Fact Sheet Series on Meat Goat Herd Management Practices

#2 - Out of Season Breeding

By tatiana Stanton revised 2019

Introduction

Most goat breeds are photosensitive with respect to reproduction. This means that day length strongly influences their likelihood to breed. In the United States, the shortening of days in the fall brings does into estrus (heat) and bucks into rut. In contrast, goats are less likely to breed in late spring or early summer when the days are getting long. The spring equinox occurs March 21st or 22nd when the sun crosses directly over the equator resulting in equal lengths for day and night. The days then continue to lengthen until June 21st or 22nd when the summer solstice, the longest day of the year, occurs. The time from the spring equinox to the summer solstice is considered the "anestrous" or "out of season" period in goats (Table 1). Consequently, very few kids are likely to be born from mid August through mid November making it difficult for farmers to provide a consistent supply of goat meat throughout the year or to meet consumer demands for suckling kids at Christmas and New Years. Several meat goat breeds including the Boer, Kiko and Savanna have been introduced into the United States since 1982. Initial assumptions were that these breeds might not be photosensitive and could easily breed year round. However, results with out of season breeding have been very mixed.

Table 1. Astrological seasons and their typical effect on breeding performance in goats

Season begins following the:	Season	Ease of getting does bred
Fall Equinox Sept 21 or 22	Fall - Sept 23 to Dec 21	Prime Breeding Season
Winter Solstice Dec 20 or 21	Winter - Dec 22 to Mar 20	Intermediate
Spring Equinox Mar 20 or 21	Spring - Mar 21 to June 20	Anestrous Season – most difficult time to get does bred
Summer Solstice June 20 or 21	Summer - June 21 to Sept 22	Intermediate

This fact sheet provides an overview of common procedures used in dairy goats to induce them to breed out of season. A very rudimentary understanding of reproduction in goats and sheep will help improve a farmer's knowledge of the methods used to manage breeding and the principles underlying their effective use. Therefore, this factsheet starts out with a basic review of reproduction in goats. It then summarizes the results of observations from 2005 to 2007 for 13 Northeast US meat goat farms attempting to breed their meat goats out of season and describes the successful management practices used by some of the farms. Farmers seeking to produce kids at less common times of the year can review these practices to determine which will work as management tools in their own goat herds.

Role of Hormones in Breeding

During the prime breeding season, female goats come into standing heat (allow the buck to mount them) approximately every 19 to 21 days. This estrus cycle (time from one standing heat to the next) is shorter, approximately 16 days, for ewes. Ovulation, the release of mature egg(s) from ovarian follicle(s), occurs approximately 30 hours after the onset of standing heat in both species.

Hormones tightly controlled both the estrus cycle and ovulation. The pineal gland is a small gland in the brain that converts the hormone serotonin to the hormone melatonin during periods of darkness. Light inhibits this process. Thus when days are short, more melatonin is produced. In many breeds of goats and sheep, this increase in melatonin production is necessary to trigger the production of Gonadotropin releasing hormone (GnRH) by the hypothalamus of the brain to jumpstart the estrus cycle. The GnRH causes the pituitary gland to release follicle stimulating hormone (FSH) and luteinizing hormone (LH) into the blood stream. The hormone FSH then stimulates the production of estrogen (estradiol) and also causes some of the ovarian follicles (eggs) to start to mature. In turn, the release of estrogen causes the female to show signs of heat while LH stimulates ovulation. Once the egg(s) are released the follicle turns into a corpus luteum (CL). The CL is responsible for the secretion of progesterone following ovulation. A high concentration of this hormone inhibits the release of GnRH, FSH and LH and prepares the uterus for a possible pregnancy and suppresses further standing heats. If the egg(s) are not fertilized during estrus, the uterus releases the hormone prostaglandin which causes the CL to regress and progesterone production to stop, thus permitting the start of a new heat cycle.

