NSIP EBV Notebook

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NSIP EBV and Indexes

EBV for Weight Traits

- The **Birth Weight (BWT) EBV** (kg) estimates direct genetic effects on weight at birth. Positive selection on Birth Weight EBV is anticipated to increase birth weight and have correlated positive effects on early lamb survival, especially in twins and triplets. Negative selection on Birth Weight EBV is anticipated to reduce birth weight and lambing difficulty associated with oversized lambs, especially in singles. Changing birth weights is generally not a primary selection goal. Positive selection may be advantageous in prolific breeds and in flocks where lambing difficulty is not a problem, whereas negative selection may be desirable in less-prolific breeds or flocks with a history of heavy birth weights and associated lambing difficulties. The birth weight EBV is positively correlated with weaning and postweaning body weight EBV. Selection to increase weaning and postweaning weights is anticipated to result in increased birth weights, and negative selection on birth weight EBV will reduce selection responses in weaning and postweaning weights.

  [All Breeds]

- The **Maternal Birth Weight (MBWT) EBV** (kg) estimates genetic effects of the ewe on the birth weight of her lambs. This EBV mainly reflects the quality of the uterine environment provided by the ewe and may also be influenced by ewe effects on gestation length. Ewes with positive Maternal Birth Weight EBV provide a favorable uterine environment for lamb development, whereas ewes with negative Maternal Birth Weight EBV provide a more limiting uterine environment. The Maternal Birth Weight EBV will not receive major selection emphasis in most flocks, but positive emphasis on Maternal Birth Weight EBV can be useful in flocks that have had problems with small weak lambs.

  [All Breeds]

- The **Weaning Weight (WWT) EBV** (kg) provides an estimate of preweaning growth potential and will likely receive positive selection emphasis in most flocks. In extensively managed flocks with weaning at 90 to 150 days, the Weaning Weight EBV is commonly estimated from preweaning weights taken at 45 to 90 days of age. In such flocks, the true weaning weight is recorded as an early postweaning weight, with genetic differences reflected in the Postweaning Weight EBV.

  [All Breeds]

- The **Maternal Weaning Weight (MWWT) EBV** (kg) estimates the genetic effects of the ewe on the weaning weight of her lambs. It can be thought of as a measure of the ewe's merit for mothering ability. This EBV mainly reflects genetic differences in ewe milk production, but other aspects of maternal behavior may also be involved. The Maternal Weaning Weight EBV is derived by evaluating if individual ewes produce lambs that are heavier or lighter than expected based on the weaning weight EBV of the parents. Ewes whose lambs grow faster than predicted are assumed to be better milk producers, whereas ewes whose lambs grow more slowly than predicted are assumed to produce less milk. Selection for high maternal milk EBV is expected to improve milk production and mothering ability and is considered to be important for maternal breeds. The total anticipated genetic contribution of an animal's daughters to lamb weaning weight includes effects on both weaning weight and maternal milk, and can be calculated as:

$$\text{Total Genetic Effect on Weaning Weight} = \text{MWWT EBV} + 0.5 \times \text{WWT EBV}$$

This calculation recognizes that the genetic contribution of a ewe to the weaning weight of her lambs combines effects of her milk production (measured by the Maternal Weaning Weight EBV) and a sample one half of her genes for preweaning growth potential (measured by the Weaning Weight EBV).

[All Breeds]

- The **Postweaning Weight (PWWT) EBV** (kg) combines information on preweaning and postweaning growth to predict genetic merit for postweaning weight at 120 days. Up to two postweaning weights can be recorded: an "early" postweaning weight at 90 to 150 days and a "late" postweaning weight at 150 to 305 days. Either or both can be recorded. These two postweaning weights are assumed to have a genetic correlation of 1.0 and contribute equally to the final Postweaning Weight EBV. In extensively managed flocks with weaning at 90 to 150 days, the weaning weight is commonly recorded as an early postweaning weight, and the Postweaning Weight EBV predicts genetic differences in body weight at typical weaning ages. Positive selection on Postweaning Weight EBV is expected to favor rapid growth to typical market ages.

  [All Breeds]

- The **Yearling Weight (YWT) EBV** (kg) estimates growth potential to 12 months of age. Animals with high Yearling Weight EBV exhibit sustained postweaning growth, but ewe lambs with high Yearling Weight EBV are anticipated to have heavier adult body weights and greater maintenance requirements.

