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Bluegrass Equine DIGEST

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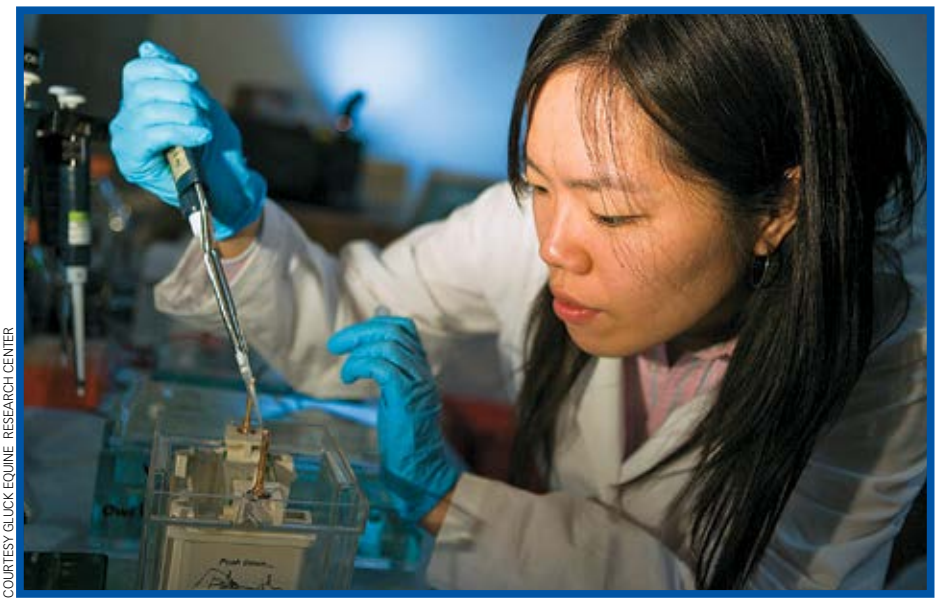
Genetic Basis for Establishment of EAV Carrier State

New research from the University of Kentucky (UK) suggests that genetic factors play a role in determining stallion susceptibility to equine arteritis virus (EAV) infection.

Results from the laboratory of Udeni Balasuriya, BVSc, PhD, professor of virology at the UK Gluck Center, demonstrated a correlation between horse genetic factors and establishment of EAV carrier state in stallions. Genome-wide analysis shows that equine chromosome 11 (ECA11) carries genes that are likely involved in cellular susceptibility to the virus.

Results of previous studies by Yun Young Go, DVM, MSc, PhD, a former graduate student in Balasuriya's laboratory, identified that horses can be divided into two groups based on *in vitro* (in the lab) susceptibility of their lymphocytes (white blood cells) to EAV infection. One group of horses had lymphocytes susceptible to *in vitro* EAV infection and the other group had lymphocytes resistant to *in vitro* EAV infection. Based on this finding, the investigators hypothesized that there must be a genetic basis for this phenomenon.



COURTESY GLUCK EQUINE RESEARCH CENTER

Based on Dr. Yun Young Go's studies, Dr. Udeni Balasuriya and other Gluck Center researchers hypothesized there must be a genetic basis for EAV infection.

Equine viral arteritis (EVA) outbreaks result in significant economic losses to the equine industry due to high rates of abortions, death in young foals, and establishment of the carrier state in stallions. Persistently infected carrier stallions function as the natural reservoir of EAV, and they disseminate the virus to susceptible mares at breeding.

In their study, the researchers randomly selected 310 horses representing four breeds (Thoroughbreds, American Standardbreds, Standardbreds, and Quarter Horses) from Kentucky farms. They collected blood samples and divided them into two groups according to the susceptible and resistant types of lymphocytes to *in vitro* infection with EAV. Then, using genome-wide analysis tools, they analyzed DNA from each group's cells to determine which genes might contain markers involved in viral infection of the cell.

