

by Les Sellnow • courtesy of AAEP

Exercise and diet are important in increasing a mare's chances of getting in foal. When a mare is left to her own devices reproductively, she will fall into a rhythm with nature. When the days are short, dark and cold, her reproductive system will shut down. When the longer, warmer days of spring arrive, her reproductive system will begin to stir and within weeks will be ready for procreation.

For a number of reasons, man has interfered with nature's approach. Perhaps the prime reason is the creation of a universal birthday for certain breeds of horses of Jan. 1. Thus, the foal, which is born in January, February, March, etc., of a given year becomes one year of age on the next Jan. 1. So, does the foal that is born Dec. 1, although both become yearlings, one is nearly a full year of age chronologically while the other is only one month of age? This is significant because racing and other forms of competition, such as halter classes at Quarter Horse, Arabian, Paint, Appaloosa and other shows, all divide entries by age. It would be difficult for a Thoroughbred foal born late in the year to be able to make the Run for the Roses, for example, when it is only two-plus years of age chronologically while its counterparts are three-plus years. The same would be true at the annual Thoroughbred sales. Potential buyers, generally speaking, are looking for young horses born early in the year so that training can begin and the horses can be racing when two years old.

Then, there is the matter of racing and showing fillies and mares. During the spring and summer months, their reproductive systems want to operate in normal rhythm with nature. This, however, can be counter-productive to success on the track and in the show ring. "Whenever I'm doing a pre-purchase examination of a performance mare, I always give the prospective owner my 'female speech'," says Dave Beckman, DVM, a practitioner from Anchorage, KY. "How she will react when in estrus is not something I can objectively evaluate during a pre-purchase exam, so I make certain they know that there are some mares that, when they come into heat, are a definite behavioral problem and they will not perform well, be it in a race, jumping, eventing or whatever. It is like a big rolling ball of hormones within their reproductive system and you don't know what to expect.



Now, there are some mares that humiliate me. I give that speech, the person buys the mare, and she never causes them a problem. There are a handful of great, athletic mares out there that will perform at their peak without Regumate or anything else. However, in my experience, the majority of them are some sort of problem during the heat period.”

There also is the matter of the stallion to consider. If the breeding farm is able to control ovulation in the mares being bred, it is far easier to manage the stallion, especially if he happens to have fertility problems. Having mares come into estrus at regularly spaced intervals can be an important assist in maintaining his fertility. The same can be true for stallions, which are being used in an artificial insemination program. In many cases, several mares can be bred with sperm from a single ejaculate if they all are in estrus at the time the stallion is collected.

Then, too, there is the matter of embryo transfer. The donor and recipient mares must be on the same page, reproductively speaking, if the transfer is to be a success. What all of this boils down to is that in modern horse breeding, regulating estrus has become a necessity in many instances. Before one discusses regulating an important part of the horse’s system, it would be wise to review just what it is that is being regulated and how.

The Reproductive Cycle

We start with the basic premise that the key to reproduction is light. We can talk about the balmy days of spring, the arrival of green grass and the gentle touch of soft winds and warm rains, but what matters the most is light. Because of this knowledge, horsemen literally can trick nature into moving out of its natural rhythm with the administration of artificial light.

First, let’s take a look at the role light plays in jump-starting the reproductive system of both male and female. The mare’s reproductive activity is described as being “seasonally polyestrous.” Basically, this means that she has a reproductive season and a non-reproductive season. Both are controlled by light. The non-reproductive season, known as anestrus, comes during the fall and winter when there is little light. The reproductive season begins in the spring and continues through the summer when there is a great deal of light. During anestrus, the mare will not respond to a stallion’s attention, her ovaries become reduced in size and are inactive.

During the reproductive season, the mare’s attitude changes, at least on certain days, along with hormonal activity within her reproductive system. During the reproductive season, the mare will experience a series of estrous cycles. During this period of sexual activity, the ovaries swell up to the size of tennis balls and become active, rather than dormant. These cycles will repeat themselves at 21 to 23-day intervals until she becomes pregnant or until she reverts to anestrus as light fails and late fall and winter arrive. The above is true if man does not interfere.

