Objective analysis of the ewe flock will help a producer determine what characteristics a ram should possess to best complement a flock to improve performance.

Improving genetics within a flock starts with selecting a quality ram that complements existing ewe traits and improves any weaknesses in the flock. Ram selection principles should consider a number of different aspects, including performance, visual appraisal and cost.

When selecting a ram, producers should begin by analyzing what production traits the ewes in the flock exhibit as strengths. Then, producers should analyze what traits would be considered weaknesses. Ewe estimated breeding values (EBVs) or production records from the past couple years can be used to assess these strengths and weaknesses. Finally, rank the traits that a ram should possess to best fit the operation’s goals. These traits can be classified into categories such as growth traits, carcass traits, or maternal traits. Growth traits include weaning and post weaning weights, while carcass traits include loin depth (or size) and fat thickness. Maternal traits often include number lambs born and number lambs weaned and may include scrotal circumference of the rams, because rams with larger scrotal size tend to improve sire ewes with improved reproductive performance. Other categories to consider, depending on operation needs, would be parasite resistance or wool traits.

Once the top traits desired in the new ram have been identified, then the selection process can begin. Single trait selection often results in decreased desirability of other important traits. Therefore, always consider several traits in order to select a ram that will move the flock toward more optimum genetics.

Selection Using Performance Data

One of the best ways to compare individual sheep is by using data. Producers collect these data starting when lambs are born and add information throughout a ewe's or ram's life.

When selecting rams based on data, there are two options: EBVs and individual performance within a flock. EBVs, are the preferred selection parameter because these numbers focus on genetic estimates for performance across a breed. EBVs are measurements of heritable traits such as number of lambs born, weaning and post weaning weights, and wool traits. While an individual's performance within a flock is still useful information the performance of that individual will be influenced by management and environmental factors in addition to genetics.

The National Sheep Improvement Program (NSIP) uses data collected on a farm and makes genetic connections to other flocks through a database in Australia known as LambPlan. This database uses a record keeping software called Pedigree Master to submit data for LambPlan. Participating in the EBV program helps producers improve genetic predictability in order to produce a more consistent product, which could be breeding stock, meat, or wool, for customers.

In addition, records allow producers to make informed decisions for both selecting replacement animals and for culling poor performing animals. This is especially important for identifying animals within the flock that do not produce offspring that meet minimum production standards. Producers can also utilize records on progeny to make culling decisions once ewes and rams produce offspring. Performance data collected on individual sheep can be interpreted at the farm level or can be sent to NSIP to develop EBVs.
Common performance data includes the following items.

**Birth weight**: Most lambs should weigh between 8 and 12 pounds at birth, depending on the mature size of their parents. Larger lambs may cause lambing difficulties, while smaller lambs may require producer assistance for the first few days after birth. This adds to the labor requirements at lambing and can increase the likelihood of death losses.

**Birth date**: To best manage groups of ewes and lambs, ewes in the flock should give birth as close to the same date as possible. A good goal is for all lambs within the flock to be born within two heat cycles, or 34 days. Lambs born outside this 34-day window often weigh less than the average at weaning. Producers should consider culling ewes that do not lamb within this timeframe.

**Birth Type and Rearing Type**: Birth type refers to lambs born as a single, twin or triplet. To be profitable, many operations need their ewes to produce twins and ewes should rear those lambs as twins. Yearling ewes are the exception, as most will produce a single lamb. Selecting rams, as well as ewes, born as twins can help to boost the genetic likelihood of twinning. But nutrition also plays a large part in twinning rates. (Refer to the Penn State publication "Breeding Season Preparations" for information on flushing to increase twinning.

Many producers prefer to purchase rams born and raised as twins. Photo by Melanie Barkley

**Weaning weight**: Many lambs in the northeast are sold at weaning, so heavier weaning weights can increase the profitability of an operation. A good goal is to have lambs weigh 45 to 60 pounds or more by 60 days of age. However, this is not a realistic goal for all breeds.

Lambs born as singles normally weigh more at weaning than lambs born as twins or triplets. Other factors, such as the sex of the lamb and the age at weaning, also influence the weaning weight. Keep in mind that a pair of twins will most likely weigh more at weaning than the single lamb. Thus, the weight of the pair, even if its individuals weigh less than the single born lambs, determine the income produced by the ewe.