Of the 310 horses, 167 had the susceptible lymphocytes and 143 had the resistant type. By breed, 95% of the Standardbreds and approximately 90% of the American Standardbreds had the susceptible type. Thoroughbreds and Quarter Horses had the lowest prevalence of the susceptible type (23%). Quarter Horses had evenly distributed resistant and susceptible cell types.

The genome-wide analysis of EAV susceptibility showed that Standardbred horses were most fixed for susceptibility markers, meaning that almost all Standardbreds have the genetic markers associated with cell susceptibility to EAV. Of the four breeds, Thoroughbreds had the lowest number of

Articles of Interest

EAV Carrier State

markers associated with the susceptible type.

Thoroughbreds have less diversity for genetic markers than other breeds. By analyzing this breed first, the researchers were able to uncover a specific marker for lymphocyte susceptibility indicating that EAV infection is highly associated with the ECA11 chromosome. The genes on this chromosome encode proteins that are involved in virus attachment and entry into the cells, the inflammatory response, and cellular immunity.

EAV might interact with some of these cellular proteins to evade the equine immune response and establish persistent infection in some, but not all, stallions infected with the virus, as only some stallions become persistently infected carriers, according to the authors. Recently, the same researchers demonstrated that stallions with lymphocytes susceptible to EAV infection might have a higher risk of becoming carriers.

"These studies can help us develop working hypotheses about why horses become infected, and how persistent infection is established in the stallion," said Balasuriya. "The next step is to test semen samples using the same techniques. To continue these studies, we have recently been awarded a $2.9 million five-year grant by the United States Department of Agriculture-Agriculture and Food Research Initiative to specifically identify the genetic factors responsible for establishment of the EAV carrier state in stallions."

These papers are available at http://jvi.asm.org/content/85/24/13174 and http://jvi.asm.org/content/86/22/12407. UK

>Nancy Zacks is a horse lover and freelance writer with an MS in Science Journalism from the Boston University College of Communication.

Gluck Center Researchers Study Ways to Advance Breeding Season

Equine Recombinant Follicle Stimulating Hormone

University of Kentucky Gluck Equine Research Center scientists recently studied the use of recombinant hormones to induce mares' reproductive cyclicity and advance the breeding season. The study, done in collaboration with the University of California and Colorado State University, aimed to determine the efficacy of an equine recombinant follicle stimulating hormone (reFSH) in non-cycling mares housed under natural light conditions.

A mare's transition from reproductive inactivity during the winter to the breeding season can be lengthy and complicated. Increased daylight suppresses melatonin (a hormone preventing mares from cycling in winter) and allows secretion of reproductive hormones necessary to induce ovulation and reproductive cycles. Mares under natural light do not enter the breeding season until late April. Their transition period is characterized by an increase in follicle development and uterine edema.

ANNE M. EBERHARDT

Mares are often housed under artificial barn light to hasten their transition period for breeding season.

The facemask consists of a leather headpiece with a single blue LED fitted on the inside of a semi-rigid rubber eye cup over the right eye. The mask is equipped with adjustable Velcro down the center of the head piece.

Veterinarians have developed various management and therapeutic strategies to shift a mare's first ovulation of the year from April to February. The most common management is light treatment, which should begin in December for mares to begin their reproductive cycles in mid-February.

"Even housed under artificial barn light, the mares may still experience normal length of transition period lasting 50 to 70 days or more, prior to the first ovulation of the season," said Mats Troedsson, DVM, PhD, director of the UK Gluck Equine Research Center and chair of the department of veterinary science. Therefore, there might be a need for alternative treatments of shorter duration.

In their study, the researchers employed 60 deep anestrous (wintertime, non-cycling) mares in California, Colorado, and Kentucky from the end of January until one or more pre-ovulatory follicles developed. They divided the mares into two groups and administered either 0.65 mg of reFSH or a placebo by random selection. They monitored the mares by ultrasound until a 35 mm or larger follicle developed, discontinued reFSH treatment, and administered human chorionic gonadotropin (hCG) to induce ovulation. All mares treated with reFSH developed follicles after a week, and 23 of 30 mares in this group ovulated within 72 hours after receiving hCG. The control group did not develop follicles during the period.