However, as mentioned, artificial light can be used to stimulate an earlier onset of the reproductive season and drugs can be administered that can shorten her cycle and dictate when she will ovulate. When a mare is operating in rhythm with nature, without human

interference, there will be peak times for both conception and anestrus. While there are two basic reproductive seasons, each of these two can be split once again, making four in all. As already mentioned, the natural breeding season occurs during spring and summer, with the highest efficiency coinciding with the longest day of the year, June 24. During this period, nearly 100 percent of mares will be cycling. Conversely, the anestrus season is at its peak during the winter months, coinciding with days when there is relatively little light. During this period, only a small percentage of mares will cycle and ovulate. The other two cycles are transitional stages that occur prior to the active season and just before anestrus. During those times, mares generally are erratic in their cyclic and sexual behavior.

The estrous cycle, during the active months, is controlled by the interaction of various hormones within the body. However, it all starts with the eye, which allows the entry of light. As days get longer, the mare's brain records the increased amount of light. This stimulates the hypothalamus gland located within tissues of the mid-brain. The hypothalamus starts the reproductive system by producing gonadotropic-releasing hormone (GnRH). When GnRH is secreted in the proper quantity, the pituitary gland, located at the base of the brain, is stimulated. The pituitary is attached to the hypothalamus by a stalk containing both blood vessels and nerves, which serve as its pathway for communication with the hypothalamus. When stimulated, the pituitary gland secretes two hormones that affect the ovaries.

The first hormone is known as follicle stimulating hormone (FSH). This hormone moves through the bloodstream to the ovaries, where it stimulates development of one or more follicles. The now-developing follicles in the ovaries, when they reach the stage where they are 20 to 25 millimeters in diameter, secrete estrogen. The estrogen has several effects, including affecting behavioral centers in the brain, stimulating estrual activity, affecting the cervix by allowing relaxation for entrance of spermatozoa into the uterus, stimulating the smooth muscles in the mare's reproductive tract for increased contractions to transport sperm and ovum, and, causing the pituitary gland to inhibit further secretion of FSH and stimulate the release of the second gonadotropic hormone, luteinizing hormone (LH).

LH facilitates maturation and ovulation of the growing, egg-bearing follicle. Ovulation occurs when the mature egg leaves the follicle and begins its trip through the oviduct, generally late in estrus. Once ovulation has occurred, the luteal phase of the estrous cycle is ushered in. In the wake of ovulation, the estrogen level falls and the remains of the ovulated follicle are converted to form a corpus luteum (CL) or yellow body.

Luteal cells secrete the hormone progesterone, which has as its task the shutting down of secretion of the estrus-stimulating hormones and thus setting the stage for maintaining a pregnancy. Because of its role in the reproductive system, progesterone (in a synthetic state) becomes highly important in artificially manipulating the estrous cycle. During a normal estrous cycle, the first task for progesterone is to subdue the actively contracting reproductive tract and to tighten and close the relaxed and open cervix. At the same time, progesterone inhibits the secretion of FSH and LH from the pituitary. When this has been accomplished, the mare goes into a state of diestrus, which means she is no longer in heat and is no longer receptive to the stallion. Under natural circumstances, what happens next is dependent on whether the mare has become pregnant.

If she did not conceive, the uterus will remain under the influence of progesterone for 12 to 14 days. If no embryo is present in the uterus at the end of that time, the uterine endometrium will secrete the hormone prostaglandin. This hormone will destroy the corpus luteum, which is producing progesterone. With the corpus luteum destroyed, no progesterone is produced. Without progesterone as an inhibitor, the level of follicle stimulating hormone (FSH) rises and the cycle starts all over.

Manipulating The Cycle

The most basic procedure involved with controlling the estrous cycle in a mare is light. It is basic and simple because all it involves is utilizing a 200-watt light bulb. Martha M. Vogelsang, PhD, of Texas A&M University, says that light usage can bring benefits, but there is at least one side effect (shedding) that could pose a problem unless dealt with.

“Currently, the simplest and most effective management protocol for bringing mares into heat prior to the natural breeding season is the use of extended day length,” said Vogelsang. “By imposing an artificially long day on mares beginning in late November or early December, the hormonal mechanisms that control estrous cyclicity are stimulated such that mares will begin to ovulate in mid- to late February (rather than March or April).” Although different lighting schedules have been studied, a lighting program that supplies 16 hours of light to eight hours of dark seems to provide a consistent response. The additional light can be provided by placing mares in stalls or paddocks where there is sufficient light in the afternoon, and maintaining the light artificially until approximately 11 p.m.

