

HIGHLIGHTING RESEARCH
AND OUTREACH EFFORTS AT
THE UNIVERSITY OF KENTUCKY

NOVEMBER 2020
ISSUE #0008

EQUINE SCIENCE REVIEW

CA.UKY.EDU/EQUINE
[@UKAGEQUINE](#) ON FACEBOOK/TWITTER

**NOVEL BIOMARKER FOR ASCENDING
PLACENTITIS:IL-6, 3**

Recently, cytokine interleukin-6
found to be biomarker for disease.

**LEADING HORSERACING ORGS PARTNER
WITH UK ON SURFACE RESEARCH, 5**

Sustained efforts by group who
formed partnership early in year.

**UK AG EQUINE PROGRAMS HOSTING
RESEARCH SHOWCASE VIRTUALLY, 7**

To continue life journey theme,
emphasize weanlings to yearlings.

PCR,QPCR: WHAT IS THE DIFFERENCE?, 11

As technology has advanced,
ability to run PCR with automated
protocols has too.



College of Agriculture,
Food and Environment

WRITER, EDITOR AND LAYOUT

Holly Wiemers, MA, APR communications and managing director; UK Ag Equine Programs | holly.wiemers@uky.edu

EDITORIAL ADVISORY BOARD

Emma Adam, DVM, PhD, DACVIM, DACVS, assistant professor, research and industry liaison, Gluck Center

Craig Carter, DVM, PhD, Dipl. ACVPM, director, UK Veterinary Diagnostic Laboratory

Richard Coffey, PhD, chair, Animal and Food Sciences

Bob Coleman, PhD, PAS, Dip. ACAN, associate professor and equine extension specialist, Animal and Food Sciences

David Horohov, PhD, chair, Veterinary Science, director; Gluck Center, Jes E. and Clementine M. Schlaikjer Endowed Chair, Gluck Center

Laurie Lawrence, PhD, professor, Animal and Food Sciences

Krista Lea, MS, coordinator, UK Horse Pasture Evaluation Program, Plant and Soil Sciences

James N. MacLeod, VMD, PhD, director, UK Ag Equine Programs and John S. and Elizabeth A. Knight chair, Gluck Center

Martin Nielsen, DVM, PhD, Dipl. ACVIM, Schlaikjer professor of Equine Infectious Disease, associate professor, Gluck Center

Mick Peterson, PhD, professor, Biosystems and Agricultural Engineering

Laura Skillman, director, Agricultural Communications Services

Ray Smith, PhD, extension professor, Plant and Soil Sciences

Jill Stowe, PhD, associate professor, Agricultural Economics

DESIGN

Jordan Smith, marketing manager, UK College of Agriculture, Food and Environment

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

NOVEL BIOMARKER FOR ASCENDING PLACENTITIS:IL-6

The broodmare is the cornerstone of the breeding industry, and immense effort, countless hours and considerable finances go into the delivery of a healthy foal. While achieving a viable pregnancy is a hurdle in itself, maintaining that pregnancy to term is the primary concern of practitioners, breeders and managers alike.

In North America, the leading cause of equine abortion is the ascending migration of bacteria through the cervix to localize on the placenta. The inflammation/infection that this causes is deemed ascending placentitis, and this disease results in the loss of 3-5% of all pregnancies. Currently, ascending placentitis is diagnosed based on clinical alterations, including vaginal discharge alongside premature mammary gland development and lactation. Additionally, practitioners may rely on trans-rectal ultrasonography, where an increase in placental thickness at the caudal pole of the cervix may be indicative of placental inflammation. Unfortunately, many of these alterations occur late in the disease process, resulting in a delay in therapeutic interference. Because of this, considerable work has gone into the detection of biomarkers that can be accessible in a noninvasive sampling procedure, sensitive for the early detection of inflammation/infection, and specific for the disease of ascending placentitis.

Recently, the cytokine interleukin-6 (IL-6) was found to be a novel biomarker for this disease, with a sensitivity of 97% and a specificity of 75%. This discovery will soon be published in the American Journal of Reproductive Immunology in the article “Interleukin-6 Pathobiology in Equine Placental Infection,” with Carleigh Fedorka, PhD, postdoctoral fellow at the University of Kentucky Gluck

Equine Research Center as the lead investigator. The research will also be presented at a December conference sponsored by the American Association of Equine Practitioners.

Although considerable differences exist when comparing horses to humans, pregnant women sometimes experience a similar disease to that of ascending placentitis, and this is known as intra-amniotic infection (IAI; chorioamnionitis). The gold standard diagnostic for IAI is an elevated IL-6 concentration within amniotic fluid, although this cytokine is also elevated in cervical fluid, vaginal fluid and within circulation. IL-6 is a pleiotropic cytokine, and therefore can function as both pro- and anti-inflammatory due to its ability to activate varying receptors and different pathways. In the horse, IL-6 protein has been found to increase in both amniotic fluid and allantoic fluid during ascending placentitis, in addition to increasing within both fetal and maternal tissues following the experimental induction of this disease. Unfortunately, fetal fluid sampling is rarely used in veterinary practice due to concerns for iatrogenic abortion.

In contrast, the present study found IL-6 to increase in circulation; indicating a safe, sensitive and specific sampling method for the prediction of ascending placentitis.

This was further expanded utilizing transcriptomics and immunolabeling to determine that IL-6 was activating the IL-6 receptor (IL-6R) via the classical signaling pathway. This activation of the JAK/STAT pathway is proposed to lead to various downstream effects, including an inhibition of apoptosis, epithelial cell proliferation and anti-inflammatory outcomes. Additionally, this is the first paper



PHOTO COURTESY UK COLLEGE OF AGRICULTURE, FOOD AND ENVIRONMENT.

to report that the IL-6R was expressed in the equine placenta, indicating a paracrine signaling pathway between the equine fetus and mare.

Future research is needed to determine the utility of this biomarker in the field. It is believed that the naturally occurring disease of ascending placentitis is more chronic to that of the experimental model, and therefore the IL-6 response may differ. Additionally, it is unknown if this anti-inflammatory pathway is altered preceding abortion in comparison to the delivery of a viable neonate. This is an obvious next step in the research, alongside investigating alterations in IL-6 concentrations in other pregnancy-related complications, including nocardioform placentitis, leptospirosis and idiopathic abortions.

| *Carleigh Fedorka, PhD, Postdoctoral Fellow at the UK Gluck Equine Research Center, provided this information.*

NOV. 20 IS DEADLINE TO COMPLETE NATIONAL SURVEY ON HORSES AGED 15 YEARS AND OLDER

While horses aged 15 years and over make up a significant portion of the U.S. equine population, surprisingly little is currently known about their management and health status. In response, the University of Kentucky Gluck Equine Research Center has launched a survey to better understand the special needs of this age group. Eligible survey participants should own one or more horses that currently reside(s) in the U.S. While the survey focuses on horses, including ponies, aged 15 years and older, owners of younger horses are also invited to participate in the survey. The survey takes between three and 25 minutes to complete. The survey can be accessed at https://uky.az1.qualtrics.com/jfe/form/SV_bxAeIRSV6gAOvb, and will be available through Nov. 20. Participants will also have the option to enter a raffle to win two bags of BUCKEYETM Nutrition feed (1st prize), or four pounds of Reasons® Joint Support Treats (2nd and 3rd prizes).

The survey project is coordinated by Alisa Herbst, a doctoral candidate at the Gluck Center in the College of Agriculture, Food and Environment, who is concentrating on the aging process of horses. She is being supervised by assistant professor Amanda Adams, PhD, MARS Equestrian Fellow and a specialist working with geriatric horses.

“The main goal of this survey is to create a management and health profile of U.S. horses aged 15-plus years,” she said. “By applying the insights that we gather from the survey, and other work in my PhD, I hope that we can provide improved support for those managing horses of this age group.”

Herbst is collaborating on this project with an international and national research team that includes Adams; Patricia Harris, PhD, DipECVCN, VetMB, MRCVS, RCVS specialist in veterinary clinical nutrition (equine) and director of science, MARS Horsecare; Michelle Coleman, DVM, PhD, veterinarian and assistant professor at Texas A & M University College of Veterinary Medicine and Biomedical Sciences; and Erica Macon, doctoral candidate at UK’s Gluck Center. MARS Equestrian™ is providing



UK RESEARCHER AMANDA ADAMS’ GERIATRIC HORSE HERD GRAZES IN A PASTURE AT THE UNIVERSITY OF KENTUCKY. PHOTO BY ALISA HERBST, UK DOCTORAL STUDENT.

sponsorship for this study.

“We’re very excited about the information that this survey will provide. While much beloved by their owners, we still know very little about the specific needs of this population. I look forward to hearing more about the results from this survey, and I greatly appreciate the sponsorships provided by MARS Equestrian for this effort,” said David Horohov, PhD, chair of the Department of Veterinary Science at UK, director and Jes E. and Clementine M. Schlaikjer Endowed Chair at the Gluck Equine Research Center. The contribution of every horse owner, and especially those with any horse or pony over 15 years of age, will be vital for the success of this project and the continued improvement in the health of horses.

ABOUT THE GLUCK CENTER

The mission of the Gluck Center is scientific discovery, education and dissemination of knowledge for the benefit of the health and well-being of horses. Gluck Center faculty conduct equine research in seven targeted areas: genetics and genomics, immunology, infectious diseases, musculoskeletal science, parasitology, pharmacology, therapeutics and toxicology and reproductive health. The Gluck Equine Research Center, a UK Ag Equine Program, is part of the Department of Veterinary Science in the College of Agriculture, Food and Environment at the University of Kentucky.

ABOUT MARS EQUESTRIAN™

MARS Equestrian™ Sponsorship by Mars, Incorporated is the link between our iconic brands and the equestrian community. For

generations, Mars has celebrated a rich equestrian heritage, and through purposeful partnerships, MARS Equestrian™ is committed to the sport and building an enduring legacy. From world-class competitions across all equestrian disciplines, to stewarding the power of horses on society and sustainability, MARS Equestrian™ is dedicated to our purpose to improve the lives of horses, pets, and the people who love them. Check out our website at www.marsequestrian.com and social media @marsequestrian.