While reFSH proved successful stimulating early dominant follicles and ovulation in the seasonally anestrous mares, a continued cyclicity failed to appear. "However, the treated mares returned to anestrus following the induced ovulation and followed the calendar of the control group," Troedsson said. He suggested that continuous treatment might be necessary in mares that fail to become pregnant following breeding on induced ovulation.

Breeding Season Studies

Mobile Light Therapy Efficacy

Using artificial indoor light to speed up mares' transition to breeding season can be time-consuming and costly in electricity, bedding, and labor.

Researchers at the Gluck Center collaborated with Barbara Murphy, BSc, PhD, a researcher at the University College Dublin, Ireland, who recently developed a facemask with blue light directed at a single eye to suppress melatonin production in mares under natural light. The team set out to determine if the facemask was as effective in advancing breeding season as traditional indoor barn light.

From mid-December to mid-February 2013, the researchers studied 59 Thoroughbred mares, ages 4 to 17, from farms in Lexington, Ky. They divided the mares into three groups. One group was stalled individually under indoor barn light (250 Lux) that remained on until 11 p.m.; the second group was housed outside wearing the facemask with timed light (50 Lux blue light) from 4:30 p.m. until 11 p.m. daily. The third group was a control group maintained outside in natural light. The researchers performed transrectal ultrasound examinations of the mares' reproductive tract to determine the presence and size of the follicles in conjunction with sampling serum progesterone to confirm ovulation.

Fourteen of 16 mares exposed to indoor barn light and 20 of 26 mares wearing the light masks exhibited reproductive activity. The control group only showed four mares in activity. There was no statistical difference between the two light treatment groups, but all treated horses had advanced reproductive cycles compared to the control mares.

"We concluded that the timed low level blue light was as effective as traditional indoor barn light in advancing breeding," Troedsson said. "In addition, we emphasize that the mobile head gear saves electricity and labor as the horse can remain in pasture."

Troedsson added that the light facemask is an excellent alternative to indoor barn light as it also allows the horse more outdoor time in its natural environment. UK

>Shaila Sigsgaard is an editorial assistant for the Bluegrass Equine Digest.

MASTHEAD

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AAEP Launches Equine Parasite Control Guidelines

The first official set of guidelines for parasite control in horses is now available on the American Association for Equine Practitioners' (AAEP) website. An AAEP-appointed subcommittee of researchers, clinicians, industry representatives, and veterinary practitioners spent the last several years formulating the document.

"We are facing a significant paradigm shift in equine parasitology, and there has been lots of confusion and controversy in our field in recent years," said Martin K. Nielsen, DVM, PhD, Dipl. EVPC, assistant professor in the Department of Veterinary Science at the University of Kentucky Gluck Equine Research Center. Nielsen is chair of the subcommittee.

Nielsen explained that guidelines for parasite control in horses are highly needed to help veterinarians and their clients maneuver the challenging landscape between the many different parasite species infecting horses and the increasing levels of drug resistance in several of these. Parasite control is not as straightforward as we once believed.

"We are facing a significant paradigm shift in equine parasitology."
Dr. Martin K. Nielsen

"We have long been emphasizing there is no one-size-fits-all program for parasite control, which is a true statement but does not provide much help for the veterinarian in the field," Nielsen said.

The document states that the goal should never be to eradicate a parasite. Not only is this impossible, but the inevitable result

Parasite Control Guidelines

is accelerated development of parasite drug resistance. Instead, goals are to minimize parasitic disease risk; control parasite egg shedding; maintain effective drug control; and avoid further development of anthelmintic (drugs used to treat parasitic worm infections) resistance.