The amount of light necessary to elicit photoperiodic stimulation is at least three foot-candles at the level of the horse’s eye. A 200-watt incandescent bulb provides adequate light in the average stall. It is important for the mare owner to understand that extending the day length does not provide an immediate response, nor does it eliminate the transitional period between anestrus and the ovulatory season.

A behavioral response can be seen 30 to 60 days after the program is initiated, with the first ovulation occurring 60 to 90 days after the lighting program begins. It should also be noted that exposure to extended day length stimulates shedding. Depending on the climate, mares in extended day length programs may need shelter and/or increased nutrient intake during this period. Although not as frequently mentioned as a key element in controlling the estrous cycle, nutrition can play a pivotal role, as can exercise.

Scott Bennett, DVM, a practitioner who also operates an equine hospital in Shelbyville, KY, and focuses much of his practice on breeding problems, believes that both exercise and diet can play significant roles in the estrous cycle. Mares can be put under lights to stimulate an earlier onset of the cycle, but if they receive no exercise and either are too fat or too thin, light therapy alone might do little. “I like to see these mares get exercise,” says Bennett. “I believe a stall is a horse’s worst enemy. I like to see mares turned out during the day where they can exercise and keep themselves fairly fit, and brought into the barn at night and put under lights. A lot of times, I will just group them in a shed under lights.”

He also believes there must be middle ground between a mare, which is too fat and one, which

is too thin. The way to control a horse's condition, he says, is to feed by weight: "Feed horses individually and feed by weight, not by coffee can." Mares, which are too fat, he says, should be placed in a dry lot where their intake can be closely monitored. Those, which are too thin, should be fed an increased ration. Diet can be especially important to the senior mare, according to results of a study conducted by Elaine M. Carnevale, DVM, MS, Ph.D. The study was based on the premise that normally mares 19 years of age and older ovulate two weeks later than mares 13 years of age and younger. Another premise was that more cycles per conception were required for the older mares. The objectives of her study were to compare the effects of two diets on young and old mares for time to first ovulation of the year and to compare circulating concentrations of insulin, free fatty acids and cortisol.

Involved in the study were eight mares ranging in age from three to 15 years, and 10 mares which were 19 years of age and older. The mares were primarily of Standardbred and Thoroughbred lineage. At the beginning of the study, young and old mares randomly were divided into two groups. One group received a commercial ration designed specifically for older horses at the rate of 10 pounds per day, and the other group received 10 pounds of oats per day. Both groups also were fed hay that was a mixture of orchard grass and alfalfa. The results were significant for the older mares. Carnevale reported this as a conclusion: "Old mares fed a highly digestible, nutrient-dense diet ovulated approximately two weeks earlier in the spring than old mares fed an isocaloric control. Type of feed did not affect time to ovulation for younger mares. Old mares fed the special diet ovulated on approximately the same mean dates as young mares, in contrast to a later ovulation date for old mares fed the control diet. Concentrations of insulin and free fatty acids were higher in old horses receiving a nutrient-dense diet. Differences in effects of diet between young and old mares were probably caused by the reduced capabilities of old mares to digest and assimilate feed, resulting in a functional nutrient deficiency.

From data, it is apparent that older horses need to be maintained on a feed program that supplies them with the additional nutrients that they need for reproductive performance." Before we leave the matter of light, nutrition and exercise, it should be noted that what is good for the goose is good for the gander. Research has shown that the use of lights also can stimulate the stallion to early reproductive capability when combined with a proper diet and exercise. (Caution should be used, however, because some studies have indicated that stallions "started" earlier in the year from light therapy tend to "shut down" earlier in the year.)

While the use of light, plus appropriate diet and exercise, can influence the estrous cycle, they are basically non-invasive. In a sense, their influence on the cycle is indirect. By contrast, the administration of certain drugs or hormones has a direct effect.

Early Season Chemical Ovulation Control

One of the most popular forms of treatment involves the administration of altrenogest, a synthetic form of progesterone that is marketed under the trade name Regumate. Its basic function is the same as that of progesterone during a normal cycle, which is to shut down sexual activity until nature can determine whether a pregnancy has occurred.