Common practices in dairy goats

Buck effect

United States dairy goat farmers seeking to breed does out of season for a year-round supply of milk commonly use either the “buck effect” or artificial lighting to bring does into heat. Bucks have musk glands located behind their horn area that secrete strong odors when the bucks are in rut. Suddenly introducing a strong smelling buck to does that have been housed away from the smell of bucks can trigger heat. This “buck effect” is used to synchronize heats early in the breeding season because most does will come into heat roughly 2 to 5 days after the sudden introduction of a buck. It has been used with more limited success to bring does into heat out of season. The major limitation is that many bucks of dairy goat breeds do not show rut during the anestrous period and, therefore, do not have a strong odor. Even when bucks do have a strong odor, it is not always enough stimulus to cause anestrous dairy goat does to come into heat.

Artificial lighting

The use of artificial lighting is a more reliable but costly alternative. Bucks and does are housed separately during the winter but both are exposed for 60 days to at least 20 hours of light including daylight exposure. The artificial lighting used to extend day length to 20 hours requires that light intensity be bright at the goat’s eye level. This can be provided by 40 to 60 watt florescent lights set 9 feet above the ground at the rate of 1 ft of bulb for each 10.5 sq. ft of floor space. It needs to be bright enough that no shadows are cast. It is also recommended that the goats not be able to see the night outside while under the artificial lighting. The goats are then

returned to natural lighting for 45 days after which the buck is put in with the does for breeding. Standing heats should follow shortly but may not last long and it is recommended that one buck be used per 15 does to make sure that the buck has the opportunity to breed all of the does despite the short heats. The does do not appear to continue cycling past this first heat.

Synchronization Practices in Sheep for Out of Season Breeding

The "ram effect" and artificial lighting can be used to bring ewes into heat during the anestrus period. Several sheep breeds have also been genetically selected to breed year round. However, sheep breeders are also able to use progesterone intravaginal inserts or sponges as one of their tools to mimic pregnancy, and upon removal, bring ewes into heat. The most common current practice is to use progesterone impregnated silicone inserts called CIDRs (controlled internal drug release dispensers) initially marketed as Eazi-Breed™ **CIDR**® by Pfizer but now by Zoetis. Official approval was granted for sheep in the US in 2009 and it was thought that approval for goats would follow shortly. Pfizer Animal Health had obtained a minor species drug designation from the FDA for both the Progesterone EAZI-BREED™ CIDR® Sheep and Goat Inserts meaning they had several years of marketing exclusivity upon FDA approval of these CIDRs and testing in goats was ongoing. However, the change in ownership of the product delayed final approval for goats in the US although use is approved in Canada and Australia. Dairy goat breeders often combine removal of CIDR implants with injections of a prostaglandin such as Lutalyse or Estrumate during the normal breeding season to synchronize heats.

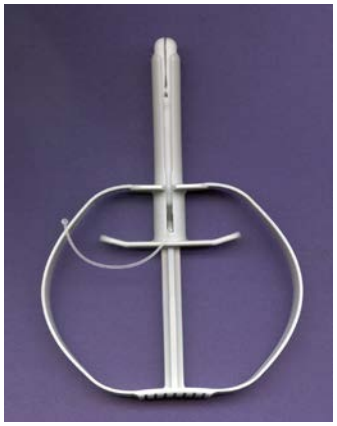

Figure 1. Small ruminant CIDR

However, for out of season breeding in goats, a gonatropin containing compound such as PG600 is generally administered shortly before or after removal of the CIDR. Although PG 600 is available through most veterinary supply catalogs, farmers should be aware that it is labeled for swine. Extra label use of Lutalyse and Estrumate in the US is also limited to medical conditions.

Observations in Northeast Meat Goat Herds

In 2005, the Cornell Animal Science Department in cooperation with the Empire State Meat Goat Producer's Association was awarded a grant from the Northeast Sustainable Agriculture Research and Education Program (NE SARE) to observe the effectiveness of various herd practices on Northeast US meat goat farms. One focus of this project was to pinpoint management practices that meat goat producers were successfully using to improve out of season breeding performance. Over the course of three years, observations were obtained from a total of 46 breeding groups on 13 different farms attempting out of season breeding.