For adult horses, the guidelines state that one or two yearly treatments are sufficient to prevent large strongyles infection. Cyathostomin (small strongyle) parasites can be treated based on strategically performed fecal egg counts. Tapeworm treatments should be included annually in most regions.

The document recommends not basing foal treatments on egg counts. Instead, foals should receive about four treatments their first year. The guideline provides information about the timing and choice of anthelmintic drug. Veterinarians should continue treating yearlings and 2-year-olds as "high" shedders and administer approximately three yearly treatments with effective drugs. In all ages it is highly recommended to perform routine screenings of anthelmintic efficacy with fecal egg count reduction tests.

"We hope these guidelines will reduce the confusion and controversy about parasite control and hope to continue to update this document as we generate more information," Nielsen said.

To read the complete guidelines, visit www.aaep.org/images/files/ParasiteControlGuidelinesFinal032413.pdf. UK

>Shaila Sigsgaard is an editorial assistant for the Bluegrass Equine Digest.

GRAD STUDENT SPOTLIGHT

KRISTA COTTEN

From: **Amarillo, Texas**

***Degrees and institute*: B.S., Animal Science, University of Kentucky**

Krista Cotten, a master's student in Plant and Soil Sciences at UK, came to the Lexington area with the Kentucky Equine Management Internship program.

"I fell in love with the area and transferred to UK (from West Texas A&M University) to finish my undergrad degree," Cotten said. "I ended up in Plant and Soil Sciences (PSS) because of a great opportunity that a friend knew about working with Dr. Ray Smith and the UK Horse Pasture Evaluation Program. So I guess PSS found me."

Cotten's research project focuses on the effects of tall fescue sample handling and storage on ergovaline concentrations in fresh material. Ergovaline (a toxin produced by the fungus that infects some tall fescue) adversely affects many livestock species, including horses.

However, knowing how much ergovaline is present in a pasture at any given point is tricky because ergovaline appears to be unstable in the fresh plant, Cotten said.

"The goal of my research is to determine the best method of sample handling and ideal storage conditions of samples until the lab can process them," she said.

Cotten also works with the UK Horse Pasture Evaluation Program, which helps local horse farms of all sizes improve pastures by providing detailed recommendations based on observations made in each field. The program also samples tall fescue on some farms to determine the risk present to late-term mares. Last year, the program worked with 18 farms for a total of more than 3,800 acres and expects to cover even more ground this year.

"My hope is that my research provides guidelines for more standardized tall fescue sample handling and storage so that results from both research and diagnostic cases can be compared from across the country," Cotten said.

Cotten plans to graduate in December 2013. UK

>Shaila Sigsgaard is an editorial assistant for the Bluegrass Equine Digest.

Gluck Center's Nielsen Receives Grayson-Jockey Club Grant for Parasite Study

Martin Nielsen, DVM, PhD, EVPC, assistant professor in the Department of Veterinary Science at the University of Kentucky Gluck Equine Research Center, received a one-year grant from the Grayson-Jockey Club Research Foundation to study the interaction between anthelmintic treatment and vaccines.

The study will generate useful information about the interaction between deworming and vaccination in horses. The presence of intestinal worms and the host reaction to deworming can potentially influence vaccination effects through modulating inflammatory reactions in the horse. In addition, the study allows Nielsen to evaluate possible differences between two types of dewormer (ivermectin and pyrantel pamoate) in their effect upon vaccination responses.

Well-managed equine establishments deworm and vaccinate their horses against infectious agents on a routine basis—sometimes having a veterinarian administer both dewormer and vaccination(s) during one visit. Until recently, practitioners considered this practice unproblematic, but recent findings have raised concerns whether the horse's response to deworming might affect vaccination efficacy. Deworming causes a mild and transient inflammatory reaction in the horse, which appears to depend on the type of dewormer used. In addition, intestinal worms have been shown to possess properties capable of modulating an inflammatory response.