In-depth research on manipulation of estrous cycles has been carried on at Colorado State University. While the CSU program prefers using altrenogest in controlling the estrous cycle, researchers point out that there are alternatives, such as injections of progesterone in oil. That being said, let's take a look at how CSU prepares its mares for manipulation of the estrous cycle. The researchers begin with light. Starting on Dec. 1, mares are provided 16 hours of light per day. After 60 days of exposure to light, each mare is fed one milligram of altrenogest per 100 pounds of body weight daily for 15 days. The mare is kept on this regimen for 15 days, and then the altrenogest is removed.

Research at CSU has demonstrated that the use of lights and the 15-day administration of altrenogest are effective in establishing normal estrous cycles early in the year. In a study headed by E. L. Squires, Ph.D., 34 mares were split into experiment and control groups. One group of 17 received the above described light and altrenogest treatment, and the other 17 received neither. All 17 of the mares under lights and administered altrenogest returned to estrus within six days post-treatment, compared to only seven of the 17 control mares. If one wants to "short cycle" a mare and shorten the above treatment period from 15 to nine days, prostaglandins are used. The administration of altrenogest or progesterone in oil for nine days, plus an injection of prostaglandin (the hormone that works to bring a mare into estrus) on day nine, has proven to be an effective combination for estrus synchronization, says Squires. Unfortunately, he adds, the corpus luteum is easier to control than follicular growth. Therefore, there is no guarantee when ovulation will occur.

Enter two more hormones: human chorionic gonadotrophin (hCG) and gonadotropin releasing hormone (GnRH). Both can be utilized to hasten ovulation and make it more predictable. First, hCG. One of the early studies carried out involving hCG was at Colorado State when Carnevale attended the school as a graduate student seeking her doctorate. The study, however, concentrated on ovulation in mares in the spring transitional phase of the cycle rather than those already in the receptive stage. In the study, 38 light horse mares were involved. Beginning on Feb. 1, the mares were presented daily to a stallion to detect estrous behavior. Follicular activity was monitored at four-day intervals via ultrasonography. When follicular development reached a particular stage, some of the mares were administered hCG and others were not. The mares administered hCG ovulated earlier than the controls. This led Carnevale to report the following: "It was concluded that administration of hCG is an effective method to hasten time to ovulation in transitional mares. Human chorionic gonadotrophin could be used to minimize time, expense and stallion use during the extended transitional estrous period by reducing time from recruitment of a dominant follicle to ovulation. Diestrus progesterone concentrations were not affected by treating mares with hCG, suggesting adequate luteal function for sustained pregnancy."

This study at CSU was followed by one that took a look at administering GnRH for hastening ovulation in transitional mares. In this study, 45 non-lactating, seasonally anestrous light horse mares were assigned randomly to one of three groups, with 15 in each group. One group was an untreated control. The second group was given an injection of the GnRH agonist buserelin at 12-hour intervals. The third group had GnRH administered via an implant that was designed to release GnRH over a 28-day period. The implants were placed beneath the skin of the neck.

The results revealed that GnRH agonist-treated mares, receiving the hormone as either an injection or an implant, experienced hastened ovulation when compared with the non-treated control mares. Seven of 15 mares in Group 2 responded to twice-daily injections of GnRH agonist and ovulated between Day 10 and Day 25 after initiation of treatment. Similarly, nine mares given an implant of GnRH agonist (Group 3) ovulated between Day 4 and Day 30. None of the control mares ovulated within 30 days of initiation of treatment.

The researchers concluded the following: “A GnRH agonist hastened the initial ovulation of the breeding season in mares. The ability to administer GnRH agonist via a subcutaneous implant has practical applications for early foal production.”

Cycling Mares And Chemical Ovulation Control

Now for a look at using GnRH on mares, which already are in the midst their receptive estrous cycles. At a past AAEP Convention, Patrick J. Meyers, DVM, MS, Diplomate ACT, of Ontario, Canada, reported on a study involving the administration of the GnRH analog deslorelin. (Dorland’s Illustrated Medical Dictionary describes an analog as being a chemical compound with a structure similar to that of another, but differing from it in respect to a certain component, while an agonist is described as being a drug that has affinity for and stimulates physiologic activity at cell receptors normally stimulated by normally occurring substances.)