"Buck rag" samples were obtained from most of the service sires on these farms to rate for out of season odor. Samples were taken during the out of season by rubbing the bucks on their polls with a "buck rag" for 60 seconds and storing the rag in a sealed canning jar. A control sample was created by taking a clean rag and sealing it in a canning jar. Goat producers at goat events were asked to smell these rags and rate them for "buckiness" from a score of 1 to 5 with 1 = no odor or just a trace, 2 = mild odor, 3= moderate odor, 4 = strong odor, 5 = "phew! Buck in

raging rut"! Of eight bucks sampled in 2005, only one had an average score greater than 4 (4.12) while the remaining bucks had scores of 2.12 or less. Two bucks actually scored lower than the control sample. Fifteen bucks were sampled in 2006. Of these, one third had scores of <2, 2 to <3, and 3 to <4, respectively. Of the 17 bucks sampled in 2007, one buck had a score greater than 4 (4.18), six bucks scored between 3 and <4, four bucks scored between 2 and <3, and six bucks scored between 1 and <2. Average scores for twelve Boer, two Kiko, and two Savannah bucks in 2007 ranged from 1.18 to 4.18, 1.45 to 2.18, and 2.55 to 3.27, respectively. The sole pygmy teaser buck had an average score of 3.1. Results indicated that although weak buck odor is a problem in most meat goat breeds during the anestrous period, there is considerable variation among bucks within the same breed. Dr. Lou Nuti, the reproductive physiologist at the International Dairy Goat Research Center in Prairie View, Texas, has suggested selecting bucks for out of season breeding based on their smelliness and sexual aggression. This is probably an excellent suggestion. However, there is probably an additional chicken before the egg component to this, i.e., a doe in heat will make the bucks more aggressive and smellier while an aggressive, smelly buck will make does come in heat.

Out of season reproductive performance varied across the 13 farms and even within the same farms in different years. However, three different successful approaches emerged and are outlined below.

Method 1: Taking advantage of weaning stress and other factors

There are several ways to achieve successful out of season breeding. If at least one doe or buck in the breeding group becomes sexuality aware, this provides the stimulus for making the rest of the group and even goats in bordering pens sexually active. Several factors can interact as possible triggers.

It became clear during the course of our observations that does that were being weaned from kids and suddenly introduced to a buck were far more likely to breed out of season than either maiden does (does that had never kidded before), dry does (does that had been weaned from kids several months prior to introduction of the buck), or does that were continuously housed with bucks. For example, out of season conception rates for three groups of recently weaned does on three different farms in 2005 ranged from 67% to 100% (Table 2).

Table 2. Out of season breeding results for five farms observed in 2005

Herd/Group	Breeding group composition	Grain during breeding	Light prior to breeding	Conception rate	Average days until breeding after buck introduced	Average litter size
1A	2 yearling maiden does	1 lb	None	0%	NA	NA
1B	4 yearling maiden does	1 lb	None	0%	NA	NA
1C	10 yearling maiden does	1 lb	None	0%	NA	NA
2A	15 Yearling maiden does/5 Dry does	None	None	0%	NA	NA
3A	10 yearling maiden does	¾ lb	Dusk/Dawn Mercury	60%	13 days	1.7 kids
3B	15 does weaned 2 weeks prior to buck introduction	¾ lb	Dusk/Dawn Mercury	67%	29 days	1.6 kids
4A	16 does weaned 18 to 30 days prior	3 lb	Dusk/Dawn Mercury	81%	10 days	2.2 kids
5A	9 does weaned same day	1½ lb	None	100%	21 days	1.5 kids

However, in the same year, only one of five breeding groups made up of either all maiden yearling does or maidens mixed with does that had been dry for many months had any of their yearlings or dry does breed out of season. Pregnancy rate in that one successful yearling/dry doe group was 60%.