ABOUT WALTHAM PETCARE SCIENCE INSTITUTE

The WALTHAM Petcare Science Institute is Mars Petcare’s pet research center. Our work focuses on the nutritional and behavioral needs of pets, as well as preventive health. We use this knowledge to support development of innovative products and services, advancing science to deliver our Purpose: A BETTER WORLD FOR PETS™. The WALTHAM™ Equine Studies Group, which is headed by Professor Pat Harris, MA, PhD, VetMB, DipECVCN, MRCVS, is dedicated to advancing the science of horse nutrition and provides the scientific support for MARS Horsecare globally including the BUCKEYETM Nutrition, SPILLERSTM, and WINERGY™ brands. By collaborating with key research institutes and universities around the world its work remains at the forefront of equine nutritional science.

| *Alisa Herbst, a doctoral candidate at the Gluck Center in the College of Agriculture, Food and Environment, who is concentrating on the aging process of horses, provided this information.*

LEADING HORSERACING ORGANIZATIONS PARTNER WITH UK TO SUPPORT RESEARCH EFFORTS TO IMPROVE SURFACE SAFETY

While 2020 has largely seen tracks closed for in-person fans, racing has continued. So have the sustained efforts of a group of tracks and industry organizations who formed a partnership early in the year to collectively support the surface safety research efforts at the University of Kentucky. Churchill Downs, Del Mar Thoroughbred Club, Keeneland, the New York Racing Association, Inc. and The Stronach Group have pledged resources to bolster this unprecedented research initiative as part of their combined efforts to increase safety and transparency in the sport of horseracing.

The aim of this fund is to improve the safety of horseracing by supporting equine surfaces and safety research under the direction of Mick Peterson, PhD, director of equine safety and researcher in the Department of Biosystems and Agricultural Engineering in UK's College of Agriculture, Food and Environment. Peterson joined UK's team in 2016 and is nationally and internationally recognized for a career in track surface safety research and testing. The position of director of equine safety was created this year by the college to support the industry through the continued development of technologies to ensure safety of surfaces for racehorses and all performance horses.

"The UK College of Agriculture, Food and Environment is committed to our signature equine industry in all ways. In particular, we are dedicated to all aspects of safety in our sport," said Nancy Cox, PhD, UK vice president for land-grant engagement and college dean. "This gift allows us to do important research to assist Thoroughbred racing and to create



PHOTO COURTESY MARK PEARSON PHOTOGRAPHY.

a pipeline of experts to serve racetrack safety."

Since Peterson joined the UK team, much progress has been made in supporting surface safety efforts. In 2019, the National Thoroughbred Racing Association committed \$100,000 to transform a large industrial research laboratory located on the UK campus. And during The Jockey Club Round Table in 2019, The Jockey Club committed to supporting the efforts of the Racing Surfaces Testing Laboratory, led by Peterson, and its ability to serve the equine industry.

"The selection and maintenance of racing surfaces has the potential to reduce catastrophic injury rates. Providing a consistent surface also helps trainers and owners make sound decisions for the welfare of their horses," Peterson said.

Under the direction of Peterson, the lab has been particularly effective at reinforcing the welfare and safety commitment through its central testing laboratory for dirt, turf and synthetic surface materials. To date, testing has included more than 70 different racing and training tracks around the world. Equipment development from the lab includes riding crop design

assessment, testing maintenance equipment and performance tests of starting gate and rail padding. In the industry-supported role of director of equine safety, Peterson will develop a discovery research program and provide contemporary testing capabilities. Part of this vision includes establishing a national and international center of excellence for safety of the equine athlete, training the next generation of equine surface safety experts and collaborating extensively with racetracks. This collaboration will foster translational research by identifying the research and technology needs for the UK Racetrack Safety Program.

Through the support of participating tracks and organizations, Peterson's work will help develop innovative technologies to assess track safety, working collaboratively with veterinarians, biologists and others to develop models for track surfaces that promote optimum safety and performance.

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

COST SAVING MOVES FOR WINTER PASTURE

If ever there was a time to be more conscientious of how we spend money, 2020 is probably it. Feeding horses is often one of our largest expenses, particularly in winter when pasture isn't available. This month, we'll look at a few cost saving moves you can make right now to extend your resources and reduce the cost of feeding horses.

Hay Feeders

Hay is expensive, and there really is no way around that. Horses are also wasteful. But we can reduce the expense of winter feeding by preventing waste with the use of hay feeders. Feeders prevent horses from stomping on hay, either out of carelessness or seeking to escape muddy conditions.

This seems like a small improvement, but the numbers can add up very quickly. One study in Minnesota suggested that more than 50% of hay was lost when fed without a feeder. Conversely, adding a feeder reduced hay losses to as low as 5% without affecting intake.



HAY FEEDERS CAN REDUCE HAY FEEDING LOSSES, THEREFORE EXTENDING YOUR HAY STORES AND CUTTING WINTER FEEDING COSTS. PHOTO COURTESY UK COLLEGE OF AGRICULTURE, FOOD AND ENVIRONMENT.

Feeders come in many different shapes, sizes and types, and what you select will depend on the num-

ber of horses you are feeding, type of hay, bale size and management. The same study also found that all feeders recouped their costs, some in as little as one month's time. While none will eliminate all hay losses, they will significantly reduce the cost of hay feeding by reducing waste, saving you money this winter.

Sacrifice Paddocks

Now is a great time to designate a sacrifice area for the winter. By selecting just one or a few paddocks and pastures to use all winter, other pastures are protected. Limiting the feeding area reduces the damage done by horses on wet, muddy ground.



DRY LOTS ARE A GREAT PLACE FOR HORSES TO SPEND THE WINTER TO PROTECT PASTURES AND ALLOW YOU TO START GRAZING SOONER. PHOTO COURTESY UK COLLEGE OF AGRICULTURE, FOOD AND ENVIRONMENT.

If you don't have a dry lot with a gravel base, select a paddock that is already in poor condition and hasn't been improved recently. Don't overwinter on your higher quality pastures or those you have more recently invested in.

Ideally, this paddock(s) is one that is easily accessible when putting out hay, fairly flat and one you can tolerate being damaged. A heavy use area, such as one built with rock and geotextile fabric, will give horses a place to get out of the mud and further reduce hay feeding losses and erosion.

Using a sacrifice area will pay big dividends later in the winter and the following spring. Pastures that have rested all winter will be drier and have more growth on them in the early spring, allowing you to transition to grazing sooner.

Soil Sampling

Soil sampling is a simple and easy way to understand the state of your pasture land. Sampling itself can often be done through your county Cooperative Extension agent with little to no cost or through your local farm supply store. Soil test and fertilize anytime the pasture isn't covered by excessive moisture and can support equipment traffic. Similar to sacrifice paddocks, sampling and fertilizing have deferred benefits. Applying fertilizers according to a soil test will increase the odds that you have quality pasture available for grazing earlier in the spring, therefore reducing the number of days you have to feed costly hay.

Pasture investments like building sacrifice areas, soil testing and strategic fertilization are small steps with big benefits, starting with reducing the cost of feeding horses over the winter.

| *Krista Lea, MS, coordinator of the University of Kentucky's Horse Pasture Evaluation Program, provided this information.*

UK AG EQUINE PROGRAMS TO HOST 10TH ANNUAL EQUINE RESEARCH SHOWCASE VIRTUALLY

University of Kentucky Ag Equine Programs will host its 10th annual UK Equine Showcase virtually through four sessions over four dates in January and February 2021. The event will continue the “life journey” theme initiated last year and will emphasize weanling to yearling horses, presenting both completed and work-in-progress projects relevant to this age group.

“We are excited to once again put together an excellent set of lectures and continuing education featuring many of our colleagues,” said Emma Adam, DVM, PhD, DACVIM, DACVS, assistant professor and research and industry liaison at the Gluck Equine Research Center. “The way our industry is helped through the resources we have at the University of Kentucky is unparalleled.”

Due to the current pandemic, the event has moved to a virtual format. Organizers wanted to continue to provide information and continuing education opportunities in 2021 rather than postpone for a year. Recognizing that staying engaged for long periods of time via a virtual format is challenging, organizers chose to break up the annual event into several shorter sessions over the course of a few weeks.

Jan. 5, 6-7:30 p.m. EST, will focus on musculoskeletal issues and include the following topics and speakers:

- Bisphosphonates, NSAIDs and other medicines in the juvenile horse with Scott Stanley, PhD, professor of analytical chemistry at the Gluck Equine Research Center.
- Sesamoid bone maturation by



PHOTO COURTESY UK COLLEGE OF AGRICULTURE, FOOD AND ENVIRONMENT.

the laboratory of James MacLeod, VMD, PhD, director of UK Ag Equine Programs and John S. and Elizabeth A. Knight chair and professor of veterinary science at the Gluck Center.

- Bone pathology in Wobbler’s Syndrome with Jennifer Janes, DVM, PhD, Dipl. ACVP, assistant professor of anatomic pathology at UK’s Veterinary Diagnostic Laboratory.

Jan. 19, 6-7:30 p.m. EST, will focus on nutrition and pasture topics and include the following information and speakers:

- Mineral requirements for a growing horse with Mieke Brummer-Holder, PhD, assistant professor in the Department of Animal and Food Sciences.
- Amino acids and protein synthesis in the growing horse with Kristine Urschel, PhD, associate professor in the Department of Animal and Food Sciences.
- UK Horse Pasture Evaluation

Program information with Krista Lea, MS, program coordinator, and Ray Smith, professor and extension forage specialist, both from the Department of Plant and Soil Sciences.

