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# Enhancing Reproductive Performance in Small Ruminants
# Part III. Breeding and Management Systems

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This series of fact sheets has been designed to assist producers in enhancing reproductive performance in their herd so that overall production can be optimized to promote profitability. Fact sheet topics included in the Enhancing Reproductive Performance in Small Ruminant Series include:

Part I. Biology of Reproduction

Part II. Puberty and Estrous Cycles

**Part III. Breeding and Management Systems**

Part IV. Breed/Selection

Part V. Nutrition and Health

Part VI. Reproductive Management Techniques

## Breeding Systems

Deciding which breeding system to use depends ultimately on the goal of the operation. Breeding systems permit selecting for desirable traits and, at the same time, selecting against undesirable/negative traits. To make the best breeding decisions from a production standpoint, it is essential to collect data.

Before delving into types of breeding systems, it is important to define "breed." A breed is simply a specific group of animals that have similar looks, behaviors, and other distinguishing traits that set them apart from other animals in the same species. Some breeds are referred to as "landrace" sheep or goats. As opposed to a formal breed that was deliberately bred to meet specific breed standards, a landrace breed is locally adapted and developed over time by natural processes. Use of any of the breeding systems described below will depend on your goal, size and quality of animals, finances, and skill level.

### Pure-breeding

A purebred animal is a member of a specific breed that possesses similar characteristics/traits and shares common ancestry. Pure-breeding is the mating of females and males within the same breed or type. Figure 1 provides an example of a purebred breeding group of Katahdin hair sheep. These animals are eligible for registration in associations for that breed. While there are pros and cons to pure-breeding, the major goal is to provide animals with superior genetics for marketing to other purebred or commercial producers. Purebred animals can be sold at higher prices and therefore offer a chance for increased profitability.

Figure 1. A breeding group of Katahdin hair sheep. (Reprinted with permission from Stephan Wildeus, 2007)

### Outcrossing

Outcrossing is the mating of animals from the same breed who have no relationship closer than four to six prior generations. This is a more favorable form of breeding because it is unlikely that two unrelated

animals would carry the same undesirable traits. It is also the most widely used mating system by purebred/seedstock and commercial producers.

Figure 2. A group of Spanish and Myotonic females eating at a fence line feeder. (Reprinted with permission from Stephan Wildeus, 2007)

## Inbreeding

Inbreeding, on the other hand, is the mating of close relatives such as the breeding of siblings or of parents to offspring. While inbreeding is not associated with an increase in performance, it is acceptable to use for one generation if there are specific goals in mind. Inbreeding can result in poor reproductive efficiency as a result of higher mortality rates, slower growth rates, and an increased incidence of hereditary abnormalities.

Linebreeding is a mild form of inbreeding which involves the mating of animals that are not so closely related, such as cousins and half-siblings. The establishment of several sire lines can be implemented to avoid any negative effects from inbreeding. These sire lines can be used in a closed flock where females are mated in rotation to the sire they are least related to. Linebreeding is generally practiced to conserve the characteristics of a superior male or female. Due to this, offspring produced in this mating system usually depict a high degree of uniformity and performance.

## Crossbreeding

Crossbreeding is the mating of animals of different breeds. There are substantial differences in performance traits among breeds and no one breed is superior in all traits. Crossbreeding takes advantage of the superior traits of the dam and sire breeds to produce an offspring with a combination of traits superior to those present in any one breed. The name given to the biological phenomenon that causes crossbred offspring to outproduce the average of their parents is "hybrid vigor," or "heterosis."

In addition to hybrid vigor, crossbreeding systems offer breed complementarity. For example, producers frequently breed hair sheep ewes to larger, heavier muscled ram breeds, such as a Suffolk, to obtain market animals that are hardier and faster-growing, and which also can meet market needs. In doing this, they are taking advantage of the qualities in both the maternal and paternal breeds: the hair sheep ewe's traits of good mothering ability, no shearing requirements, and/or tolerance to heat and parasites, and the Suffolk ram's traits of fast growth rate and muscling.

Figure 3. Purebred and crossbred (Dorset-sired) landrace hair sheep lambs grazing on pasture. (Reprinted with permission from Stephan Wildeus, 2014)

## Grading Up

"Grading up" is the system of breeding in which a purebred male of a given breed is mated to graded (not eligible for registration) females and their daughters with the goal of creating a flock similar in quality and performance to the sire breed. This practice is used when only the males of a desired breed are available and allows producers to raise purebred-quality animals without the investment in purebred females.

Figure 4. F1 Boer and Kiko sired kids from Spanish dams at Virginia State University. (Reprinted with permission from Stephan Wildeus, 2007)

# Management Systems

Regardless of the breeding system selected, a number of breeding management choices can be made depending on one's goals and resources. One of the ways in which a producer can enhance reproductive efficiency is by choosing a lambing/kidding season that best fits the goals and resources at hand.

