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Michigan State University Cooperative Extension Service  
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# Breeding Systems For Farm Flock Sheep Enterprises

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COOPERATIVE EXTENSION SERVICE

MICHIGAN STATE UNIVERSITY

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Genetic progress in a sheep flock is made through proper selection and appropriate breeding systems. Selection involves choosing animals that possess a desirable trait or several traits that, through reproduction, will be transmitted to the next generation. Breeding systems are the manner in which the animals retained in a flock are used to promote genetic progress or improvement. This bulletin provides information to the sheep producer on some of the breeding systems commonly used in farm flock sheep operations.

## Breeding Systems

Breeding systems frequently used in sheep production include:

**CROSSBREEDING:** a scheme in which rams and ewes of two or more breeds are used.

**OUTCROSSING:** a system in which ewes in a flock are bred to a ram of the same breed but from a totally different pedigree.

**LINEBREEDING:** a type of inbreeding using rams and ewes that are all direct descendants of a single outstanding animal.

Line breeding and outcrossing are used by purebred producers

and some commercial producers. The advantage to crossbreeding is that the offspring of these matings possess *hybrid vigor*, or *heterosis*. This means that the average performance of the lambs resulting from a crossbred mating is greater than the average of the parents that produced the lambs. Generally, heterosis exists for those traits that have low heritabilities, or traits, such as weaning weight (heritability estimate—10 percent), multiple births (heritability estimate—15 percent), carcass quality grade (heritability estimate—12 percent) and milk production (heritability estimate —26 percent).

Another advantage to crossbreeding is the increased production of crossbred ewes. In general, crossbred ewes are more fertile, raise a higher percent lamb crop, have a higher percentage of twins and produce more milk than straightbred ewes. Other production may also improve as a result of crossbreeding. In addition, crossbred lambs have greater livability (lower mortality) and tend to gain weight faster.

The producer must consider several major factors for successful implementation of a crossbreeding program. Table 1 lists some of the desirable traits for breeding stock.

The breeds selected in a crossbreeding scheme depend on the producer's goal and the conditions under which the sheep must produce. The goals and conditions of a range flock in the southern or western United States, for example, are different than those of a Michigan farm flock.

The producer must also consider the adaptability of the breed or crossbred used. In general, white-faced breeds are the considered ewe breeds. These breeds are either fine- or medium-wooled, hardy and possess good maternal traits—prolificacy (the ability to produce a large number of offspring), milk production, mothering ability and longevity. Black-faced breeds generally possess superior carcass and growth traits. Therefore, a successful slaughter lamb production system would typically involve breeding white-faced, crossbred ewes to a black-faced ram.

**Table 1: Desirable characteristics for breeding stock used in a sheep crossbreeding system.**

Trait	Ewe	Ram
<b>Fertility</b>	<ul style="list-style-type: none"> <li>• Early maturing (6-8 months).</li> <li>• Able to drop and raise 2 lambs or more per year.</li> </ul>	<ul style="list-style-type: none"> <li>• Early maturing.</li> <li>• Able to breed throughout season.</li> </ul>
<b>Soundness</b>	<ul style="list-style-type: none"> <li>• Mouth, udder, structure, reproductive system.</li> </ul>	<ul style="list-style-type: none"> <li>• Reproductive system, mouth, structure.</li> </ul>
<b>Health</b>	<ul style="list-style-type: none"> <li>• Disease resistant.</li> </ul>	<ul style="list-style-type: none"> <li>• Disease resistant.</li> </ul>
<b>Longevity</b>	<ul style="list-style-type: none"> <li>• Productive life (5-8 years).</li> </ul>	—
<b>Disposition</b>	<ul style="list-style-type: none"> <li>• Workable, good maternal characteristics.</li> </ul>	—
<b>Efficiency</b>	<ul style="list-style-type: none"> <li>• Good milk production.</li> </ul>	<ul style="list-style-type: none"> <li>• Good growth rate pre- and post-weaning.</li> </ul>
<b>Libido</b>	—	<ul style="list-style-type: none"> <li>• Aggressive, can breed 30-50 ewes.</li> </ul>
<b>Prepotence</b>	—	<ul style="list-style-type: none"> <li>• Transmits his desirable characteristics to offspring.</li> </ul>
<b>Wool Production</b>	<ul style="list-style-type: none"> <li>• Shear moderate to heavy fleece (10-12 lb).</li> </ul>	<ul style="list-style-type: none"> <li>• Desirable fleece (depending on present fleece characteristics).</li> </ul>

Many of the characteristics of the various breeds used in a crossbreeding program are described below. Other breeds not mentioned can also be helpful additions to a crossbreeding program.