Feb. 2, 6-7:30 p.m. EST, will focus on parasitology, vaccination immunology and causes of mortality and include the following information and speakers:

- Vaccination, immunity and immune response in weanlings with David Horohov, PhD, chair of the Department of Veterinary Science, director of and Jes E. and Clementine M. Schlaikjer Endowed Chair at the Gluck Center.
- Parasitology as it pertains to weanlings and yearlings with Martin Nielsen, DVM, PhD, Dipl. ACVM, Schlaikjer professor of Equine Infectious Disease at the Gluck Center.
- Common(est) causes of mortality in this age group with Laura Kennedy, DVM, DACVP, assistant professor

and veterinary pathologist at the UK VDL.

Feb. 9, 6-7:30 p.m. EST will cover hot topics in a mini session format of 10 minutes each, with updates about equine research literature resources at UK, no-cardioform placentitis summary from 2020, COVID-19 economic impact and the next equine survey, lab updates, Equine Biological Passport update, genetic diversity project, updates on equine surface research, important parasitology updates and more.

"This is a unique and special outreach event. The purpose is to showcase some of what is happening at the University of Kentucky in terms of scientific discovery and service efforts relevant to the young horse," MacLeod said. "Participants will hopefully gain new information they can apply to their programs, but importantly also a greater appreciation for some of the critical questions being addressed at UK, why these issues are important and where the cutting edge of research is on a number of very interesting topics. This annual program, now reaching 10 years, highlights our commitment to advance research, service and teaching for the benefit of horses and the equine community."

The UK Equine Showcase is open to veterinarians, owners and managers of all horse breeds or anyone with an interest in learning more about foals and horse management. Its virtual format means that this opportunity is open to attendees from across the U.S. and even world.

The cost to attend all sessions is \$25 until the early-bird registration deadline of Jan. 5. This package

will include a PDF of the presentations and access to a recording of the sessions after the event has concluded. Attendees can also opt to attend only one or two of the sessions they are interested in. Individual event registration will also be available for \$10 each. There are special rates for farms interested in having multiple employees attend. Students from any university can participate for free. Please contact equine@uky.edu for help in registering for those discounted or free sessions. Continuing education credit for veterinarians and veterinary technicians is pending approval by the Kentucky Board

of Veterinary Examiners. Register [here](https://www.uky.edu/equine). Contact equine@uky.edu with questions about the event or with help registering.

UK is also accepting sponsor participation for the showcase. Presenting opportunities are available to participating organizations on a first-come, first-served basis. Email equine@uky.edu for details.

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



2021 ANNUAL UK Equine RESEARCH SHOWCASE

A focus on UK equine research and service programs, with relevance for horses from weanling to yearling.

LIVE TUESDAY
6-7:30 PM
JANUARY 5
JANUARY 19
FEBRUARY 2
FEBRUARY 9

University of Kentucky
Ag Equine Programs
College of Agriculture, Food and Environment

TO REGISTER SCAN HERE



TOPICS AND SPEAKERS

MUSCULOSKELETAL	
01/05/2021 6-7:30 PM	
Dr. Scott Stanley	BPs, NSAIDs and other meds in the juvenile horse
Dr. MacLeod Lab	Sesamoid bone maturation project
Dr. Jennifer Janes	Bone Pathology in Wobbler's Syndrome
NUTRITION AND PASTURE TOPICS	
01/19/2021 6-7:30 PM	
Dr. Mieke Brummer-Holder	Mineral requirements for a growing horse
Dr. Kristine Urschel	Amino acids and protein synthesis in the growing horse
Dr. Ray Smith & Krista Lea	UK Pasture Evaluation Program
PARASITOLOGY, VACCINATION IMMUNOLOGY, CAUSES OF MORTALITY	
02/02/2021 6-7:30 PM	
Dr. David Horohov	Vaccination, immunity and immune response in weanlings
Dr. Martin Nielson	Parasitology as it pertains to weanlings and yearlings
Dr. Laura Kennedy	Common(est) cause of mortality in this age group
HOT TOPICS (10 MIN SESSIONS)	
02/09/2021 6-7:30 PM	
SPEAKERS	Holly Wiemers, Dr. Barry Ball, Dr. Jill Stowe, Dr. Mick Peterson, Dr. Scott Stanley, Dr. Martin Nielson, Dr. Kimberly Tumlin, Dr. Allen Page, Dr. Ernie Bailey, Dr. Ted Kalbfleisch
TOPICS	Literature resources, ESR sign-up, no-cardioform placentitis summary of 2020 initiative, COVID impact & next equine survey, lab updates, equine biological passport, genetic diversity and more!

PCR, QPCR – WHAT’S THE DIFFERENCE?

As we have discussed in two previous issues ([PCR – what’s behind this commonly used acronym?](#) and [Wanted Dead or Alive – Does PCR supersede traditional techniques?](#)) PCR, or the polymerase chain reaction, is an incredibly sensitive technique to detect DNA and is used extensively in diagnostic testing.

Initially, the PCR reaction was run for 40 cycles and the resulting DNA segments amplified were examined by gel electrophoresis to determine if the DNA of interest was present or absent. The number of reaction cycles, 40 in most cases, means that the reagents become exhausted and additional amplification slows or stops, hence the term ‘end-point’ PCR. The DNA of interest, or target DNA, might be a gene identifying *Streptococcus equi* subsp. *equi* (the causative agent for ‘Strangles’) or a gene identifying Equine Herpes Virus 1 (EHV-1). Figure 1 demonstrates what end-point PCR results might look like were we to run four samples, three of which were positive and one negative.



FIGURE 1. END POINT PCR GEL ELECTROPHORESIS SHOWING THE RESULTS OF FOUR SAMPLES TESTED. FROM THESE RESULTS IT CAN BE SEEN THAT SAMPLES 1, 3 AND 4 TESTED POSITIVE FOR THE DNA OF INTEREST. SAMPLE 2 WAS NEGATIVE FOR THE DNA OF INTEREST.

As technology has advanced, the ability to run PCR with automated protocols and read out semi-quantitative results has become available. These PCR methods have become known as Real-Time PCR or Quantitative PCR (qPCR). The many benefits of this more advanced technol-

ogy include the ease with which it can be automated and scaled up, quick turnaround times and ability to roughly quantify the amount of target DNA of interest in the sample. For example, when testing for EHV-1, the question of approximately how much virus is present can be asked and help us understand if the quantity of virus particles being shed from its nasal passages or circulating in its blood stream.

A popular way to provide this semi-quantitative data is by having one of the reagents that make up the PCR reaction mix contain a fluorescent marker. This fluorescent marker is released when the reaction proceeds as target DNA is amplified. In this way fluorescence is detected at each amplification cycle of the reaction. Figure 2 shows a typical graph where fluorescence intensity is plotted against reaction cycle number.

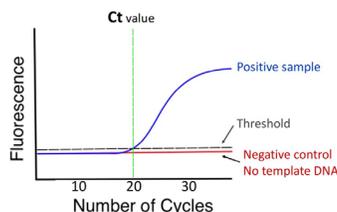


FIGURE 2. QPCR REACTION GRAPH SHOWING FLUORESCENCE PLOTTED AGAINST THE NUMBER OF CYCLES. THE THRESHOLD IS SHOWN AS A DASHED GRAY LINE. THIS SAMPLE’S FLUORESCENCE CROSSES THE THRESHOLD SETTING SUCH THAT IT WOULD BE CALLED POSITIVE AT CT = 20.

Logically, when a sample contains a large amount of target DNA, the reaction will become exponential in fewer numbers of reaction cycles than if the sample contained few target DNA templates. This concept is illustrated in Figure 3. To compare the relative quantity of starting material in samples a threshold is applied. This threshold is a level of fluorescence above which the sample is considered positive. The number of cycles of the reaction it takes to

cross that threshold is the Ct value. For example, in Figure 2, the sample would be reported at Ct = 20, because it took 20 reaction cycles to cross the threshold. When we examine Figure 3, you can see that the larger the quantity of starting DNA template, the lower the Ct number.

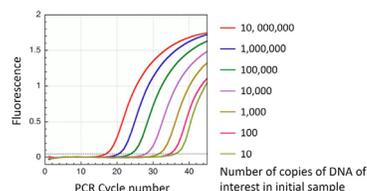


FIGURE 3. QPCR PLOT SHOWING THE EFFECT ON CT OF INCREASING STARTING TEMPLATE DNA COPY NUMBERS IN THE STARTING REACTION MIX. THE SAMPLE WITH 10 MILLIONS COPIES OF TARGET DNA (RED LINE) HAS A LOWER CT VALUE THAN THE SAMPLE WITH 10 COPY NUMBERS (GREEN LINE TO THE RIGHT OF THE GRAPH).

As PCR reactions proceed, mistakes are made – fidelity of DNA replication is never 100%. Statistically, the more cycles the reaction undergoes, the more likely errors are going to occur and off-target sequences amplified. With this in mind, much more research is needed to understand what positive results based on high Ct values (i.e., very low amounts of the target DNA) really mean in a biomedical context with regard to infection risk and disease control. However, whether we are thinking about animal or human infections, one thing is certain: proper biosecurity measures are essential for the control of any disease.

Emma Adam DVM, PhD, DACVIM, DACVS, is based at the University of Kentucky Gluck Equine Research Center and Veterinary Diagnostic Lab and is responsible for research and serve as a veterinary industry liaison. Jackie Smith, MSc, PhD, MACE, Dipl AVES, is an epidemiologist based at the University of Kentucky Veterinary Diagnostic Lab.

ROCHA ONE OF TWO GLUCK CENTER GRADUATE STUDENTS COMPETING IN UK'S 3MT COMPETITION

Izabela de Assis Rocha, DVM and graduate student at the University of Kentucky Gluck Equine Research Center, is currently competing in UK's virtual Three Minute Thesis competition with a presentation entitled "A neurologic horse and me." Her presentation can be found [here](#). Alisa Herbst, the other UK Gluck Center graduate student who is competing, can be seen [here](#).

Participants with the most likes on their videos will be presented with a "people's choice award" at the end of the judging period.