**Adjusting Weaning Weights**

As alluded to earlier, animal performance is based both on genetics and the environment. Producers can adjust weaning weights in order to compare individual lambs born the same farm, since these animals have theoretically all been exposed to the same environmental conditions.

Weaning weights can be adjusted for:

- age at weaning
- birth type (single, twin, or triplet)
- rearing type (single, twin, or triplet)
- sex of the lamb
- age of the dam or mother
To adjust for the age at weaning:

1. Determine an age to adjust to. Weaning weights are typically adjusted to 60 days of age but could also be adjusted to other ages such as 90 or 120 days of age.

2. Subtract the birth weight from the weaning weight. This is the weight gained.

3. Divide by the age of the lamb (in days) when it was weighed. This is the average daily gain.

4. Multiply the average daily gain by the weaning age you are adjusting to (usually 60 days).

5. Add the birth weight.

Estimated 60-day weight = (((weaning weight – birth weight)/age at weaning) X 60) + birth weight.

The estimated 60-day weight can then be adjusted for more factors. The following table lists adjustment factors to account for the age of the ewe, sex of the lamb, birth type, and rearing methods for three breeds of sheep (Targhee, Suffolk, and Polypay) as well as generic breed adjustments.

The tables below are adapted from the Breeding and Selection Chapter of the Sheep Production Handbook produced by the American Sheep Industry Association, Inc. (This handbook can be purchased through the American Sheep Industry Association and through select sheep supply companies.)

### Lamb Preweaning and Weaning Weight Adjustment Factors

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<th>Polypay</th>
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<td>1.14</td>
<td></td>
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</tr>
<tr>
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<td>1.05</td>
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<td>1.04</td>
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</tbody>
</table>

Adapted from Sheep Production Handbook

* Type of birth and rearing:

- 1/1 = single raised as a single
- 1/2 = single raised as a twin
- 2/1 = twin raised as a single
- 2/2 = twin raised as a twin
- 3/1 = triplet raised as a single
- 3/2 = triplet raised as a twin
- 3/3 = triplet raised as a triplet
Example of Adjusting a Weaning Weight

A twin ewe lamb was born on January 2nd, weaned on March 4th, and was raised as a twin. The dam is 2 years old.

- Birth weight = 10 lbs.
- Weaning weight = 62 lbs.
- Actual age at weaning = 61 days
- Weaning age to adjust to: 60 days

1. Adjust the weaning weight for sixty days. Use the following formula: Estimated 60-day weight = \((\text{weaning weight} - \text{birth weight})/\text{age at weaning}) \times 60 + \text{birth weight}\).

\[
\text{Estimated 60-day weight} = \left(\frac{(62 - 10)}{61}\right) \times 60 + 10 \approx 61.15 \text{ lbs.}
\]

2. Now adjust the weaning weight for ewe age, sex of the lamb, and the type of birth and rearing, by multiplying by the generic adjustment factors found in the table:

- 1.08 = adjustment factor for a 2-year-old ewe
- 1.00 = adjustment factor for a ewe lamb
- 1.21 = adjustment factor for a twin raised as a twin

\[
61.15 \text{ lb.} \times 1.08 \times 1.00 \times 1.21 = 79.91 \text{ lb.}
\]

Therefore, the adjusted 60-day weight of this ewe lamb is **79.91 lbs**. This calculation allows producers to better compare lambs and make more informed selection decisions. The Sheep Production Handbook also contains tables for adjustments to adult fleece weights for ewe age and for the expected number born adjustments for ewe age.

Selection Using Visual Appraisal

In addition to using individual performance and EBVs, anyone involved in sheep production should have the skills to evaluate the physical characteristics of individual rams for their potential as breeding stock. Producers should be able to visually evaluate sheep structure and they should also be able to evaluate muscling.

In order for a ram to be sound on his feet and legs, he must be structurally correct. Correct structure enables the ram to move properly and proper movement allows rams to comfortably mount ewes during breeding.

To be able to evaluate or select structurally correct rams, producers must first have an understanding of the parts of a sheep as well as each part's correct structure. Remember, selection should begin with a look at performance records followed by visual evaluation. Visual appraisal can be a good indicator of frame size, muscling, body structure, feet and leg structure, and breed character.