All the breeding groups observed in 2005 used either full blood Boer or high percentage Boer service sires. Although no artificial lighting was deliberately used to stimulate heat in any of the herds, both Herd 3 and Herd 4 inadvertently housed their service sires under dusk to dawn mercury lights throughout the winter and spring prior to initiating breeding. Herds 4 and 5 fed the most grain during breeding and also had the best conception rates.

This trend for improved out of season reproductive performance in recently weaned does being bred by Boer bucks as compared to dry does or maiden does was observed again in 2006 (Figure 2) for 15 different breeding groups. The maiden breeding group with an 86% conception rate was actually introduced to the breeding buck on Feb 1st with all conceptions taking place prior to March 20th, which would be the official start of the anestrous season and, therefore, should probably not be considered as having bred out of season.

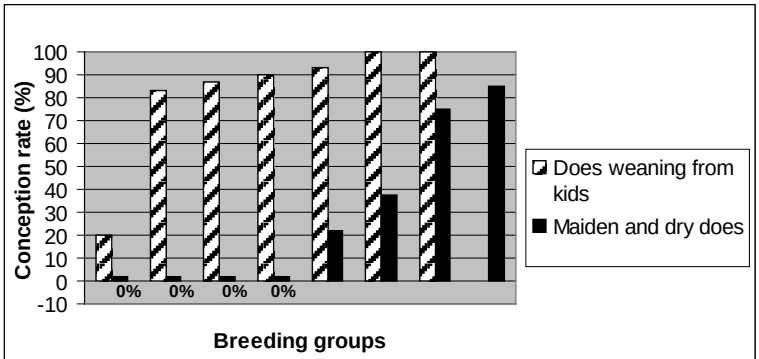

Figure 2. 2006 conception rates for weaned does versus maiden or dry does

In 2007, out of season conception rates improved in most herds for both dry and maiden does that were suddenly introduced to breeding bucks. Several farms adopted strategies that may have contributed to this improvement including 1) mixing these hard to breed does in with does that were being weaned from kids, 2) using dusk to dawn mercury or florescent lighting on service sires and even does over the winter months or year round, and 3) keeping dry and maiden does on 1 to 2 lb of grain during the breeding season. In many cases, at least one buck in the breeding paddock or neighboring pen had an odor rating of 3 or more. One herd did successfully breed 100% of its maiden does without using any source of light on does or bucks. However, on closer inspection, these does were actually not put with the buck until June 30th and breeding did not begin until 14 days later which was after the end of the official anestrous season.

Over the course of the three years, we worked with only four breeding groups that either left Boer bucks in the herd continuously. No out of season breeding occurred in these four breeding groups. One herd perceived their does to breed year round but after considering kidding dates found that breeding usually stopped after March 20th and resumed again about June 20th. Bucks should probably be suddenly introduced to does for out of season breeding in order to get the benefit of the 'buck effect'. We did interview one herd that left bucks in continuously and was successful at out of season breeding but on closer inspection this herd indicated that they used intense artificial lighting in the barn and barnyard year round to discourage coyote attacks.

Method 2: Artificial lighting

During 2007, one farm invested in artificial lighting to breed their yearlings out of season. The same farm had unsuccessfully attempted to breed 20 Spanish and 20 Spanish x Savanna doelings out of season the previous year without lights.

Large three sided sheds were fitted with 600 watt white halogen lights at a height of 14 ft. on 20 ft. centers (one light per 400 sq. ft.). The shed roofs did not cover the entire pens, thus, doelings were able to observe nightfall and even get out from under the lights. However, all concentrate feeding and free choice round bale feeding took place under the lights to encourage the doelings to remain in lighted areas at night. Spanish and Savannah x Spanish doelings were exposed to 24 hour lighting at the rate of about 55 candlefeet (cf) of uniform light at goat eye level during the night and anywhere from 40 to 90 cf of light (most readings from 50 to 60 cf) during the day depending on the intensity of daylight and distance from the lights.