About Rocha

Rocha is from Brazil and attended school at Universidade Federal de Lavras (UFLA) there. She graduated from veterinary medicine in 2016, and then completed a residency in equine internal medicine at Universidade Federal de Minas Gerais (UFMG), also in Brazil.

She is currently in the second year of her PhD program at the UK Gluck Equine Research Center, having chosen UK because she had previously studied at the Gluck Center for a year as an exchange student. During that time, she was able to conduct research under Dan Howe, PhD, director of graduate studies, associate chair and professor, focusing on equine protozoal myeloencephalitis (EPM). She plans to pursue a career in academia after completing her PhD.

According to Rocha, her 3MT video describes how attending to a horse with neurologic syndrome during her residency focused her research and sparked her interest in returning to UK to continue working with EPM.

"The horse had all the clinical signs compatible with EPM, how-



PHOTO COURTESY UK COLLEGE OF AGRICULTURE, FOOD AND ENVIRONMENT.

ever both the serological diagnosis and the treatment outcome failed to confirm this diagnosis. Unfortunately, the horse was euthanized and we were surprised when we received a post-mortem EPM diagnosis," she said. "Because of that experience, I am currently focusing my research on understanding the challenges of EPM diagnosis and also exploring how EPM treatment works.

"My thesis research project focuses on how the current EPM treatment affects the parasite's biology, and I am also contributing in a multicenter project investigating novel treatment options for EPM," she said. "By combining both clinical experience and my training in science, I believe in a patient-oriented approach to research, relying on an active search of patients that may help us understand complex diseases and provide better care for horses."

About the 3MT

According to its website, UK GradResearch Live! is a research showcase and Three Minute Thesis competition that challenges graduate students to communicate their research effectively to a general audience, with a single slide, in three minutes or less. The event is sponsored by Graduate Student Professional Enhancement and the Graduate Student Congress.

There are three tracks featured in the competition to accommodate students in different stages of their research: a Pre-3MT track for students in the early stages of their research; a standard 3MT track for students in the later stages of their research, who have results or conclusions; and a Postdoctoral track for postdoctoral scholars or fellows involved in post-graduate research.

"Due to COVID-19, these presentations were recorded via Zoom instead of delivered live in front of an audience, but the research is still just as compelling, so please take some time to browse these videos and like your favorites. We will be presenting 'People's Choice Awards' for the video in each track with the most likes at the end of our judging period," the website said.

All videos can be found [here](#).

| *Holly Wiemers, MA, APR, is the communications and managing director for UK Ag Equine Programs. University of Kentucky Department of Veterinary Science at the Gluck Equine Research Center, provided this information.*

UK GLUCK CENTER'S MACON WINS GRADUATE STUDENT CONGRESS RESEARCH AWARD



PHOTO BY CHIP STAMPER, COURTESY ERICA MACON.

University of Kentucky's Graduate Student Congress awarded one of its three annual Research Awards to Erica Macon, MS, PAS, PhD candidate in the lab of Amanda Adams, PhD, MARSTM Equestrian Fellow and associate professor at the Gluck Equine Research Center.

The \$500 award is given each year to support quality graduate and professional student research to continue UK's reputation as a leading research institution.

According to Macon, the award

will help fund her final dissertation, which examines the effects of season and nutrition on insulinemic responses in the insulin dysregulated horse. Her final project investigates the effects of varying concentrations of non-structural carbohydrates on insulinemic responses in the insulin dysregulated horse.

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

EQUINE INNOVATORS PODCAST FEATURES UK'S DR. AMANDA ADAMS ON OLDER HORSES



In this month's podcast Amanda Adams, PhD, MARSTM[™] Equestrian Fellow and associate professor at the University of Kentucky's Gluck Equine Research Center, describes her senior horse research, which focuses on EMS, PPID and immune system health.

You can find "Equine Innovators" on TheHorse.com, Apple Podcasts, Spotify, Stitcher, and Google Podcast.

AFRICAN HORSE SICKNESS: POTENTIAL THREAT FOR DISEASE-FREE COUNTRIES

A major outbreak of African horse sickness (AHS) in Thailand earlier this year was a timely reminder for animal health officials, veterinarians, and members of the horse industry of the vulnerability of equine populations to this disease. Of all known equine infectious diseases, AHS is the single most important in terms of devastating losses in naïve horses and economic impact on international trade. It is a dreaded, non-contagious, vector-borne disease with the potential to kill 50% to 95% of affected horses.

The etiological agent of AHS is an RNA virus belonging to the family Reoviridae, genus Orbivirus, that is transmitted naturally by species of *Culicoides* or midges. There are nine antigenically distinct serotypes of the virus. While the primary host species are members of the family, Equidae, evidence of infection has also been found in African elephants, black and white rhinoceroses, camels and dogs, none of which are considered epidemiologically significant.

Historically, AHS was considered restricted to tropical and subtropical regions of sub-Saharan Africa, where it had been known to occur regularly for over 200 years. Although infrequent, the disease has spread from west and north Africa to various southern European or Middle Eastern countries. The most significant such event occurred between 1959 and 1963 when serotype 9 of AHS virus spread out of Africa into and throughout the Middle East, as far north as Turkey, and extended as far east as Afghanistan, Pakistan, and India.

Concern over the risk that AHS poses for horse industries in Europe has been keenly felt for some time. Southern European countries are faced with the potential threat of disease introduction from migration of the virus northwards from regions in Africa, where the

disease is endemic. Spread of the virus could result from the movement of nomads and their animals, passive wind-borne carriage of infected *Culicoides* over long distances, and legal or illegal trade in zebra from countries where the disease is currently active. A similar if not greater risk exists for the Middle East which experienced incursions of AHS more frequently than any other region or country. As the most recent occurrence of AHS in Thailand has shown, distance is no guarantee of safety from the risk of introduction of this disease. Thailand is approximately 6,000 miles distant from where the virus responsible for this event probably originated, and the furthest east in Asia where AHS has ever been recorded. The most plausible explanation as to the source of virus lies in the fact that a shipment of zebra arrived in Thailand three to four weeks before the first AHS outbreak of the disease was discovered. Zebra are considered the natural reservoir of the virus, developing viremias lasting up to 40 days.

This would not be the first occasion that importation of zebra from a country in which AHS is a seasonal occurrence has been implicated in the introduction of disease into a disease-free country. A shipment of zebra was the confirmed source of this virus for a major disease event that occurred in Spain in 1987 and subsequently involved Portugal and Morocco. International trade in wildlife, both legal and illegal, is believed to have increased significantly in recent years. What happened in the Iberian Peninsula in 1987 and Thailand in 2020 highlights the inherent risks of introducing a disease, such as AHS, into previously disease-free countries.

The influence of climate change and global warming on the epidemiology of AHS must also be considered vis-à-vis the threat it poses for a disease-free country.

Increased ambient temperatures and reduced rainfall over a period of years has resulted in more widespread geographic distribution of some of the major vectors of AHS, especially *C. imicola*, in southern Europe. An increase in ambient temperature can influence not only the life cycle of the *Culicoides* vector but also replication of the virus in the vector. As temperatures rise, the infection rate in *Culicoides* midges increases and transmission of the virus can occur sooner, however there is a concomitant decrease in the survival rate of the adult *Culicoides*. The overall result of these changes is a higher transmission rate of the virus in a country possibly at risk of the introduction of AHS.

The occurrence in Thailand and the very recent confirmation of AHS in Malaysia underscore the importance of increasing awareness and familiarity with this dreaded disease among animal health officials, veterinarians and members of the equine industry around the world. The potential consequences of AHS for the health of a country's equine population and economy highlight the need for an adequate level of national preparedness in a) minimizing the risk of introduction of this disease, b) maintaining a program of active surveillance for the disease and c) having a response plan in place in the remote event of the introduction of the disease.

The take-home message from past and recent occurrences of AHS is that there is no room for complacency over the potential threat it represents for disease-free countries.

| *Source: October 2020 Equine Disease Quarterly, funded by underwriters at Lloyd's, London. Commentary by Peter Timoney, MVB, PhD, FRCVS, Professor, Frederick Van Lennep Chair in Equine Veterinary Science at UK's Gluck Equine Research Center. this information.*

ALFALFA INCLUDED IN SECOND ROUND OF CORONAVIRUS FOOD ASSISTANCE PROGRAM

Alfalfa has been included in the U.S. Department of Agriculture's latest expansion of the Coronavirus Food Assistance Program. Recently, USDA announced an additional \$14 billion for farmers who continue to face market disruptions and associated costs because of COVID-19.

The Coronavirus Food Assistance Program 2 (CFAP 2) provides farmers of eligible commodities with financial assistance that gives them the ability to absorb some of the increased marketing costs associated with the COVID-19 pandemic.

A list of CFAP 2 eligible commodities can be found by clicking here (<https://www.farmers.gov/cfap/tool>). Alfalfa is included under the "Flat-Rate Crops" category which includes crops eligible for a \$15/acre payment for all acres certified



Coronavirus Food Assistance Program

Are you a farmer or rancher whose operation has been directly impacted by the coronavirus pandemic? The Coronavirus Food Assistance Program provides direct relief to producers who faced price declines and additional marketing costs due to COVID-19.

to that commodity for 2020. USDA's Farm Service Agency will accept CFAP 2 applications from Sept. 21 through Dec. 11, 2020. Information on how to apply for CFAP 2 funding can be found here.

Farm Service Agency staff at local USDA Service Centers will work with farmers to file CFAP 2 applications. Farmers can also

call 877-508-8364 to speak directly with a USDA employee ready to offer assistance at the CFAP call center. Visit farmers.gov/cfap for additional information on CFAP 2 eligibility, payment limitations, structure and how to apply.

| *Source: Oct. 1 Kentucky Forage News*

DEADLINE APPROACHING FOR NRCS EQIP ASSISTANCE

The first FY 2021 Natural Resources Conservation Service (NRCS) Environmental Quality Incentives Program (EQIP) application cut-off period for Kentucky will be Nov. 20. All eligible applications received by this date will be evaluated and considered for FY 2021 funding. Applications received after that date will be held for the next funding opportunity.