In the grant proposal, Nielsen said, "Deworming has been found to cause disease in newly dewormed horses, but usually the inflammatory reaction is mild with no apparent symptoms. However, it is unknown whether this reaction can possibly affect the result of vaccination. Our hypothesis is that deworming causes an inflammatory reaction that affects the response to vaccination."

Nielsen's Grayson-Jockey Club Grant

In the study Nielsen will evaluate three groups of ponies. Each will receive different vaccinations. He will deworm two of the groups with two different dewormers (pyrantel pamoate and ivermectin) at the time of vaccination and maintain the third group as an untreated control. He will then monitor the ponies for 60 days to evaluate deworming effectiveness, inflammatory response, and generation of vaccine-specific antibody levels.

"This allows us to measure the effectiveness of the deworming, the antibody response to the vaccine, and the inflammatory reaction to vaccination with and without the accompanying deworming," Nielsen said.

The Grayson-Jockey Club Research Foundation will fund 17 projects in 2013, totaling $874,024. The research includes the launch of 12 new projects, the continuation of five projects entering their second year, and three Storm Cat Career Development Awards. For more information on all the grants, visit http://grayson-jockeyclub.org/default.asp?section=2&area=Research&menu=2. UK

>Jenny Evans, a MFA candidate, is the Gluck Equine Research Foundation coordinator at the Gluck Center.

WEED OF THE MONTH

Common name: **Spiny pigweed, Spiny amaranth**
Scientific name: ***Amaranthus spinosus*** **L.**
Life Cycle: **Warm season annual**
Origin: **Tropical America**
Poisonous: **No**

Spiny pigweed is distributed widely across the United States and grows most frequently along fence borders, feeding and watering areas, and other compacted areas. Spiny pigweed can sometimes infest entire pastures that are overgrazed. Seed germination occurs in late spring or early summer. Stems are reddish, stout, and branched. Mature plants can grow 3 feet tall and are most noticeable in late summer. Sharp spines that inhibit grazing are found in stem axils and are surrounded by dense clusters of female flowers. The male flowers are long terminal clusters.

Spiny pigweed control is relatively easy with herbicides when applied to plants less than 12 inches tall. Mowing and hand weeding are effective if done before flower production to prevent seed production. Consult your local Cooperative Extension Service personnel for herbicidal control in your area. UK

>William W. Witt, PhD, a researcher in Plant and Soil Sciences, provided this information.

Equine Coat Color Genetics 101

At the 2013 University of Kentucky (UK) Equine Showcase, held Jan. 18 in Lexington, Ky., Kathryn Graves, PhD, the director of the UK Animal Genetic Testing and Research Laboratory, reviewed the basics of equine coat color genetics.

Why should the average horse owner care about the genetics behind their horse's coat color? Graves explained that some breed registries are either based on horses' coat colors or have color restrictions. For instance, The American Paint Horse Association, the Appaloosa Horse Club, and the International Buckskin Horse Association, among others, are all color breed organizations. Other groups like the Friesian Horse Association of North America and the Kentucky Mountain Saddle Horse Association won't allow horses to be registered if they have certain amounts of white patches, she said. Graves also said some horsemen believe horses of certain coat colors are easier to market and sell than others. Some owners even opt to have genetic tests run on horses to identify their genotypes (the genetic make-up of a given physical trait), especially if the animals will be used for breeding.

The completion of the equine genome in 2007 opened a door for geneticists to identify mutations for the basic coat colors as well as modify genes for other coat colors and spotting patterns, Graves said. In her presentation, Graves first reviewed the key terms "dominant" and "recessive." Dominant means only one copy of the mutation is needed for it to be expressed outwardly, while recessive means two copies are needed. If a horse carries two copies of the same allele for a gene, he is homozygous (for instance, E/E or e/e, with the lowercase letters indicating recessive genes, and capital letters signifying dominant) for that trait. If he carries one dominant and one recessive allele, then he is heterozygous (E/e) for the trait.