Correct skeletal structure is important and essential for any animal to move to feed and water. This structure can be observed in shoulder angle, pastern angle and levelness of the hips and top line from neck to dock. The angle of the shoulder should be approximately 45 degrees, while the pastern angle should be approximately 50 to 55 degrees or slightly more. Skeletal angles in the shoulders, hips and legs are all important for ease of movement. When angles are within appropriate ranges, the animal is generally level across their topline and able to move freely.

When making visual selection decisions for correct structure, it is important to know all the external parts of a sheep. Each part has an ideal characteristic for breeding rams.
An ideal breeding ram should have certain physical characteristics. These include

- a long, square, level rump,
- long, smooth thick muscle,
- adequate diameter of cannon bone,
- a long, wide loin,
- a strong, level, thick top,
- well-sprung ribs, or in other words a round rib cage with large volume
- a deep forerib,
- smooth shoulders,
- a masculine neck and head,
- a trim neat throat and breast,
- strong upright pasterns, and
- Adequate and evenly sized testicles
- And the feet and legs should be placed directly underneath the animal
Producers should select rams that possess correct structure as well as other visual characteristics and good performance data. Photo by Melanie Barkley

There are a number of undesirable feet and leg characteristics that animals can exhibit. As you evaluate animals, you should be aware of these issues:

**Pigeon toed**: An animal is pigeon toed or toed-in if when viewed from the front, the toes turn towards each other rather than pointing straight forward.

**Bowlegged**: An animal is bowlegged if when viewed from the front, the knees curve out away from each other or if viewed from the rear, the hocks curve out away from each other.

**Splayfooted or toed-out**: An animal is splayfooted or toed-out if when viewed from the front, the toes turn out away from each other rather than pointing straight forward.

**Knock-kneed**: An animal is knock-kneed if when viewed from the front, the knees lean toward each other and are not in a straight line with the legs.

**Cow hocked**: An animal is cow hocked if when viewing the hind legs from the rear, the hocks, which are the hind leg joints, are turned inward or are placed too close together. This causes the toes to turn outward.

**Sickle hocked**: An animal is sickle hocked if when viewing the rear legs from the side, the hock has too much angle or set. A line dropped perpendicular from the pin bones to the ground should lie parallel to the cannon bone. A sickle hocked cow has hocks that angle too much, which causes the animal's feet to stand too far underneath their body. Often these animals will droop excessively from hooks to pins.

**Post legged**: An animal is post legged if the hock has too little angle or set. The animal is too straight through the joint, which results in a very stiff, restricted movement due to the lack of flexibility. More sheep become unsound because of being post legged than sickle hocked.

**Buck kneed**: An animal is buck kneed, or "over at the knees", if the full extension of the animal's knee cannot occur. When observed from the side, the legs appear slightly bent. This is usually seen in sheep that are too straight in the shoulder.

**Calf kneed**: Calf kneed is the opposite of buck kneed. This means that the animal stands "back at the knees" when viewed from the side.

**Weak pasterns**: Weak pasterns, which are the leg bones between the hoof and fetlock, can be determined by visually looking at their angle. Weak pasterns have more than the normal slope to them and can indicate a structural fault. As mentioned previously, correct pastern angle should be approximately 50 to 55 degrees or slightly more.

Sound hind legs are vital to the mating ability of rams, because during mating, most of the ram's weight is supported by the hind legs. A ram with hind leg defects may suffer pain while moving or mounting, which may interfere with his desire to mate. In an aging ram with faulty conformation, defects become more apparent and may tend to decrease their ability to breed larger groups of...
The ram's legs should be free of excessive swelling at any of the joints, and joint flexure should be smooth and free of locking in any position. A sheep with straight hind legs, or post legs, is predisposed to swollen hocks and arthritis in the hind leg joints. A sheep with post leg or sickle hocks also may have more difficulty moving earlier in life, leaving it lame or unable to move freely throughout a pasture or, in the case of rams, to breed ewes.

Other visual characteristics to consider when evaluating rams relate to how filled out the animal may appear. Rams selected for breeding should exhibit volume and capacity. Indicators of volume are:

- Width of the chest floor, which is the lower chest between the two front legs,
- Depth of body, which is the depth from the top of the animal's back to the bottom of their belly
- Shape of ribcage, which is the roundness of the ribcage.
- Uniformity of body depth, which refers to the animal being the same depth at the top of the shoulders to fore flank compared to the top of the hips to rear flank.