EQIP is a voluntary conservation program that helps agricultural producers in a manner that promotes agricultural production and environmental quality as compatible goals. Through EQIP, agricultural producers receive fi-

ancial and technical assistance to implement structural and management conservation practices that optimize environmental benefits on working agricultural land. Agricultural producers and owners of non-industrial private forestland and Tribes are eligible to apply for EQIP. Eligible land includes cropland, rangeland, pastureland, non-industrial private forestland and other farm or ranch lands. Find more information [here](#).

| *Source: Oct. 30 Kentucky Forage News and USDA NRCS website.*

UK VDL RELEASES NEW ACCESSION FORM

The University of Kentucky Veterinary Diagnostic Laboratory has released a new accession form. The update has the most up-to-date test offerings and improved layout for ease of reading.

The form can be downloaded from UKVDL's [website](#). Additionally, the form can be filled out as an Adobe PDF and submitted via email directly.

Join us for the 11th annual

Pastures Please!!

Tuesday, January 26th, 5:30 – 7:30 pm

Fayette County Extension Office or Online

1140 Harry Sykes Way, Lexington

Program

- 5:30 Refreshments
- 6:00 Managing Carbohydrates in the Equine Diet,
Dr. Laurie Lawrence
- 6:25 New Herbicides: Do They Provide Control of
Troublesome Weeds in Horse Pastures?,
Dr. Bill Witt
- 6:50 Wise Investments for Pasture Management,
Dr. Ray Smith
- 7:15 Questions
- 7:30 Adjourn

Register online at

<https://UKPasturesPlease.eventbrite.com>



University of Kentucky
College of Agriculture,
Food and Environment
Cooperative Extension Service



College of Agriculture,
Food and Environment
Equine Programs

Limited seating will be available, advanced registration is required. Masks and social distancing will be enforced.

Cooperative Extension Service
Agriculture and Natural Resources
Family and Consumer Sciences
4-H Youth Development
Community and Economic Development

Educational programs of Kentucky Cooperative Extension serve all people regardless of economic or social status and will not discriminate on the basis of race, color, ethnic origin, national origin, creed, religion, political belief, sex, sexual orientation, gender identity, gender expression, pregnancy, marital status, genetic information, age, veteran status, or physical or mental disability. University of Kentucky, Kentucky State University, U.S. Department of Agriculture, and Kentucky Equine Center, Lexington, KY 40546



Disabilities
accommodated
with prior notification

UK INDOOR HORSE ARENA SURVEY INFOGRAPHIC AND FOLLOW-UP INFORMATION

When University of Kentucky College of Agriculture, Food and Environment graduate student Staci McGill set out to learn more about the air quality of indoor horse arenas almost three years ago, she was surprised to discover there wasn't any existing research available. So she forged the way with first-of-its-kind research, melding her passion for riding with her academic research interests.

In May 2018, she launched a survey about indoor arenas in partnership with UK's College of Public Health and facility design experts within the College of Agriculture, Food and Environ-

ment. The survey set out to gather information on arena design and construction, footing, maintenance and the arena environment. Owners, managers and riders were asked about arena construction characteristics, air quality, arena footing and associated health outcomes in horses and humans.

The online survey indicated that 77% of respondents are concerned about dust, moisture levels, and/or the lack of air movement.

"It's mind-blowing that this hasn't been done before," said McGill, a graduate student in the Department of Biosystems and

Agricultural Engineering. "We know these issues exist, but no one has ever documented the concerns."

McGill's team released some of the initial findings through an [infographic](#) in late 2019, as well as follow-up, hands-on information in response to the study.

The facility design and use information shows trends with arena age and construction costs. An example of changing trends is lighting. The use of LEDs has increased, while the use of metal halide lights has dramatically decreased. LEDs look to be surpassing even fluorescents in

newly built arenas. The size of the arenas has shifted to greater square footages in newer arenas and, as expected, larger arenas also tend to be more expensive to build. The definition of an indoor arena varies by where respondents live and how their climate impacts horse sport participation. Primary riding disciplines, wall and window configuration and footing materials, like the presence of fiber, all varied by region as well. The major finding is that the arena is a complex environment. Facility design, management, footing, usage and amount of horse activity within the space all interact to affect the environment in an indoor arena.

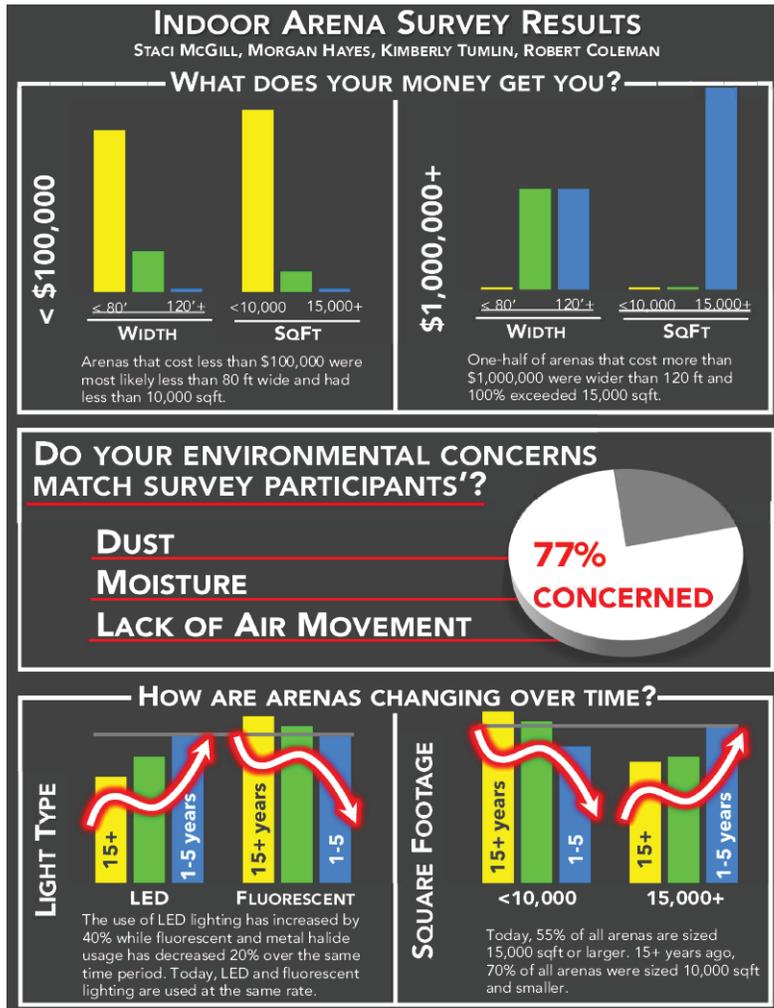
[ID-265: Riding Arena Footing: Materials and Characteristics](#)

[ID-266: Riding Arena Maintenance: Dragging and Treatments](#)

[ID-267: Riding Arena Maintenance: Equipment Guide](#)

Those publications referenced above can be found on the next several pages or accessed via the hyperlinks provided.

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



Riding Arena Footing: Materials and Characteristics

Claire Burnham, Morgan Hayes, and Staci McGill, Biosystems and Agricultural Engineering;
and Robert Coleman, Animal and Food Sciences

This publication provides an overview of riding arena footing. Many factors must be considered when planning to build an arena or in determining how to care for an existing arena. This basic guide explains how arenas are structured, describes the components that generally make up arena surfaces, and discusses various considerations that apply to all arenas.

Structure of Arena Surfaces

Footing

The footing is comprised of the following three layers (Figure 1).

Top: The actual riding surface. This layer is lighter, less compact, and can be composed of many different primary components and additive combinations. Depending on use, this layer is often two to six inches thick.

Base: The solid, compacted layer between the sub-base and the top layer. Usually, this layer is six to eight inches thick, depending on arena use.

Sub-base: The lowest part of the arena surface, usually made up of the existing soil structure or added rock to promote drainage. The sub-base can include multiple layers.

Crown

The crown is a raised area in the middle of the arena that promotes drainage to the sides and outside of the arena. Crowns are only necessary in outdoor arenas, due to variable rainfall. The suggested slope for the crown is 1 to 2 percent. Outdoor arenas can be built with either a crown or with an elevated, well-drained surface. Crowns are often used in arenas with less permeable surfaces to eliminate ponding of water. The crown is typically developed

during the initial earthwork and is present in both the sub-base and base layers. A crown will affect maintenance protocols; one must be sure not to damage the crown by not crossing over the center of the arena and by dragging from end to end whenever possible.

Footing Materials

Sand

Sand is a very common footing material due to its availability, durability, and drainage capacity. It is a granular component; often described as broken-down rock particles characterized by size, shape, and composition.

Particle Size: Sand particles can be broken down into fine, moderately coarse, and coarse particles. Most arenas utilize coarse sand to promote drainage and reduce dust concerns (Table 1).

Shape: Particles are either angular or rounded (Figure 2). Shape is often a product of the weathering mechanism that acts to shape the grains of sand. More angular particles pack together easily; rounded particles remain spaced apart.

Composition reflects the origin of the sand or mineral particle (location and geologic layer) and affects the durability of the sand. The most common origin rocks for arena use are sedimentary (commonly known as limestone), quartz (found in igneous, metamorphic, and sedimentary rocks), feldspar (found in both igneous and metamorphic rock), and river rock (mineral composition dependent on location).

Table 1. Sand size.

Size descriptor	Particle size	Sieve size	General usage
Fine sand	0.075 mm - 0.3 mm	#40 - #200	Plastering
Moderately coarse sand	0.425 mm - 1.18 mm	#10 - #40	Mortar and masonry
Coarse sand	2 mm - 4.75 mm	#4 - #10	Concrete



Figure 1. Three layers of footing.