Moving forward, Graves discussed the genetics behind specific equine coat colors.

Base Coat Colors Horses have three basic coat colors: red (chestnut), bay, and black, all of which are controlled by two gene's interactions. The Extension (or E) locus

Dr. Kathryn Graves discussed the genetics behind specific equine coat colors.

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Equine Coat Color Genetics 101

gene is instrumental in allowing black pigment to be expressed, and the Agouti (or A) locus gene controls the location of black in the horse's coat. Specifically, the E locus is located on gene MC1R and the A locus is located on gene ASIP. Graves said chestnut is a recessive trait, meaning all chestnut horses have a homozygous (e/e) genotype for that color. The E allele, which is dominant, permits the expression of black pigment; therefore, all black and bay horses have at least one copy of the E allele, Graves explained; they can be either E/E or E/e.

In horses with E/E or E/e genotypes, the A gene determines whether those animals are bay or black. Bay is the dominant phenotype (the physical expression of a genetic trait) between the two, and its genotype is expressed by either E/Aa or E/AA. Black is the recessive color, meaning it is always homozygous and expressed as E/aa.

All other equine coat colors and patterns stem from these base coat colors.

Gray The gray coat color (gene STX17) is represented by a dominant genotype (G/G or G/g), Graves said. These horses are born dark and eventually lose their hair pigment until they are all or nearly all white. To produce a gray horse, at least one parent must contribute a dominant G. Non-gray horses have two recessive genes (g/g).

"All equine coat colors and patterns stem from three base coat colors."

Dr. Kathryn Graves

Roan Although gray and roan horses can look similar in some cases, Graves stressed that their genetics are different. Instead of lightening in color over time, roan horses retain dark heads and legs and have a mixture of white and colored hairs over the rest of their body. The exact mutation behind roan coloring hasn't been identified, but researchers know it's linked to the MC1R and KIT genes, which play a role in some pinto horses' genetics.

Graves then discussed coat spotting patterns that, in most cases, produce horses with a base color spotted with a variety of white patches.

Tobiano The first spotting pattern Graves discussed was the tobiano pattern—the most popular genetic test her laboratory carries out. Tobiano horses generally have dark-colored heads with white legs and white patches breaking over their topline. Graves said chromosomal inversion on the KIT gene helps produce this color pattern. Horses with this dominant gene will always produce spotted horses, she said.

Sabino Sabino is a subclass of the other main painted coat color pattern: overo. These horses are generally solid with white facial markings, white legs, and belly spots. The KIT gene is also involved with creating this color pattern, she said. The most important thing to know about this semidominant

Q&A

Trimming Feed Costs

During the 4th annual UK Kentucky Breeders' Short Course in Lexington, TheHorse.com news editor Erica Larson caught up with Laurie Lawrence, PhD, to discuss how horse owners can cut their feed costs without cutting corners.

View the short video at TheHorse.com/31240

Kentucky Equine Youth Festival Celebrates the Horse and Kentucky's Youth

More than 2,500 school-aged children attended the 2013 Kentucky Equine Youth Festival, Celebrating the Horse, held March 27 at the Kentucky Horse Park's Alltech Arena.

Hailing from 46 Kentucky counties and two neighboring states, participants ranged in age from 4 to 18. The event featured several horse breeds that demonstrated equestrian sport in a variety of disciplines, including jumping, stock horse versatility, vaulting, driving, Arabian Horse versatility, and gaited breeds, including those native to Kentucky. Other educational opportunities included up-close-and-personal sessions about vaulting, horse dentistry, therapy horses, size comparisons of different breeds, and biomechanics of jockeys and racehorses.

"This year's festival was an educational and rewarding experience," said Jimmy Henning, PhD, associate dean for extension and director of the Kentucky Cooperative Extension Service. "The UK College of Agriculture was happy to join with our partner organizations in celebrating two of Kentucky's signature assets, the horse and our youth. We are happy to have been a part of this special day at the Kentucky Horse Park, as well as every day and across the state through our 4-H equine programs at our county extension offices."