Meyers had this to say in introducing the results of the study: “There is considerable variation between mares and sometimes within the same mare in the length of estrus, the interval from onset of estrus to ovulation, and the size of the follicle(s) at ovulation. This accounts for difficulties in controlling ovulation when attempting to time insemination accurately with imminent ovulation. The ability to control ovulation accurately and reliably in mares plays a pivotal role in maximizing our reproductive management of both stallions and mares. A single intramuscular or intravenous injection (2,500 IU) of human chorionic gonadotrophin (hCG) at the appropriate time during estrus has resulted in ovulation within 24 to 48 hours and a shortening of the estrous period compared with untreated controls.

Disadvantages of hCG include some refractory responses from antibodies formed against this foreign protein. The purpose of the studies summarized here was to determine the efficacy (ovulation response) of a highly potent GnRH analog, deslorelin, delivered in a novel slow-release implant, in accelerating and ensuring ovulation within 24 to 48 hours of administration in cyclic estrous mares.” Over a three-year study period, subcutaneous implants, delivering either zero milligrams or 2.2 milligrams of deslorelin, were administered to 967 estrous mares at several different locations in Australia, Canada, Germany, Sweden and the United States in double-blind multicenter clinical trials. Standardbred, Thoroughbred, Quarter Horse, Saddlebred and Arabian lactating and non-lactating mares were included. Horses were managed under prevailing conditions and practices. A minimum body condition score of 6 was a prerequisite for entry into the trial to insure that the mare was on an appropriate nutritional diet. Once estrus was established, the reproductive tract of each mare was examined by palpation or ultrasonography. When a lead follicle became 30 millimeters or more in diameter, implants that contained either deslorelin or a placebo were inserted just beneath the skin of the neck. The results revealed that in all geographic locations, there was a shortening of the interval to

ovulation of 38.4 hours. The mares treated with deslorelin--a total of 566--ovulated at an average of 47.9 hours after treatment. The mares treated with the placebo--a total of 401--ovulated 86.2 hours after treatment. The percentage of mares ovulating within 48 hours after treatment was 88.6 percent for those administered deslorelin and 31.6 percent for the placebo-treated mares.

Meyers offered the following conclusion: "Combined studies involving 566 treatments with deslorelin and 401 placebo implants strongly support the claim that treatment of estrous mares with a lead follicle of 30 millimeters (or more) in diameter with the GnRH analog deslorelin, delivered in a slow-release biocompatible implant, causes acceleration of ovulation and ensures that 80 percent of the treated mares will ovulate within 48 hours after treatment, reducing the time to ovulation by 55 percent. Treatment with deslorelin had no adverse effects on pregnancy rates, early embryonic loss rates, abortion rates, or foal vitality. Local reactions varied between locations, always were slight, disappeared mostly within three days, and never required treatment of any kind.

Thus, we can conclude, administration of hormones can help bring a mare into estrus and can hasten time to ovulation whether she is in the estrous cycle or in the transitional period. Not to be overlooked in the overall scheme of things, however, are the use of light, nutrition, and exercise. The above involves the mare, which we are breeding or want to breed.

What about the performance mare where we want to suppress the estrous cycle?

Suppressing the cycle there are three basic ways to get the job done, says Beckman, with the safest being the administration of altrenogest. The other two involve implants that have not been approved in the United States, and spaying. Regumate (altrenogest) appears to be the safest way to go when seeking to prevent a mare from coming into heat, says Beckman, although it does have a downside--it is expensive. Generally speaking, one can expect to pay three dollars per day for Regumate that is administered orally, either by top-dressing feed or by squirting it directly into the horse's mouth with a syringe. It takes Regumate a bit longer to act on the hormonal system than does a shot of progesterone. "You need to get the mare on it five or six days before the event or race, then keep her on it throughout the competition for it to prevent her from cycling," Beckman says. Some trainers administer Regumate continuously throughout a season, while others will remove it if the mare has a downtime of three weeks or more between performances. Normally, Beckman says, about nine days after Regumate is no longer administered, the mare will cycle.

If the owner plans on using the mare in the broodmare band in the future, Beckman believes, the on-again, off-again approach to Regumate administration would be preferred to keeping her on it constantly.

It can be argued that man should not battle nature in the equine reproductive world, but as long as certain competitions are based on age and as long as some females have erratic behavior when in estrus, it will remain an economic necessity.

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