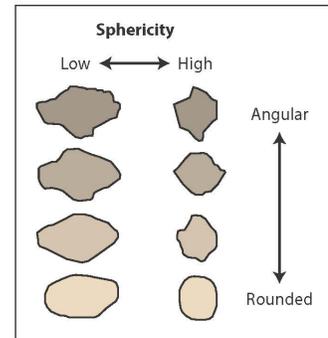


Figure 2. Shape of sand. Donnie Stamper, adapted from Sphericity of Grains on *Oil On My Shoes - Introduction to Petroleum Geology*.

The different origins of rocks will affect the strength of the rocks and the relative durability. The Mohs hardness scale rates the hardness of different materials from 1 to 10 (Figure 3). Sands with mineral

composition that are higher on the Mohs hardness scale are more likely to resist breaking down.

There are many commercially available types of sands with different regional names and with different characteristics, depending on where the sand is obtained. Following are some common names and their respective descriptions. The primary type of sand used in arena footing is mineral sand, which is formed by the weathering of igneous, metamorphic, or sedimentary rocks.

- **River sand:** Sand sourced from riverbanks and riverbeds. It is usually of varying origin, and this variance depends on the location of the river source. River sand particles tend to be rounded, as they are smoothed by the action of water sweeping particles downstream over time.
- **Silica sand:** A type of sand composed of quartz, which tends to be very hard and resistant to breakdown.
- **Class I sand:** A limestone-based sand. Can be an inexpensive option but will be softer and less resistant to breakdown.

Sorting and grading refers to the variation of size particles within the sand (Figure 4). Typically, uniformly graded (well sorted) sand is best for arenas, though some disciplines and riding styles want some variability. Well-sorted sand also provides good drainage.

Processing

Natural: Sand particles shaped by weathering from water, wind, and movement.

Artificial: Sand particles shaped by man-made processes.

Washed: A form of processing that screens sand to ensure that particles are of similar size. Washed sands will be uniformly graded. They have fewer fine particles, which reduces dust.

Crushed Rock/Construction Aggregate

Crushed rock or construction aggregate is more common in outdoor arenas because it can be very effective at draining water. It does not compact easily if it is poorly or uniformly graded, but well-graded mixtures can be compacted. This tendency for crushed rock to become compacted is dependent upon the size,

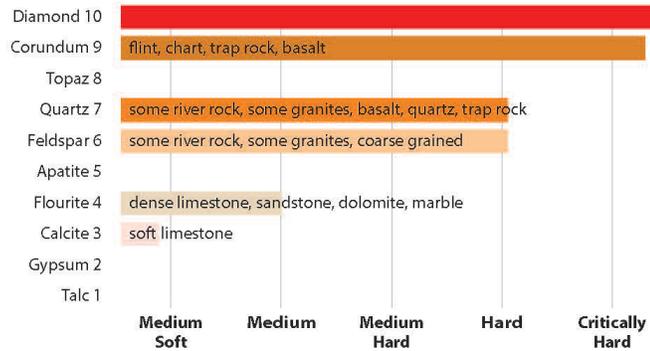


Figure 3. Mohs mineral hardness scale. Premier Equestrian.

sorting, and gradation. The characteristics of crushed rock are similar to that of sand in the variation of size, shape, and composition. Often, crushed rock or construction aggregate is used as the sub-base or base for the footing (Table 2).

Table 2. Particle size.

Size #	Size of Particle
1	90-37.5mm or 3.5-1.5"
3	50-25mm or 2-1"
5	25-12.5mm or 1-0.5"
8	9.5-2.36mm or 3/8"
57	25-4.75mm or 3/4"
67	19-4.75mm or 3/4" and smaller

Rubber

Rubber is often seen as a footing additive, but some choose to use it as a primary component. As a primary component, crumb rubber or shredded rubber can have relatively little dust. It is believed to increase shock absorption, which is a common reason it is used as an additive to the primary component. It has a low

freezing point, which is beneficial in cold climates where riders want year-round arena usage. Rubber is also affordable.

Rubber is commonly sourced from recycled materials. The source is especially important when the rubber is a recycled material, as it can potentially contain toxins or even metal particles. It is important to determine that the recycled rubber used as a footing material does not contain any materials or additives that may pose health concerns for horses or humans.

Rubber will break down with time, as will any primary component, but it can last longer than other materials.

Soil Mixtures

Soil is a highly variable material that refers to a mixture of sand, silt, and clay. The mixture within the soil can vary greatly and is dependent on the soils that are regionally available (Table 3 and Figure 5).

High proportions of clay in soil tend to produce a footing that is slippery when wet and solid and hard when dry. It is highly compressible, making the management of compaction important.

Table 3. Soil mixture materials and characteristics.

Material	Particle Size	Characteristics
Clay	Less than 0.002mm	Retains water well, and particles tend to stick together. Clay particles are the source of most of the chemical properties of the soil, and they can react with organic material. Very easily compacted due to small particle size.
Silt	0.002mm-0.05mm	Retains water but also readily releases water.
Sand	0.075mm-4.75mm	Particles do not stick together or retain water as readily. Allows water to pass through relatively easily.

Adapted from AASHTO Pavement Manual Chapter 3: Materials Characterization.

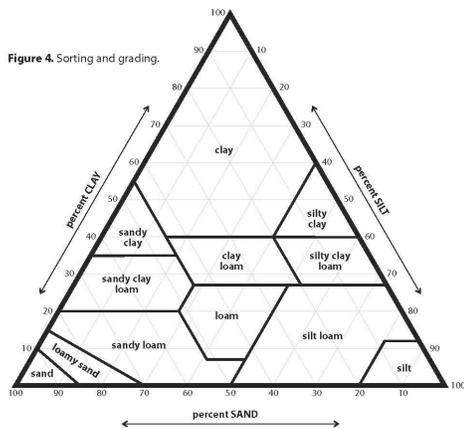


Figure 4. Sorting and grading.

Loam is simply a specific blend of sand, silt, and clay, usually with a lower percentage of clay and higher capacity for holding water.

Wood Chips

Wood chips are a softer footing material that can provide a lot of cushion. Wood chips retain water well but break down relatively quickly and thus pose dust concerns. As a primary component, wood chips require a greater amount of water for dust suppression, which can

contribute to freezing in cold climates. Riders in certain disciplines prefer this surface because it tends to be softer. It is generally considered a more affordable option for arena footing.

Common Additives

Whatever the primary component used, it will break down over time. Additives are used to extend the life of the primary footing component and to reduce dust, increase cushion and shear strength, and facilitate drainage.

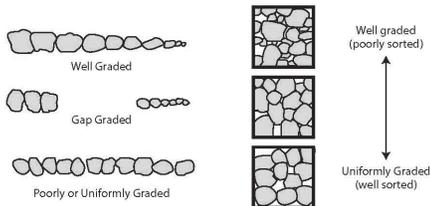


Figure 5. Soil composition in terms of sand, clay, and silt portion. Figure from https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/?cid=nrcs142p2_054167.

Fiber

Fiber is added to arena surfaces to add stability, to cushion the surface, and to increase the lifetime of the footing. The fibers act similarly to the root system of a plant in soil, which prevents erosion and gives a firmer surface. Fiber can also promote proper drainage of water throughout the footing material. Fibers are said to increase the shear strength of footing, meaning that the addition of fiber to a primary component will increase the primary component's resistance to force.

Many different types of fiber, textile, and fabric can be added to arena surfaces, although synthetic fibers (polyester, polypropylene, nylon) are more common than natural. Synthetic fibers tend to be hydrophobic, meaning they repel water; natural fibers are often hydrophilic and attract water. Hydrophobic fibers can still absorb water, but they do not retain it to the extent that hydrophilic fibers do.

Fiber is commonly added to arenas with a primary component of sand, either sold or created initially as a blend or incorporated into an existing sand arena.

Synthetic fibers are available in various lengths and from different sources. Some are marketed as recycled carpet fibers, and others are produced specifically for use in arena surfaces.

Longer fibers tend to increase shear strength more, but excessively long fibers can be difficult to mix into the primary component. There is a happy medium for fiber length, but this is dependent on many different factors, including the primary component itself, the desired surface characteristics, and even the availability and cost of product.

Rubber

While sometimes used as a primary component, crumb or shredded rubber is also incorporated into other primary components as an additive. Adding rubber can reduce compaction and concussion and increase drainage of the primary component.

Crushed Rock/Construction Aggregate

Adding crushed rock as an additive can help promote drainage of the primary component, reduce compaction (depending on particle size), and is dependent on many of the factors discussed above (size, source rock, etc.).

Other Considerations

A show or event facility will have an arena footing blend that lends itself to higher animal traffic patterns and heavy usage. The footing must be formulated and cared for in order to handle heavy traffic. Traffic includes the increased number of animals working on the surface, as well as larger and heavier equipment and drags used more frequently. This maintenance can also affect how a horse moves over the arena surface. Show facilities may have bias toward a specific discipline or may be adaptable to multiple disciplines. Adapting arena surfaces to multiple disciplines and uses can pose some difficulty depending on the variation necessary within the footing. Larger facilities may have different footings or different arenas with different footing depending on the range of events they host.

A boarding facility that caters to several disciplines will have to consider high usage. Client needs and disciplines will affect maintenance protocols. Regular and frequent maintenance will be necessary to ensure that the arena surface stays workable under heavy usage. Boarding facilities often cater to a common activity, which allows for simpler arena design and maintenance.

A private facility will likely utilize specialized footing for one discipline that the owner of the facility prefers. Depending on the facility, there may be less traffic, and the maintenance needs may vary depending on owner preference and footing type.

There are variances among disciplines. Western riders tend to prefer a deeper, softer footing that is fast and enables sliding. In addition, there is also variation in the desired underlying footing. A reiner would like a smooth surface that ensures horses can slide, but a barrel racer might prefer a chopper base with more grip. Western riders tend to prefer a sand or

sand mix footing without additives. A show jumper would instead prefer footing that is firm for take-off and soft and cushioning on landing. Dressage riders typically want something in between, softer than jumpers but not as soft as Western riders. Hunter/jumper and dressage events gravitate toward the sand and fiber blend arenas or other synthetic footings.

