.00
Contagious Equine Metritis (Culture)	29.00
Cortisol, Post ACTH	17.00
Cortisol, Pre ACTH	17.00
Creatine Kinase	8.00
Creatinine	8.00
Culture-Aerobic	20.00
Culture-Fungal	22.00
Culture-Salmonella NPIP	29.00
Cytology on Submitted Slides	50.00
Equine Herpesvirus 1	40.00
Equine Herpesvirus 2	40.00
Equine Herpesvirus 4	36.00
Equine Herpesvirus 5	38.00
Equine Infectious Anemia (AGID)	7.00
Equine Infectious Anemia (ELISA)	7.00
Equine Viral Arteritis (VN)	22.00
Fecal Examination	17.00
Giardia Antigen	25.00
Glucose	8.00

UKVDL In-State Fee Increases for fy2021	
TestName	**fy2021 Fee**
Gross Necropsy - Equine Adult	350.00
Gross Necropsy - Equine Fetus/Foal	200.00
Gross Necropsy - Equine Placenta	85.00
Gross Necropsy - Food Animal Adult	150.00
Gross Necropsy - Food Animal Fetus/Neonate	95.00
Gross Necropsy - Small Animal/Exotic Animal	175.00
Histoplasmosis	8.00
Leptospira spp	33.00
Lipase	8.00
Magnesium	8.00
Magnesium - Eye Fluid	8.00
MIC Panel - Companion Animal	20.00
MIC Panel - Equine	17.00
MIC Panel - Food Animal	7.00
Mycobacterium paratuberculosis	40.00
Nocardioform	40.00
Parasite Identification	50.00
PCV/HCT	8.00
Phenobarbital	25.00
Phosphorus	8.00
Potassium	8.00
Potomac Horse Fever (PCR)	40.00
Potomac Horse Fever (IFA)	23.00
Progesterone	16.00
RBC	8.00
Research - Embed and H&E	15.00
SGOT/AST	8.00
SGPT/ALT	8.00
Sodium	8.00
T3	16.00
T4	16.00
Theileria (Babesia) equi (equine piroplasmosis)	18.00
Total Bilirubin	8.00
Total Protein	8.00
Tritrichomonas foetus	32.00
TSH	16.00
Vesicular Stomatitis IN	21.00
Vesicular Stomatitis NJ	21.00
Virus Isolation	16.00
WBC	8.00
West Nile IgM Capture	21.00

College of Agriculture, Food and Environment
Veterinary Science

UK IN THE NEWS

CAN STALLIONS LIVE WITH OTHER HORSES?

Camie Heleski, PhD, lecturer with the UK Equine Science and Management program at the University of Kentucky talks about research into cohousing for stallions. This podcast is an excerpt from The Horse.com's Ask TheHorse Live Q&A, "Training and Care: How to Improve our Horses' Welfare."