This year's festival built upon the first one held in 2010, where children packed the venue to watch world-renowned elite equestrian athletes demonstrate the World Equestrian Games' disciplines.

New this year was an art contest with the theme, "What Horses Mean to Kentucky." Winners were revealed during the event, and bookmarks featuring the winning art were distributed to all participants.

The Kentucky 4-H Horse Program staged the event in conjunction with the University of Kentucky's Ag Equine Programs and in partnership with the Equine Academy at Lexington Catholic High School, Equine Land Conservation Resource, Kentucky Department of Education, Kentucky Equine Education Project, Kentucky Horse Council, Kentucky Horse Park, Midway College, United States Equestrian Federation, and the United States Pony Clubs.

The event's major sponsors included the Bluegrass Palomino Horse Association, North American Equine Ranching Information Council, Race for Education, United States Equestrian Federation, and the University of Louisville's Equine Industry Program. UK

>Holly Wiemers, MA, is communications director for UK Ag Equine Programs.

The event included several breed and discipline demonstrations as well as educational opportunities.

PHOTOS COURTESY MATT BARTON; BOOKMARK DESIGN DENNIS DUROSS

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[1] Data on file, sales report data from 2001 through October 2012, Zoetis Inc.

Equine Coat Color Genetics 101

trait is that foals with a homozygous genotype can be born all white and healthy (unlike some other white foals affected by the deadly overo lethal white syndrome [OLWS]; more on that in a moment). Thus, she stressed, test white foals suspected of having OLWS for the disease before euthanizing them.

Splashed White Another type of overo coloring is the splashed white pattern, Graves said, which is characterized by similar markings as the sabino pattern. Many splashed white horses have blue eyes, she said. This color pattern is caused by multiple mutations in the genes MITF or PAX3, she said, and these horses are at risk for several different types of health problems, including deafness. One type of MITF mutation (termed SW1) has been identified in several breeds, she said, and homozygotes are viable. APAX3 mutation (SW2) and another type of MITF mutation (SW3) produce a similar phenotype but are thought to be lethal in the homozygous state.

Frame Overo This color pattern (characterized by a mostly solid colored horse with white, horizontal patches on the side of the neck and/or belly; white rarely crosses the back between the withers and the tail in frame overos) is produced by a mutation on gene EDNRB, which researchers discovered while searching for the lethal white gene, Graves said. As mentioned, two recessive frame overo genes can also produce a foal with OLWS. In these horses, the colon does not develop normally and foals are unable to pass manure; affected foals die or are euthanized within a few days of birth. Because the mutation that causes OLWS is known, breeders can test mares and stallions to reduce the risk of producing an affected foal.

Dominant White These horses (born white with dark eyes) are produced by 14 to 15 different mutations in the KIT gene, Graves said. She explained that researchers have identified mutations specific to certain families of horses. Thus far, all of these horses tested have shown a heterozygous genotype.

Appaloosa The final spotting pattern Graves discussed was the appaloosa or leopard complex spotting (LP) pattern. Researchers still aren't sure what causes this spotted pattern, but they've traced the mutation to the TRPM1 gene, she said. The LP pattern is an incomplete dominant trait, meaning there is a dosage effect if the horse has two copies of the mutation (horses with one copy of the mutation are typically a different color than a horse with two copies of the mutation), Graves said.

Finally, Graves discussed the dilution patterns, in which a mutated gene dilutes a base color into a variety of different colors.

Cream The cream dilution (a mutation on gene MATP) produces palomino, buckskin, cremello, perlino, and smokey black coat colors, depending on the number of dilution mutations—one or two—and the horse's base color, Graves said:

- A palomino is a chestnut that is heterozygous for the cream dilution mutation;
- A cremello is a chestnut that is homozygous for the cream dilution mutation;
- A buckskin is a bay that is heterozygous for the cream dilution mutation; and
- A perlino is a bay that is homozygous for the cream dilution mutation.