  [Western Range Breeds, Wool Maternal Breeds, Hair Breeds]

- The **Hogget Weight (HWT) EBV** (kg) estimates genetic effects on body weight at 18 months of age. Negative selection pressure on Hogget Weight EBV can be used to control adult body weights of breeding ewes, but will limit progress in weaning and postweaning weights. Selection emphasis on Hogget Weight EBV must consider the optimum balance between these competing goals.

  [Western Range Breeds, Maternal Wool Breeds, Hair Breeds]

- LAMBPLAN also allows recording of body weights of adult ewes at 2, 3, 4 and 5 years of age and uses the first reported adult ewe weight to produce Adult Body Weight EBV. However, this option is not currently active for NSIP.

EBV for Wool Traits

Fleece data can be reported at postweaning, yearling and hogget ages, and for adult ewes at 2, 3, 4, and 5 years of age. NSIP/LAMBPLAN currently uses data from yearlings, hoggets, and the first adult fleece (regardless of ewe age) to produce yearling, hogget, and adult EBV for wool traits. However, breeders who wish to collect fleece data for adult ewes at more than one age may do so. Those data will be stored for possible future use. Records on the same fleece trait at different ages are strongly and positively correlated, so most NSIP breeders can likely base selection decisions and marketing programs on yearling EBV.

- The **Fleece Weight (GFW) EBV** (%) is based on greasy fleece weights and estimate the animal's genetic potential for wool production. Fleece weights are stored and analyzed in kilograms. However, because of the limited range in resulting EBV and potentially large effects of environment, management, and sex on yearling fleece weight, the GFW EBV is reported as a percentage of the mean fleece weight. A GFW EBV of +10 thus indicates that the animal is expected to produce fleeces that are 10% heavier than average.

  [Western Range Breeds; Maternal Wool Breeds]

- The **Fiber Diameter (FD) EBV** (microns) estimates genetic merit for fleece quality. Animals with finer, more desirable fleeces have negative fiber diameter EBV, so negative EBV are favored for this trait.

  [Western Range Breeds; Maternal Wool Breeds]

- The **Staple Length (SL) EBV** (mm) estimates genetic potential for length of the wool fiber. Positive selection emphasis on Staple length EBV is recommended in flocks that receive premiums for long-staple fleeces or have experienced discounts for fleeces with excessively short staples.

  [Western Range Breeds; Maternal Wool Breeds]

- The **Fiber Diameter Coefficient of Variation (FDCV) EBV** (%) estimates genetic merit for fleece uniformity, expressed as the coefficient of variation (CV) among individual wool fibers in a fleece sample. Animals with more uniform fleeces (lower CV) are desired, so negative EBV are favored for this trait.

[Western Range Breeds; Maternal Wool Breeds]

- The **Fiber Curvature (CURV) EBV** (° (degree)) predicts genetic differences in crimp frequency. This EBV is based on an OFDA optical measurement of fiber curvature, which is measured in degrees and is a very accurate predictor of crimp. Higher values for curvature indicate broader or bolder crimp. Positive EBV therefore indicate more crimp and, depending on the end-product (knitwear or worsted fabric), may or may not be desirable. Use of Fiber Curvature EBV in breeding programs therefore depends on the requirements, premiums, and discounts applied to your wool.

[Western Range Breeds]

- LAMBPLAN also produces EBV for clean fleece weight, scoured yield, and staple strength in yearlings, hoggets, and adult ewes. These EBV can be made available to NSIP producers who record these variables.

EBV for Body Composition

- The **Fat Depth (FAT) EBV** (mm) is an indicator of genetic differences in carcass fatness between the 12^{th} and 13^{th} ribs. It is derived from ultrasonic measurements of fat depth in live animals and adjusted to standard postweaning weight of 110 lb (55 kg) for Terminal and Maternal Wool breeds and a standard yearling weight of 187 lb (85 kg) for Western Range breeds. Animals with negative Fat Depth EBV are expected to produce leaner progeny with lower, more desirable Yield Grades and are generally desirable. However, the emphasis placed on Fat Depth EBV in individual breeding programs will depend on specifications, discounts, and premiums in current markets.

[All Breeds]

- The **Loin Eye Muscle Depth (EMD) EBV** (mm) is an indicator of genetic differences in muscling. It is derived from ultrasonic measurements of loin muscle depth between the 12^{th} and 13^{th} ribs in live animals and adjusted to standard postweaning weight of 110 lb (55 kg) for Terminal and Maternal Wool breeds and a standard yearling weight of 187 lb (85 kg) for Western Range breeds. Animals with positive Loin Eye Muscle Depth EBV are expected to produce offspring with larger loin eyes and are generally desirable. However, the emphasis placed on Loin Eye Muscle Depth EBV in individual breeding programs depends on specifications, discounts, and premiums in current markets.