The type of footing has tremendous bearing on the maintenance protocol. Some sand and fiber footings have wax or oil coatings that do not require water. Sand and fiber must be kept well mixed to prevent separation, generally requiring a multi-unit or complex drag that has a tilling action. A simple chain harrow is not adequate for such mixing action. Sand mixtures without wax coatings and dirt or clay mixtures often require regular application of water to limit dust.

The primary component of arena footing will break down over time with repeated concussion from the working horses as well as the addition of organic material (manure, bedding, and mud) over time. Even with manure removal, some degree of organic material will be introduced into the footing. Stronger sands may hold up better, and additives will increase the longevity of arena surfaces, but all surfaces will eventually break down. When this happens, it is usually best to add more footing to refresh the surface, or to replace the surface entirely, depending on the state of the primary component and additive. As the primary component of arena footing breaks down, dust often increases in the arena.

Different footing types also wear differently on arena maintenance equipment. Different types of hard sand and gravel can degrade arena equipment, especially with the frequent use required by arena surfaces. Tines and teeth should be monitored regularly to determine any necessary changes in depth setting or required replacement of parts.

The ideal surface for any horse depends on many different factors, such as discipline and environment. Because arena surfaces continually change with use and maintenance, it is important to evaluate the current footing and adapt the maintenance protocol to suit the needs of the horses using the arena.

Riding Arena Maintenance: Dragging and Treatments

Claire Burnham, Morgan Hayes, and Staci McGill, Biosystems and Agricultural Engineering, and Robert Coleman, Animal and Food Sciences

Maintenance is a key to extending an arena's lifespan, and it is extremely important for the horses and riders who use the surface. Arena maintenance is essential for the casual recreational rider as well as the high-performance athlete. The surface the horse encounters during work has a profound impact on the horse's biomechanics, and a poor surface can affect the horse's soundness over time. A well-maintained surface increases the horse's performance capabilities and enhances training.

Arenas are a large monetary investment, and proper care extends the life of an arena. Regular and good maintenance is the best way to increase the longevity

of an arena surface and protect your investment as well as your horses. This publication provides guidelines for arena care and maintenance. Each arena is different and has its own set of needs, but these basic guidelines can help to keep the surface functional and long lasting.

Dragging

Arena maintenance is more than just leveling the surface. Simply smoothing the surface is not sufficient to maintain an arena over time. The base will begin to wear away with repeated use, especially in high traffic areas such as the outside track. The top layer of the arena can never remain completely level if the base is compromised. Regular attention to the base will ensure that it remains level.

Before starting to work the arena, determine that the drag is level and properly attached to the drive unit (i.e., tractor). To ensure that you are reaching the base of the arena, perform a depth check with a ruler. Dig through the top layer of footing until you hit the solid base and adjust drag settings accordingly. The goal is not to dig

into the base, but rather glide along the base to ensure that it remains level without compromising its structural integrity.

Evaluate the arena several times a year to identify any issues, such as the movement of footing around the edges and low or high spots in the arena. Regular depth checks throughout the arena will help identify irregularities. Check depth at the quarter line, center line, and three-quarter line, as well as high-impact areas such as where jumps regularly rest, horses are stopped, or barrels are turned.

Figure 1 shows suggested depth-check points that can be used depending on the riding style. For example, if most riding tends to happen along the walls, the blue dots will be useful for checking the riding track. If riding tends to occur in the middle of the ring, the black dots are recommended for depth checks.

All arena equipment should be removed before the arena is worked. Jumps that are used continuously in the same position in the arena can compromise the arena base and create low spots of footing, so move jumps regularly. The best

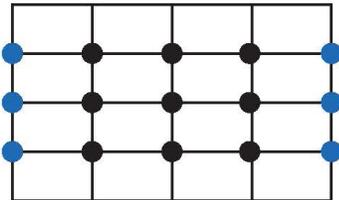


Figure 1. Potential points for depth checks.



Figure 2. A multi-unit drag can be used for redistributing footing. Claire Burnham, taken at Carriage Station Farm.



Figure 3. A box grader used to redistribute footing.

Dragging Patterns—Key

Solid black line	Arena border
Red dashed line	Centerline
Black dashed line	Quarter line

All diagrams based on a 100 ft wide by 200 ft long arena with a 10 ft wide drag.

approach is to remove jumps weekly and drag without them in the arena. Dragging with jumps in the arena is permissible between such weekly drags, but over time, this practice can affect the footing and base negatively, creating high and low spots and uneven compaction. The problem is not limited to jumping; any arena with activities concentrated in specific areas is vulnerable.

To address issues such as banking of footing around edges, rake regularly around the edges of the arena to bring footing back into the track. Certain drags are designed to alleviate this problem. For example, a plated box grader can draw material away from the edges of the drag pattern (Figures 2 and 3).

Manure removal is recommended for many different footing types, especially a sand and fiber mix. Some people choose to work in the manure over time, but this organic material will break down and impact the footing, creating the addition of small organic particles. The particles may release bacteria and potential allergens and may contribute to increased overall dust from the footing.

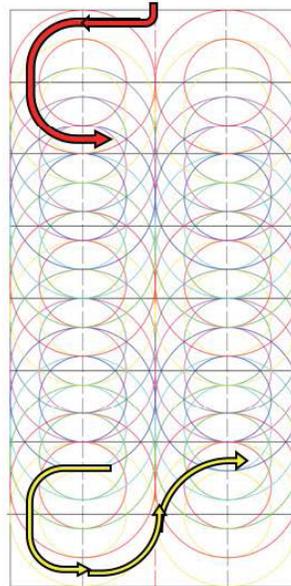
Settings

Some drags, especially multi-unit or complex drags, allow the operator to raise and lower portions of the drag to change the way the arena is groomed. Regularly monitoring and adjusting the settings can help prolong the life of the arena.

A deeper drag every month will help refresh the footing, but care should be taken not to disturb the base. Even if the drag is not adjustable, adding weights to your drag can help shift equipment closer to the base.

Patterns

Using the same drag pattern can create wear and will not address any problems that arise, so regularly change drag patterns. When drag patterns are changed, the settings of the drags should also be

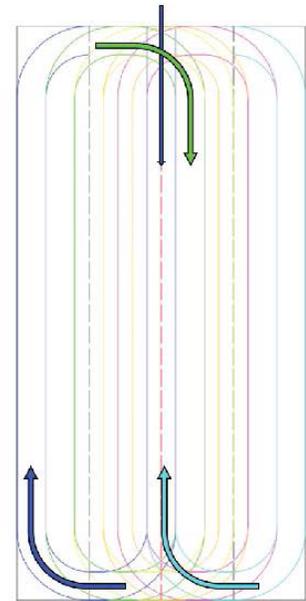


Arena drag pattern for arena with crown.

This pattern is intended to preserve the arena crown, which can be damaged when crossing over the centerline of the arena.

1	Red —Down centerline and begin first circle, which is approximately 50 feet in diameter.
2	Yellow
3	Dark Green
4	Magenta
5	Blue —Where top of blue overlaps with bottom of red (for following loops continue overlap)
6	Light Blue
7	Light Green
8-15	Same pattern as above
16/17	Yellow —Finish out circle at end of arena, go up centerline and start next set of circles at end of arena (figure 8 motion), working upwards.
Pattern follows up other side	Yellow, Red, Light Green, Light Blue (second half overlap begins top of yellow bottom of light blue, continue overlap), Blue, Magenta, Dark Green , and the pattern repeats.
On final pass (32 total)	Can go around outside track and centerline on either side of arena halves and smooth out any areas missed.

Covers 40,212 sq ft total. At a rate of 7 mph, 65 minutes to complete.



Drag pattern to bring material from center to outside.

1	Blue —Down centerline and around outside track
2	Light Green
3	Yellow —Up quarter line
4	Orange
5	Magenta
6	Light Blue —Down outside track and back up centerline

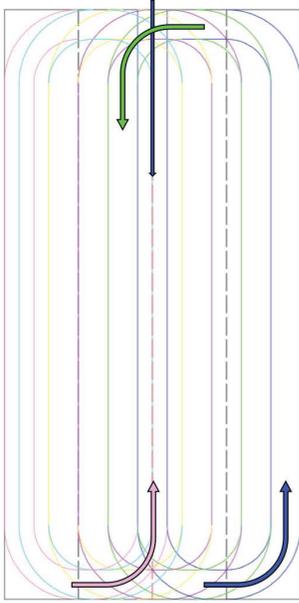
Covers 25,412 sq ft total. At a rate of 7 mph, 41 minutes to complete.

changed. Monthly, the arena surface must be dragged deeply to maintain and level the base and extend surface life.

Consider the initial construction of the arena, the levelness of the base and footing, and any other important aspects of the construction, such as a crown in an outdoor arena, to ensure that the maintenance pattern does not adversely affect the arena structure.

Treatments

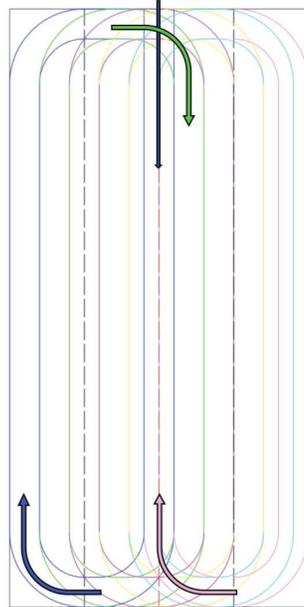
The common purpose for arena treatments is to reduce dust and prolong use of the arena surface.



Normal drag pattern.