Graves noted that a black horse heterozygous for the cream dilution mutation appears black, but is known as a smokey black; a black horse homozygous for the cream dilution mutation appears perlino and is called a smokey cream.

PHOTOS.COM

A horse with the tobiano spotting pattern is generally characterized by a dark-colored head with white legs and white patches breaking over his

Dun is a dilution pattern affecting a horse's primary base color. All dun horses have dorsal stripes, and many have zebra stripes on their legs.

Equine Coat Color Genetics 101

Champagne The champagne dilution is caused by a mutation on gene SLC36A1 and is a dominant trait, Graves said. This dilution gene acts solely on the horse's base color and does not have a dosage effect like the cream dilution gene. It simply lightens the horse's base color pigment. Horses with a black base coat will appear chocolate in color, while chestnut or lighter bay horses will appear gold. Graves said horses with the champagne dilution frequently have blue eyes at birth that become amber-colored in adulthood.

Pearl Graves said pearl dilutions (caused by a mutation on gene MATP) are often referred to as the "Barlink factor," as many horses of this color can trace their heritage back to a stallion named Barlink Macho Man. Graves said one copy of the mutation lightens the horse's skin and might produce golden undertones to the coat, while two copies of the mutation produces a diluted base color and might enhance cream and champagne colors.

Dun The mutation behind the dun coat color is still unknown, Graves said, so there is currently no direct genetic test. Researchers know, however, that it's a dominant trait affecting the horse's primary base color. A horse with a black base and the dun mutation would have a grullo coat color; a chestnut base would have a red dun color; and a bay base would have a yellow dun color. All dun horses have dorsal stripes, and many have zebra stripes on their legs, Graves said.

Silver The final dilution Graves described is the silver dilution, a phenotype commonly seen in Rocky Mountain Horses, which is caused by a mutation on gene PMEL17. This dominant trait requires either a bay or black base color; chestnut horses with the mutation will not appear any different than a chestnut without the mutation. This dilution produces a chocolate body color with a flaxen mane and tail.

Graves concluded with a caution to breeders seeking "fancy" coat colors: The mutations that cause these desirable colors can have other undesirable effects. Aside from OLWS, horses with the silver dilution pattern have been known to develop multiple congenital ocular abnormalities, a non-progressive disease that commonly includes ciliary body cysts (a congenital uveal abnormality) and megaloglobus (eyeball enlargement); homozygotes are more severely affected. Additionally, horses homozygous for the appaloosa mutation are affected by congenital stationary night blindness, causing a complete lack of night vision. UK

PHOTOS.COM

Silver dilution produces a chocolate body color with flaxen mane and tail.

>Erica Larson is the news editor for TheHorse.com.

Locust Trace Field Day

More than 250 Fayette County middle school students attended the Locust Trace Agri-Science Farm field day April 23. UK Ag Equine Programs provided educational materials and an interactive display about different forages. Students visited various stations to learn about different equine organizations and topics. Locust Trace Agri-Science Farm is a career and technical high school in Lexington, Ky., that opened in 2011. Energy and environment are key factors in the facility design and agriculture the educational focus.

COURTESY UNIVERSITY OF KENTUCKY

UPCOMING EVENTS

May 9

Kentucky Equine Networking Association (KENA) Meeting. Networking 6 p.m., dinner 6:30 p.m., Sheraton Hotel, Lexington, Ky.

UK Ag Equine Store

In response to requests for merchandise featuring University of Kentucky (UK) equine logos, UK Ag Equine Programs has launched an online store. Find UK Ag Equine or Gluck Equine Research Center logoed items from T-shirts to coats to tailgating gear all in one spot. Visit www.ukagequinestore.com and login as a guest. Want some new UK Equine gear? Find jackets, scarves, bags, and more!