Sheep with more volume are generally easier fleshing. That is, they produce external fat easily and are usually lower maintenance than sheep that lack volume. Rams should be selected with volume in mind in order to transmit these traits to offspring.

The muscling of an animal is also important to the meat animal industry. Heavily muscled animals tend to produce more meat and less fat than animals with less muscle. Consumers prefer lamb with larger loin chops and with less fat. Indications of muscling can be seen over the animal's top and in the loin area, length of the hip, width between the rear legs, and the hindquarters.

Leg structure, as well as volume, and muscling, all play a role in the correct structure of sheep. Structure helps determine how well an animal will function. It can also impact the longevity of an animal in the flock. So, it is important to consider structure when selecting rams in order to maintain a healthy and viable operation.

**Ram Cost Considerations**

The final consideration in ram selection, but often the starting point for many producers, is the price. How much can the operation afford to pay for a ram? This not only depends on a bank account but should also depend on the value of that ram to the operation. So, how does the operation determine what is appropriate?

Purchasing a new ram should always require careful consideration in all areas, including cost. All producers want to find a bargain: the highest quality genetics for a bargain price. However, progressive producers should spend some time developing a selection strategy and setting up a budget to determine what a ram is worth to the operation. Consider the ram an investment and think about what value that ram will bring to the operation.

When looking at a ram as an investment an item to consider would be how he can be expected to impact improved production. How will his lambs compare to previous lambs born on the operation? Will they have heavier weaning weights? Will they be more acceptable to buyers? What traits will his daughters exhibit to improve performance? These are all considerations that not only impact the bottom line the first year after this ram produces lambs, but into the future as daughters retained in the flock.
When considering the cost of a new ram, begin by estimating the salvage value of the ram once the operation has finished using him. If the operation has a market for aged rams, how much should the operation charge? If selling aged rams are there any health tests that should be performed to ensure the buyer that the ram won't share any diseases with the new flock? Subtract those costs to arrive at a salvage value. If the ram sells through a sale barn, what is the likely value for cull rams? Or, will the salvage value be zero because the ram can be expected to live the rest of his life at this operation?

Consider an example of a producer paying $1,500 for a ram that will be used for 2 years to service 35 ewes each year. After the producer finishes using this ram, he intends to sell him through a sale barn for about $200. This makes the difference between the purchase price and the salvage value $1,300. By dividing the salvage value by the 2 years the producer plans to use the ram, the depreciation cost amounts to $650 annually. Divide the annual depreciation cost of $650 by the number of ewes serviced to determine the depreciation per ewe, which would be $18.57 for this example. Another option would be to divide this by the average value of the lambs sold, to arrive at the pounds of lamb each ewe must produce each year in order to cover the cost of ram depreciation. Calculate this by dividing $18.57 by the sale price of the lambs. A value of $2.85 per pound for lambs sold at weaning in the Eastern United States would mean that 6.5 lbs. produced by each ewe would cover the cost of ram depreciation.

An operation must know the cost of production to determine if this is acceptable. What does it cost the operation to keep a ewe per year? If $18.57 is added to a ewe's annual costs, how will this impact the operation's profitability? Should this cost be considered an investment for the future when this ram's daughters enter the flock?
Another way to look at the salvage value of the ram is to consider how many lambs per year must be sold to cover the depreciation cost. If the operation sells 60 lb. lambs at $2.85 per pound, the value of each lamb is $171. Subtract sales and transportation costs. For this example, $160 is the value that a lamb brings to the operation. Therefore, $650 divided by $160/lamb means that it takes about four lambs each year to cover the cost of the ram.

Producers should always purchase the best ram that they can afford. A ram has the potential to impact a flock for many years through his daughters. So, spend some time determining what traits a ram should possess to improve the operation, what value a ram will have to the operation, and then decide on a fair price.

Summary

Every sheep operation should spend time developing a ram selection strategy. Analyzing the ewe flock will help to determine what traits would be important in a ram. Producers should also consider performance data, either in the form of EBVs or adjusted weaning weights, in addition to visually appraising the ram. Be willing to pay a fair price for a good ram. Developing a good strategy will yield rams that produce lambs that perform well and future daughters that improve genetics within the flock while maintaining operation profitability.

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