1	Blue —Down centerline and up outside track
2	Green
3	Purple
4	Yellow
5	Light Blue
6	Pink —Down outside track and back up centerline (overlap)

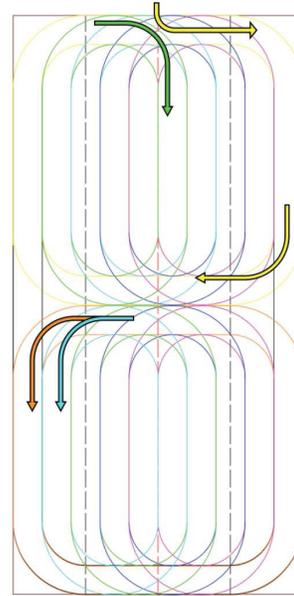
Covers 25,412 sq ft total. At a rate of 7 mph, 41 minutes to complete.



Normal drag pattern—reverse.

1	Blue —Down centerline and up outside track
2	Green
3	Purple
4	Yellow
5	Light Blue
6	Pink —Down outside track and back up centerline (overlap)

Covers 25,412 sq ft total. At a rate of 7 mph, 41 minutes to complete.



Drag pattern intended to bring material from outside to center.

1	Yellow —Divide arena into half, and go around outside track of upper half of arena
2	Light Green
3	Light Blue —Up quarter line
4	Blue —Down opposite quarter line
5	Magenta
6	Orange —Around outside track of lower half of arena
7-10	Pattern follows Light Blue, Light Green, Blue, and Magenta
11	Back around outside track of entire arena, smoothing out any missed spots

Covers 53,389 sq ft total. At a rate of 7 mph, 87 minutes to complete.

Water

The most common, and often most effective, arena treatment is water. Water can minimize dust and prevent separation of additives, and it also helps maintain the integrity of the surface and provides a better working surface.

There are many different methods for applying water, ranging from water tanks separate from or combined with the drag equipment, sprinkler systems, or even a common garden hose. Regardless of method, the goal is to add water in an even layer with no dry or wet patches.

The proper amount of water applied to an arena is relative to the overall environment. An outdoor arena will require less

water in humid climates and after recent precipitation. An indoor arena or covered arena will often need more consistent watering. Both indoor and outdoor arena needs may vary with changing seasons and different weather patterns. Humidity levels can also influence footing moisture content. In addition, footing in a climate-controlled arena must be carefully monitored to ensure that it doesn't dry out.

Different types of footing require different amounts of water. A wood chip or dirt arena can be dusty, especially as particles break down as it ages, and will likely require more water than a rubber or crushed rock arena. Synthetic mixes with

fiber and sand will require water to keep the components combined as well as to minimize dust, but this recommendation would change with the presence of a wax coating. A general rule of thumb is to add enough water so that the surface can be pressed into a ball between your hands and retain its shape.

Riding Arena Maintenance: Equipment Guide

Claire Burnham, Morgan Hayes, and Staci McGill, Biosystems and Agricultural Engineering; and Robert Coleman, Animal and Food Sciences

Oils and Waxes

- **Mineral oil/plant-based oil:** A mineral oil coating can be added to reduce dust and eliminate need for watering. Mineral oil can be messy and may cause footing to stick to horses, people, walls, and equipment. Plant-based oils can/will become rancid.
- **Motor oil:** Applying motor oil is an outdated technique that was intended to reduce dust. This practice can have potential harmful effects, has been linked to carcinogenesis, and poses concerns for groundwater leeching. Motor oil should never be used as an option for reducing dust.
- **Wax:** A polymer coating that is intended to reduce dust and the need for watering. It is also used to retain cohesion of primary footing components and additives, commonly sand and fiber. Wax is generally added during the creation of synthetic sand and fiber mixes.

Chemical Agents

Many different chemical agents are added to the footing under different names. Most are intended to increase water retention and decrease the need for watering. Often used in the winter to control dust.

- **Magnesium chloride:** Magnesium chloride is a hygroscopic material that draws water particles suspended in the air into footing. It can cause mild irritation for humans, especially if it comes in contact with the eyes. There are some concerns about corrosion of metal structures within an arena.
- **Calcium chloride:** Similar to magnesium chloride, calcium chloride is intended to draw moisture from the air. It also may cause some wear and corrosion of metal materials.

Selecting the proper equipment and maintenance protocol is essential for keeping a usable and well-maintained arena. This guide gives a basic overview of drags and their component parts, and other arena maintenance equipment. Because there is variation in the terminology used between manufacturers, this compilation of basic terms, descriptions, and pictures will improve the arena manager's understanding of common terms.

Drags

Single-unit/simple drag: A drag with a singular unit without multiple components (Figure 1). It is commonly used on plain sand or single-substance surfaces. These drags typically level the top surface but do not usually move the footing

around or correct any significant defects caused by use.

Multi-unit/complex drag: A drag with multiple parts that do different things, varying by manufacturer and purpose. They are commonly used on mixed fiber or synthetic arena surfaces (Figure 2) and sand surfaces (Figure 3). The 4-N-1 drags most commonly used on sand.

Methods of Action

The method of action describes how the drag interacts with the footing.

Ground-driven: Drags move directly across the ground and work as a result of the weight of the machinery itself interacting with the arena surface (Figure 4). There is less control over how the drag travels, though weights can be added to

increase the depth tilled or the compaction achieved.

Hydraulically positioned: A mechanical method for adjustable placement of the drag that allows the operator to raise or lower the drag during the dragging process to exert the necessary amount of force on the surface (Figure 5).

Stroke-control spacer: To control the depth with a hydraulically positioned drag, spacers can be added to the hydraulic cylinder to ensure consistent depth between uses or to limit maximum depth (Figure 6).

Wheels: May be added to hydraulically positioned drags at the rear of the drag to act as a balance point to ensure the drag remains level.



Figure 1. Single-unit drag.



Figure 2. Multi-unit drag.



Figure 3. Multi-unit drag.



Figure 4. Ground-driven drag.



Figure 5. Hydraulically positioned drag.



Figure 6. Stroke-control spacer.

Cooperative Extension Service | Agriculture and Natural Resources | Family and Consumer Sciences | 4-H Youth Development | Community and Economic Development

Depth Control Strategies

Coil tines: A softer digging apparatus that typically does not reach the base but can be set to reach it (Figures 7 and 8). Can be angled differently to achieve different purposes.

Angles

- Forward and deep will break up chunks and help mix and blend the arena surface.
- Back and shallow will push material down to help pack and will vibrate, filling in grooves.

S tines: A more aggressive digging apparatus (Figures 9 and 10). Can reach down to the base of the arena. Takes material from close to the base and redistributes it to the surface in a tilling action. Excellent for mixing surface materials, especially for sand and fiber blends.

Angles

- Forward and shallow will mix the top of the surface while compacting the base.
- Back and deep will scrape hard spots along the base and loosen and redistribute material to level the surface.
- Back and shallow will level and fluff the top layer of the arena surface.

Knives/ripper teeth: Straight or curved, they work to break up compacted material throughout the surface layer (Figures 11, 12, and 13). Can be stronger than tines and can reach the base if set deeper. Typically adjusted in a manner to not reach the base.



Figure 7. Coil tines.



Figure 8. Coil tines.



Figure 9. S tines.



Figure 10. S tines.



Figure 11. Ripper teeth.



Figure 12. Ripper teeth.



Figure 13. Ripper teeth.

Rollers

Conditioner: Open roller that aerates footing, levels the surface, and offers minimal compaction (Figure 14).

Sheepsfoot roller: Solid roller with spikes intended to compact and pulverize large clumps of material (Figures 15 and 16).

Solid roller: Roller with no spikes that smooths and offers the most compaction (Figures 17 and 18).



Figure 14. Conditioner, part of a multi-unit drag.



Figure 15. Sheepsfoot roller, part of a multi-unit drag.



Figure 16. Sheepsfoot roller, part of a multi-unit drag.



Figure 17. Solid roller, Arena 53.



Figure 18. Solid roller, part of multi-unit drag, Arena 86.

Harrows

Level top surface or layer. Break-up clumps to achieve a uniform surface.

Box scraper/grader: Designed to level arena surfaces (Figures 19 and 20). Can move large amounts of footing and even level base.

Plated: Edges on either (or both) side(s) of the grader that help pull in material (Figures 21 and 22).

Chain harrow: Flexible, made similarly to chain link fence, with small tines that will not usually reach the base but can be deep enough to drag effectively (Figure 23). Not a perfect leveler due to its flexible nature but can be supplemented with weights to deepen penetration and increase leveling ability. Effective at breaking up larger clumps.

Rotary harrow: Can be a single large rotary harrow or multiple smaller harrows (Figures 24 and 25). Spinning action evens out footing in a circular motion, constantly mixing and redistributing within the area of action.



Figure 19. Box scraper, plated.



Figure 20. Box scraper, plated, part of multi-unit drag.



Figure 21. Sawtooth rake.



Figure 22. Sawtooth rake with weights.



Figure 23. Chain harrow.



Figure 24. Single rotary harrow.



Figure 25. One smaller rotary harrow of multiple in multi-unit drag.

Attachment Methods

Three-point: Three pinned attachment points (Figures 31 and 32). The bottom two attachment pins attach to lift arms on tractor, and the third attachment pin attaches to a top link bar or hydraulic cylinder. The three-point attachment acts as part of the tractor, but there may be some sway depending on adjustment of lift arms. The goal should be to reduce sway so the tractor and the drag turn together to prevent drag from turning into tire on a tight turn. Depth of a drag adjusted using lift arms and leveling the drag can be influenced by length of the top link.

Ball hitch: Traditional ball and socket, which might be seen on an ATV or golf cart (Figure 33 and 34). Often used to drag smaller arenas. This connection allows the drag to pivot freely; abrupt directional changes can allow drive unit, like a tractor or ATV, to be turned into the drag.

Draw bar: Acts similarly to a ball hitch, but it has a pin rather than a ball and socket connection (Figures 35 and 36). The person dragging the arena can oversteer a turn in the same way as with a ball hitch) to run the drag into the tractor tire.

Depth Control

Mechanism that allows control of how deep the footing is dragged. This can be as simple as adding weight to a simple drag or as complex as a laser system.



Figures 31 and 32. Three-point attachment method.



Figures 33 and 34. Ball hitch attachment method.



Figure 35. Draw bar attachment with hitch pin connection.