[All Breeds]

- Ultrasonic measurements for Terminal and Maternal Wool breeds can be reported at either early or late postweaning ages. However, in contrast to the situation for postweaning weights, only the first reported postweaning ultrasound measurements are used to derive Postweaning Fat Depth and Postweaning Loin Muscle Depth EBV. Therefore, breeders should be sure that the most informative postweaning ultrasound record is also the first reported postweaning record.

- Measurements for later-maturing Western Range breeds can be reported at late postweaning, yearling, or hogget ages. However, late postweaning and yearling measurements are preferred. All 3 of these measurements contribute to the reported Yearling Fat Depth and Yearling Loin Muscle Depth EBV in Western Range breeds.

- All scanning records must be accompanied by a body weight and recorded at the same time as (or at least within ± 7 days of) that body weight.

- Procedures to obtain EBV for scanning traits in Western Range breeds were derived for ram lambs fed at a moderate to high plane of nutrition following weaning at 90 to 150 days of age and scanned at late postweaning, yearling, or hogget body weights of 110 to 265 lb (50 to 120 kg). Records from lambs scanned at lighter weights or ewe lambs maintained on much lower planes of nutrition may not yield valid EBV.

EBV for Reproduction

- The **Number of Lambs Born (NLB) EBV** (number) evaluates genetic potential for prolificacy. This EBV is expressed as numbers of lambs born per ewe lambing. Ewes with EBV of +0.10 for Number of Lambs Born are expected to have an average of 0.10 more lambs at each lambing than average ewes, and their daughters are expected to have an average of 0.05 more lambs at each lambing compared to daughters of average ewes. Selection on Number of Lambs Born EBV is expected to increase prolificacy in the flock.

[All Breeds]

- The **Number of Lambs Weaned (NLW) EBV** (number) evaluates combined ewe effects on prolificacy and lamb survival to weaning. The NLW EBV is expressed as numbers of lambs weaned per ewe lambing. Ewes with EBV of +0.10 for Number of Lambs Weaned are expected to wean an average of 0.10 more lambs at each lambing, than average ewes, and their daughters are expected to wean an average of 0.05 more lambs at each lambing compared to daughters of average ewes. Selection on Number of Lambs Weaned EBV is expected to increase weaning rates in the flock.

[All Breeds]

- The **Scrotal Circumference (SC) EBV** (cm) may be used to improve breeding capacity in males and reproductive performance in females. Selection of animals with positive Scrotal Circumference EBV is expected to be most useful in improving reproductive performance in ewe lambs and yearlings via desirable effects on rate of sexual maturation, but may also have small positive effects on numbers of lambs born and weaned by older ewes. Scrotal circumference measurements can be recorded at postweaning, yearling, and hogget ages. However, NSIP currently produces only Postweaning Scrotal Circumference EBV for the relatively early-maturing Maternal Wool Breeds and Postweaning and Yearling Scrotal Circumference EBV for the later-maturing Western Range Breeds.

[Maternal Wool Breeds; Western Range Breeds; Hair Breeds]

- Scrotal circumference measurements can be reported at early and late postweaning ages for Maternal Wool breeds and at late postweaning and yearling ages for Western Range breeds. Reporting of body weights is not mandatory for scrotal circumference measurements, but if both are recorded, the scrotal circumference must be recorded at the same time as (or at least within ± 7 days of) the corresponding weight. In contrast to the situation for postweaning weights, only the first reported postweaning scrotal circumference measurement is used to derive EBV. Therefore, breeders should be sure that the most informative postweaning scrotal circumference measurement is also the first reported postweaning measurement. This will normally be the late postweaning measurement.

- Measures of NLB and NLW EBV in NSIP are expressed on a “per ewe lambing basis”.

EBV for Parasite Resistance

- The **Worm Egg Count (WEC) EBV** (%) evaluates genetic merit for parasite resistance based on worm egg counts recorded at weaning or at early or late postweaning ages. Animals with low Worm Egg Count EBV are expected to have greater parasite resistance, and selection to reduce Worm Egg Count EBV is recommended in areas where internal parasites are a problem. Worm egg counts can also be recorded in yearlings, hoggets, or adult (2-yr-old only) ewes, but these measurements are not currently used to derive EBV. Most research would suggest that postweaning WEC EBV are the most useful genetic indicator of parasite resistance, but studies with Katahdin sheep in the USA have shown that weaning worm egg counts provide useful information on parasite resistance in young lambs. Weaning and postweaning Worm Egg Count EBV are strongly, but not perfectly, correlated and so convey slightly different information on patterns of development of parasite resistance. However, postweaning Worm Egg Count EBV are likely adequate for most selection and marketing purposes.