### **Ewe Breeds**

**Rambouillet:** The Rambouillet was developed in France from Spanish Merino sheep. Rambouillets are a hardy breed known for their flocking instinct. Ewes weigh 150 to 200 pounds at maturity, excel in maternal traits, are long-lived, produce a high quality, fine-wool fleece, and are less restricted in their breeding season than most breeds. Rambouillet crossbred ewes are widely used for production of market lambs. This breed is the foundation breed of most range sheep in the United States.

**Dorset:** Dorsets originated in England. The major advantage of Dorsets is their ability to breed out of season. Mature Dorset ewes weigh 140 to 180 pounds. They are heavily muscled sheep

with average growth rates, high milking ability, and good prolificacy and maternal traits. Accelerated lambing programs often use Dorset breeding in their mating systems for their out-of-season breeding potential.

**Columbia:** The Columbia was developed in the United States from the Lincoln and Rambouillet breeds. Ewes weigh 150 to 225 pounds at maturity. Columbias have high growth rates, good prolificacy, heavy, medium-grade fleece, good milk production, and are known to be hardy animals. They were developed for use as Western range sheep.

**Finn:** The Finn, or Finnsheep, was brought to the United States in the 1960s. It is the most prolific breed available. Ewes have "litters" (3 to 6 lambs at one time), mature early, breed when 6 to 7 months old, and are good mothers. They are also small at maturity (120 to 170 pounds), and have poor fleeces and poor carcass characteristics. Crossbred

Finn ewes (¼ to ½ Finn) make excellent commercial ewes because prolificacy is reduced to a manageable 200 to 250 percent lamb crop. A crossbred Finn ewe maintains good mothering ability, while her carcass and fleece characteristics improve with crossbreeding. Crossbred ewes that are at least ¼ Finn will usually produce twins at lambing.

### **Ram Breeds**

**Suffolk:** The Suffolk sheep, developed in England, is the largest framed breed used today. Mature rams weigh 250 to 350 pounds. The Suffolk excels in growth rate and carcass characteristics. With its excellent growth characteristics, the Suffolk is especially important as a terminal sire of slaughter lambs.

**Hampshire:** The Hampshire is another growthy, heavily muscled, large-framed breed developed in England. It ranks second only to the Suffolk in growth rate and average daily gain (ADG). A mature Hampshire

**Table 2: Examples of crossbreeding systems used in sheep production.**

<b>A. TWO-BREED CROSS</b>		<b>SUGGESTED MATINGS<sup>1</sup>:</b>			
Breed: Ram A X Ewe B		<b>Ram</b>	<b>Ewe</b>	<b>Lamb</b>	<b>Comments on Lambs</b>
 Lamb <hr/> 1/2A, 1/2B		S	R	1/2S,1/2R	Desirable for slaughter lambs or replacement ewes.
		R	F	1/2R,1/2F	Excellent replacement ewes with high prolificacy.
		D	R	1/2D,1/2R	Ewes should have long breeding season and out of season breeding potential.

<b>B. THREE-BREED CROSS</b>		<b>SUGGESTED MATINGS<sup>1</sup>:</b>			
Breed: Ram A X Ewe BC*		<b>Ram</b>	<b>Ewe*</b>	<b>Lamb</b>	<b>Comments on Lambs</b>
 Lamb <hr/> 1/2A, 1/4B, 1/4C		S	1/2R,1/2F	1/2S,1/4R,1/4F	Fast growing, large framed, excellent slaughter lambs.
		S	1/2D,1/2F	1/2S,1/4D,1/4F	
		S	1/2D,1/2R	1/2S,1/4D,1/4R	Possess fewer maternal traits than whitefaced sired lambs.
		D	1/2R,1/2F	1/2D,1/4R,1/4F	Useful for slaughter lambs or as replacement ewes.
		R	1/2D,1/2F	1/2R,1/4D,1/4F	
		D	1/2S,1/2R	1/2D,1/4S,1/4R	

<b>C. BACKCROSS</b>		<b>SUGGESTED MATINGS<sup>1</sup>:</b>			
Breed: Ram A X Ewe AB*		<b>Ram</b>	<b>Ewe*</b>	<b>Lamb</b>	<b>Comments on Lambs</b>
 Lamb <hr/> 3/4A, 1/4B		R	1/2R,1/2F	3/4R,1/4F	Lambing rate of ewe lambs is likely to be less than that of their dams.
OR		F	1/2R,1/2F	3/4F,1/4R	Be prepared for triplets and quads from replacements.
Breed: Ram B X Ewe AB		R	1/2R,1/2S	3/4R,1/4S	Useful for slaughter lambs or as replacement ewes.
 Lamb <hr/> 3/4B, 1/4A		S	1/2R,1/2S	3/4S,1/4R	Fast gaining, excellent slaughter lambs.
		R	1/2R,1/2S	3/4R,1/4S	Excellent replacement females.
		D	1/2R,1/2D	3/4D,1/4R	Useful for slaughter lambs or as replacement ewes.