The initial service sires (one Kiko, one Savanna) were exposed to 60 watt fluorescent bulbs 9 ft above the floor (1 bulb per10.5 sq. ft. of floor space) for 20 hours daily starting in mid February and were immediately put with a set of mature does that had just been weaned from kids on April 3rd. Thus, these two bucks did not get the 45 days of natural lighting generally recommended prior to being put with does for breeding. A second buck of the same breed that had also been exposed to 20 hr lighting was added to each breeding group in late April.

Table 3. Out of season breeding results using artificial lighting on doelings and exposing mature does to Kiko and Savannah bucks at weaning

Breeding group composition	Date introduced to bucks	Conception rates	Days to breeding (assuming 150 day pregnancy)	Litter size
Breeding Pen 1 – SAVANNAH buck exposed to 45 days of 20 hr day length and then put in breeding pen on April 3rd, 2nd Savannah buck added in late April				
2 yr olds just weaned from kids	Apr 3rd			
26 SpanXSav does		58%	30 days (26 to 38)	1.6 kids
9 Boer does		56%	30 days (24 to 34)	1.7 kids
Total		**57%**		
1 yr olds exposed to 24 hr lighting for 60 days, natural lighting 38 days	Apr 7th			
17 SpanXSav doelings		71%	25 days (20 to 34)	1.1 kids
10 Spanish doelings		70%	26 days (20 to 32)	1 kid
Total		**71%**		
2 yr olds just weaned from kids	Apr 17th			
35 SpanXSav does		34%	26 days (20 to 32)	1.9 kids
2 Boer does		50%	27 days	2 kids
Total		**35%**		
1 yr olds exposed to 24 hr lighting for 30 days, natural lighting 0 days	Apr 17th			
3 SpanXSav doelings		33%	15 days	1 kid
1 Spanish doelings		0%	NA	NA
Total		**25%**		
Breeding Pen 2 – KIKO buck exposed to 45 days of 20 hr day length and then put in breeding pen on April 3rd, 2nd Kiko buck added in late April				
2 yr olds just weaned from kids	Apr 3rd			
8 Spanish does		**75%**	42 days (31 to 52)	2.2 kids
1 yr olds exposed to 24 hr lighting for 60 days, natural lighting 38 days	Apr 7th			
45 Spanish doelings		**78%**	35 days (18 to 49)	1.4 kids
2 yr olds just weaned from kids	Apr 17th			
1 Spanish doe		**0%**	NA	NA
1 yr olds exposed to 24 hr lighting for 30 days, natural lighting 0 days	Apr 17th			
31 Spanish doelings		**23%**	30 days (15 to 37)	1.4

As noted in Table 3, each buck was introduced first to a group of mature does. A group of doelings that had been exposed to 24 hr lighting for 60 days followed by natural lighting for 38 days was added to each breeding pen on Apr 7th. A second group of does just weaned from kids was added to each breeding pen on Apr 17th, followed shortly by a second group of doelings that had been exposed to 24 hr lighting for 30 days and then been immediately put into the breeding group. Conception rates averaged 57% and 75% for each of the first groups of mature does put with the Savanna and Kiko bucks, respectively. Conception rates averaged 71% and 78% for each of the first group of doelings exposed to the Savanna and Kiko bucks, respectively. However, conception rates were much lower for both the second groups of mature does and the second groups of doelings added to each breeding pen. An obvious explanation for the lower conception in the second group of doelings is that 30 days of 24 hour lighting is probably not sufficient time at "long days" to trigger heat. Also, if the doelings had been influenced by the long day regiment, they would not be expected to show heat until about 45 to 60 days after exposure to the long days. Those doelings in the second doeling group that did breed, bred prior to 45 days indicating that the long day regiment probably had no effect on them and that they were probably responding instead to the sexual activity initiated by the first groups of does and doelings.

An additional explanation for the decreased reproductive performance of the second groups of does and doelings were that they were newcomers to the breeding pens and the bucks may have been over-challenged by the amount of short heats going on in the does that the bucks were already familiar with. By the end of April, the first breeding pen contained 51.5 females per Savanna buck while the second breeding pen contained 42.5 does per Kiko buck. The ratio of does to bucks was greater than the 15 to 1 ratio normally recommended for out of season breeding to combat the short heats normally observed in this season.