[Hair Breeds; Maternal Wool Breeds; Terminal Breeds]

- Postweaning worm egg counts can be reported at either the early or late postweaning age. Reporting of body weights is not mandatory for reporting worm egg counts, but if both are recorded, the worm egg count must be recorded at the same time as (or at least within ± 7 days of) the corresponding early or late postweaning weight.

In contrast to the situation for postweaning weights, only the first reported postweaning worm egg count is used to derive EBV. Therefore, breeders should be sure that the most informative postweaning worm egg count is also the first reported postweaning measurement.

NSIP/LAMBPLAN Selection Indexes

- At times in the past, Number of Lamb Borns and Number of Lambs Weaned EBV were expressed on a "per 100 ewes lambing" basis. However, they are currently expressed on a "per ewe lambing basis", and the weightings for these EBV in indexes have been adjusted to the current reporting scale (multiplied by 100).

- The **US Western Range Index (%)** was developed by NSIP to improve profitability in Targhee range flocks and is generally applicable to extensively managed Western range flocks with positive emphasis on both lamb and wool production. EBV for the Western Range Index are estimated from Postweaning Weight (PWWT), Maternal Weaning Weight (MWWT), Yearling Weight (YWT), Yearling Fleece Weight (YGFW), Yearling Fiber Diameter (YFD), and Number of Lambs Born (NLB) EBV as:

$$\text{US Range Index} = 100 + (2.20 \times \text{PWWT EBV} + 0.57 \times \text{MWWT EBV} - 0.57 \times \text{YWT EBV} + 0.14 \times \text{YGFW EBV} - 0.47 \times \text{YFD EBV} + 36 \times \text{NLB EBV})$$

This index places major positive weight on early growth and ewe prolificacy and modest positive weight on increasing ewe maternal ability, increasing fleece weight, and reducing fiber diameter. Negative emphasis on yearling weight EBV is designed to limit increases in adult ewe weight but, because of the large positive correlation between Weaning Weight and Yearling Weight EBV, is not expected to actually reduce yearling weights. The Number of Lambs Born EBV is used in preference to the Number of Lambs Weaned EBV because of potential bias in Number of Lambs Weaned EBV from predation in Western range flocks.

[Western Range Breeds]

- The **Maternal Indices (%)**, specifically the US Hair and US Maternal Wool, combine EBV for various traits into an index designed to maximize pounds of lambs weaned per ewe lambing. With the NSIP/LAMBPLAN procedures, these indices are estimated from EBV for other traits in the Hair and Maternal Wool breeds.

For all Hair breeds, this index is estimated as:

$$\text{US Hair Index} = 100 + (0.246 \times \text{WWT EBV} + 2.226 \times \text{MWWT EBV} - 3.5 \times \text{NLB EBV} + 40.6 \times \text{NLW EBV})$$

For all Maternal Wool breeds, this index is estimated as:

$$\text{US Maternal Index} = 100 + (0.583 \times \text{WW EBV} + 2.639 \times \text{MWWT EBV} - 3.5 \times \text{NLB EBV} + 40.6 \times \text{NLW EBV})$$

These Maternal Indices give substantial positive weight to Number of Lambs Weaned, Maternal Weaning Weight, and Weaning Weight EBV. Small negative emphasis on Number of Lambs Born EBV favors ewes that wean large litters without losing any lambs. A ewe that produces twins and weans them both will thus be favored over a ewe that has triplets but weans only two lambs. However, ewes that wean triplets will always have substantially higher index values than ewes that wean twins. Calculation of Maternal Indexes has changed slightly under NSIP/LAMBPLAN procedures, but the basic nature of the indexes in terms of underlying assumptions and expected selection responses in component traits is the same as it was under the original NSIP system.

[Hair Breeds; Maternal Wool Breeds]

- **Carcass Plus** was developed in Australia to improve carcass value in Australian markets. Carcass Plus EBV are calculated as:

$$\text{Carcass Plus Index} = 100 + (2.33 \times \text{WWT EBV} + 3.50 \times \text{PWWT EBV} + 11.40 \times \text{PEMD EBV} - 4.07 \times \text{PFAT EBV})$$

Even though developed for Australian markets, Carcass Plus Index scores provide a reasonable assessment of value for Terminal Sire types in the USA.

[Available for All Breeds, but mainly applicable to Terminal Sire Breeds]