<b>D. TWO-BREED ROTATIONAL CROSS</b>		<b>SUGGESTED MATINGS<sup>1</sup>:</b>				
Generation 1: Breed: Ram A X Ewe B		<b>Year</b>	<b>Ram</b>	<b>Ewe</b>	<b>Lamb</b>	<b>Comments on Lambs</b>
 Lamb <hr/> 1/2A, 1/2B		1	S	R	1/2S,1/2R	Market wethers, retain ewes.
Generation 2: Ram B X		2	R	1/2S,1/2R	3/4R,1/4S	Save replacement females.
 Lamb <hr/> 3/4B, 1/4A		3	S	3/4R,1/4S	5/8S,3/8R	Excellent market lambs.
Generation 3: Ram A X		4	R	5/8R,3/8S	11/16R,5/16S	Save replacement females.
 Lamb <hr/> 5/8A, 3/8B						

\*Note: The crossbred ewe may include any proportion of the two breeds and is not restricted to the 1/2 and 1/2 examples used here.

<sup>1</sup>D = Dorset, F = Finn, R = Rambouillet, S = Suffolk

ram weighs between 250 and 325 pounds.

### Crossbreeding Systems

Four types of crossbreeding systems used in sheep breeding are discussed in the following text and illustrated in Table 2. For this bulletin, Rambouillet (R), Finn (F), Dorset (D) and Suffolk (S) breeds are included in the discussion. Other breeds may also be used in any of these systems.

**TWO-BREED CROSSES:** A simple system in which a ram of one breed is mated to ewes of another breed. The resulting lambs are half-bloods of each breed. This system is especially important in the production of crossbred ewes to be used as replacements. When lambs from this mating are retained in the flock, however, the breeding system is no longer a two-breed cross but may fall into one of the following systems.

**THREE-BREED CROSSES:** In this system, a crossbred ewe is mated to a ram of a third breed. This cross is typically used in the production of slaughter lambs and takes advantage of heterosis and crossbreeding benefits described earlier. This type of cross may be called a "terminal cross" if all lambs are marketed for slaughter.

**BACKCROSSING:** In this system, a crossbred ewe is mated to a straightbred ram from one of the ewe's original breeds. This system is used to increase the influence of a particular breed used in the dam's breeding. Backcrossing generally produces offspring that have more maternal characteristics and less emphasis on carcass traits than

**TABLE 3: How various sheep breeding systems may affect the average predicted production index.\***

Breeding system	Average predicted production index*
<b>3-breed cross</b>	<b>187</b>
<b>Backcross</b>	<b>181</b>
<b>2-breed cross</b>	<b>146</b>
<b>Straight breeding</b>	<b>136</b>

\*Average predicted production index = predicted 120-day litter weight (lb) + 3X predicted greasy fleece weight (lb).

SOURCE: Gallivan, et al., *Journal of Animal Science*, 64:43-49, 1987.

their dam, or vice versa.

**ROTATIONAL CROSSBREEDING:** In this system, a ram from each breed in a desired cross is used in rotation for production of the specific cross. In a two-breed cross, one breed selected may be strong in growth traits and carcass merit. The ram used to produce the second generation may represent a breed better known for maternal traits. Rams of these two breeds are alternated each generation. The two-breed rotation will maintain approximately  $\frac{3}{4}$  blood individuals of each breed in alternate generations. This allows replacements to be selected in years when a sire is used that emphasizes maternal traits (Rotational systems may consist of two-, three- or four-breed rotations.)

Producing slaughter lambs and replacement ewe lambs are two very different objectives and are not easily accomplished with a single breeding system. Therefore, the best solution for many flock owners is to split their flock and select 25 percent of their most productive ewes to raise replacement females. The remaining 75 percent of the flock would be bred to a terminal sire, with all offspring marketed as slaughter lambs.

Recent research data from Oregon State University (Gallivan, et al., 1987) indicate advantages to two-breed and three-breed rotational cross matings over straightbreeding. Table 3 summarizes some of these findings based on production from 350 ewes of Columbia, Targhee, Hampshire and Finn breeding. The average predicted production index was highest in the three-breed cross and lowest in straightbred ewes. Although the table shows that the three-breed cross method was most productive in this study, using this system requires maintaining a substantial number of straightbred ewes to continually supply the required crossbred ewes. Offspring of the three-breed cross were not retained as replacements.

### Summary

Several breeding systems are available to the farm flock producer. Crossbreeding can be a valuable and appropriate tool that allows increased expression of valuable traits and boosts productivity.

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