# Winter lambs/kids

For winter lambing/kidding, females should be bred in August and September for kidding/lambing starting in January through February (approximately five months later). Breeding earlier for winter kidding/lambing takes advantage of the downtime on most farms since labor requirements of other agricultural ventures are low. Additionally, breeding earlier reduces internal parasite problems in lambs and kids because temperatures are unfavorable for parasite growth, and it allows for marketing at a time when prices are high, around Easter. The downside to winter kidding/lambing would of course be death loss associated with lower temperatures and unpredictable weather conditions at that time of year, especially in temperate areas.

## Spring lambs/kids

For spring kidding/lambing, females should be bred in late September, October, and November for kidding/lambing starting in late February through April. This system coincides more with the natural mating and kidding/lambing seasons and, due to this, a greater offspring crop can be expected. All things considered, a lamb/kid crop of 150% (sheep) to 180% (goats) should be the goal. Ovulation rates and male fertility are at a peak during fall breeding and embryo loss should be minimal due to cooler temperatures. However, under this system, offspring won't be ready for market until later in the season and possibly on pasture where internal parasites might be a problem.

Figure 5. Spanish doe nursing twins. (Reprinted with permission from Stephan Wildeus, 2007)

## Fall lambs/kids

For fall kidding/lambing, females should be bred in late April, May and June for kidding/lambing starting in late September through November. This system will require the use of less seasonal breeds of sheep and goats. The lamb/kid crop will likely be low and many females might need some form of hormone treatment for estrus induction. Males might also have reduced quality and production of sperm. Being pregnant over summer also brings the risk of embryo losses from heat stress in females as well as the possibility of lower birth weights. However, internal parasites should not be a problem and with grains and high-quality hay, lambs and kids should grow optimally.

## Continuous breeding

Continuous breeding/mating is a system where males are kept with females year-round. In this system, managing for optimal reproductive efficiency is impossible: When you don't know when to expect kids/lambs, proper management, feeding, and health care is quite difficult. Also, unless offspring are routinely removed from the herd, it will be impossible to prevent inbreeding.

## Accelerated breeding programs

To achieve the greatest reproductive efficiency, producers should breed more than once a year to take advantage of the relatively short gestation period in does and ewes. The two most common systems include kidding/lambing three times every two years, or a "3 in 2" system (figure 6), and the Cornell STAR System. In a modification of the 3 in 2 system, females are managed in a dual flock system and bred four months apart for lambing/kidding every eight months. For this system to be successful, both breeding and lambing/kidding seasons would have to be shortened using a synchronization protocol (see part VI in this series). In addition, offspring would have to be weaned earlier at around 60 days to allow for rebreeding. What's nice about this system is that if a female from one group fails to become pregnant, she could be added to the second group for breeding, and lambs are produced throughout the year.

In the Cornell STAR System, ewes are bred and lamb every seven months. Instead of 3 in 2, it is possible to have a female lambing five times in three years. There are multiple benefits in this type of system including increased production and continuous lamb supply for markets that enhance profitability. However, the highest level of management is required and the benefits of selling to higher value markets need to be weighed

against feed availability, labor, and additional input costs associated with such a system.

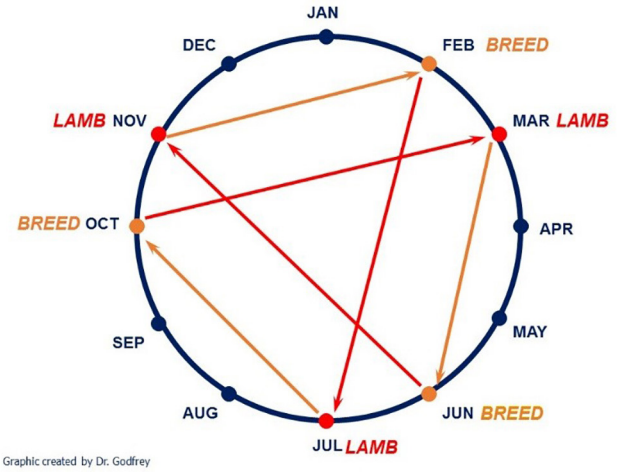


Figure 6. Accelerated mating system used at Virginia State University. (Reprinted by permission from Bob Godfrey, University of the Virgin Islands, 2018)

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## Additional Resources

Ensminger, M.E. 2002. *Sheep and Goat Science*. 6th edition. Danville, IL: Interstate Publishers, 63-68.

Hogue, D.E. 1991. "Sheep Management on the STAR Sheep Production System." Cornell University. Revised October 2015. http://blogs.cornell.edu/newsheep/management/reproduction/star-management/.

Schoenian, S. 2011. "Sheep 201: A Beginner's Guide to Raising Sheep. Breeding systems." University of Maryland Extension. Updated May 26, 2019. http://www.sheep101.info/201/breedingsystems.html.





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