When artificial lighting is used to trigger out of season breeding, breeding usually starts shortly after the bucks are placed with the does. On this farm, successful breeding did not start until about 24 days after the first groups of does were placed with the bucks. This may have been because the bucks inadvertently had to be put with the does immediately after the bucks were removed from 20 hr/day lighting and may not have actually come into true rut until about 24 days after stopping the long day light treatment.

When using artificial lighting, it is probably advisable to subject bucks and does to 20 to 24 hr lighting for 60 days followed by at least a 38 day (preferably 45 day) period of natural lighting prior to being put together. If possible, more bucks should probably be used than are necessary during the normal breeding season.

Method 3: Teaser bucks

Another successful approach taken to improve out of season breeding performance is to use a vasectomized teaser buck to keep does or doelings coming into heat regularly for several months past the normal breeding season. In 2006, one farm was only able to breed 22% of its maiden does successfully out of season despite having tried to sexually activate the yearling does by introducing them to the service sire on May 17th simultaneously with a group of does that were weaned from their kids on that same day. In contrast to the poor reproductive performance of the maiden does, 92% of the "recently weaned from kids" does bred out of season. Their average days until breeding (after introduction of the buck) was 14 days with an average litter size of 2.7 kids. The owner decided to try to improve the percentage of yearling does bred out-of-season the following year by using a teaser buck. A pygmy buck kid was purchased and

vasectomized. This teaser was put in with a group of yearlings on February 15th approximately 60 days prior to when "real" breeding was to commence. Pygmy bucks are known for their strong libido and ability to stay in rut year round. These are very important qualifications for effective teasers. On our odor test for 2006, this teaser buck rated 3.09, a "moderate" odor.

The pygmy buck was exchanged with an intact Boer service sire on April 16th. Eight of 10 yearlings (80%) were successfully bred out of season conceiving an average of 14 days after introduction of the intact buck. Average litter size was 1.6 kids. A group of mature does at the same farm that had been dry approximately 3 months were not exposed to a teaser buck in advance of breeding. Only 64% of these mature does conceived during the out of season breeding period with conception also occurring approximately 14 days after introduction of a breeding buck on April 16th and resulting in an average litter size of 2.6 kids.

In later use on mature does, the pygmy teaser became aggressive and severely bit the tails of some does in an apparent fit of sexual frustration. A healthy pygmy doe companion free of sexually transmitted diseases would probably alleviate this problem.

Summary

Meat goat farms in the NE US have successfully adopted at least one of three methods of improving the success of out-of-season breeding. These methods include: 1) attempting to breed does shortly before, during, or after weaning; 2) using artificial lighting to manipulate day length, and 3) using teaser bucks to extend the normal breeding season. Decisions as to which method to try depend on whether 1) your herd is on an accelerated kidding schedule and has does ready to be weaned from kids at the onset of the out of season period, 2) bucks or does or both can be economically and practically exposed to an artificial lighting regime, or 3) it is practical to have a pygmy or other high libido buck vasectomized and maintained on-farm.

Observations over the three years suggest that additional factors can help improve out of season reproductive performance. Year round use of dusk to dawn mercury lights may make goats less photosensitive and, thus, easier to breed out-of-season. Flushing does with concentrates and having them at a body condition score of 3 to 4 prior to and during breeding appears to improve out-of-season breeding performance. Suddenly introducing breeding bucks rather than having them continually with the does and making sure that at least one buck in the breeding group or in paddocks bordering breeding groups actively exhibits rut and a strong odor also contributes to the success of out of season breeding.

This study did not involve formal research. Therefore, breeding groups were not designed to study the influence of different breeds or genetics within breeds on out of season breeding performance. However, variations in buck odor and in reproductive performance were noted within breeds. Therefore, selecting bucks and does to use for future out of season breeding based on their previous performance may improve the out of season breeding potential of their offspring.