Using Estimated Breeding Values for Breeding and Selection

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Production Improvement Program and Estimated Breeding Values

The growth of the dairy sheep industry in North America has been greatly hampered by the low level of milk production from most of the dairy stock available. The majority of North American dairy sheep producers currently do not produce enough milk to break even with the cost of production. The greatest expenses in dairy sheep production are feed and labor, and increasing the milk yield produced per ewe and improving milk components can maximize the marginal returns in dairy sheep production. Recent importation of semen from Europe has allowed the introduction of improved genetic stock and significantly higher producing ewes. By taking advantage of these improved European genetics and by implementing a system of data collection and analysis, producers can see marked increases in the productivity and profitability of their flock.

DSANA's Production Improvement Program uses detailed data collection, record-keeping and statistical analysis to enable producers to objectively assess their flock and make informed decisions on breeding and flock development. As part of this program, DSANA facilitates the use of **Rocky Mountain DHIA** in Utah for component and SCC analysis, and **GenOvis**, a livestock genetic evaluation program in Quebec, which generates estimated breeding values (EBVs) from collated milk production and component data. Producers participating in DSANA's Production receive EBVs on milk yield, component yield, SCC, and persistency.

Throughout the production season participating farms collect the following data from their flock: individual animal identification, date of birth, breed, and pedigree; lambing data; reproduction traits; milk yield, and milk quality (fat, protein, somatic cell count, etc). Per-ewe milk production is metered monthly (minimum of 4 metering events per season). Milk samples are collected on metering days and sent to Rocky Mountain DHIA for component analysis. Genovis collates the data and generate EBVs for each flock. These data can then be used to select a breeding protocol for each specific participating herd based on their cull rates, need for replacements, and EBVs.

Understanding EBVs

An EBV is a value which expresses the difference (+ or -) between an individual animal and the flock benchmark to which the animal is being compared (in our case, the dairy sheep whose milk production has been submitted to Genovis' North American database). EBVs are reported in terms of actual product such as kg of milk or fat %, etc. EBVs measure the genetic component of these traits, and allow dairy sheep to be compared, excluding their management and environment. EBVs are the best measure we have of comparing performance traits and important production values between dairy sheep within a flock and between individual animals in different flocks.

You can see the EBVs for milk yield, fat and protein. These are calculated against the current North American dairy flock averages but are expressed in the same units you would use to measure those traits. For instance, if the ewe has a +30 EBV for milk, that means the ewe is estimated to have the genetic potential to produce, over the year, 30 kg more milk than the N.A. flock average. The same principle applies for protein and fat yield. EBVs are meant to give you useful data to aid in making breeding and culling decision in your flock. The amount of emphasis you put on the numerical values is up to you. The combination of actual milk performance information and EBVs should allow you to quantify the value of each individual ewe. Essentially, an EBV for any particular dam is an estimation of her ability to pass on traits of value to her offspring. For instance, if a dam has a milk EBV of 30 kg, you would estimate that she would pass half of that ability, 15 kg over the breed average, onto any of her daughters (the other half of course coming from the chosen sire).

In general, how are EBVs calculated? Data collected on each ewe is entered into a computerized database program. The actual production is first adjusted for known, non-genetic influences – such as the age of the ewe, the system for rearing of lambs, and number of days in milk – to remove systematic, non-genetic effects on performance. The adjusted performance for each animal is then compared to the average production of a group of contemporary animals (i.e., other North American dairy ewes in the Genovis system). The system then combines the performance record for each animal with the performance records of all its relatives and weights the relative's information in proportion to how closely the animals are related. Again, all records are expressed in relation to their

contemporary groups to remove non-genetic differences (among years, flocks, and so forth) in average performance. Finally, the numbers are adjusted for the heritability of each trait and the numbers of records available. The resulting EBV is the best estimate of the true genetic merit of any individual animal for any specific genetic trait measured. While the mathematics of EBV calculation are complex, the result is a straightforward reflection of the actual performance of the individual and its relatives, expressed relative to their contemporaries (other dairy sheep being performance recorded in North America).

Excerpts taken and adapted* from:

- Ccsi.ca: Canadian dairy goat genetic evaluation and selection program
- Katahdins.org: Frequently asked questions about Estimated Breeding Values and NSIP
- Thedairysite.com: What is an EBV and how can it help you?

*Note from Bee Tolman: to make the excerpts clearer, I have entered in “Genovis” or “dairy sheep” where appropriate.

Barn name	COMP Index	% COMP Index	EBV Fat kg2	Acc Fat kg2	% Fat kg2	EBV Protein kg2	Acc Protein kg2	% Protein kg2	EBV Milk Yield kg2	Acc Milk Yield kg2	% Milk Yield kg2
Pennycress	159	96	4.97	63	95	5.23	63	97	107.71	64	96
Apache Plume	131	93	3.63	66	90	2.66	66	85	71.37	66	90
Mayweed	129	92	4.19	57	93	4.01	57	93	81.35	57	92
Farewell to Spring	124	90	2.29	70	81	2.42	70	83	41.59	70	79
Ipomoea	122	89	0.95	68	66	0.78	68	63	24.52	70	69
Valerian	121	88	3.21	66	87	1.83	66	77	49.81	67	83
Pearl Bush	135	87	3.06	59	87	3.68	59	91	61.17	59	87
Yucca	117	86	-0.03	39	51	-0.01	39	49	-5.13	40	43
Cinquefoil	115	84	2.78	67	85	1.77	67	77	38.5	70	77
Posey	114	84	2.27	63	81	1.14	63	69	29.59	65	72
Mariposa Lily	114	84	1.38	71	71	0.43	71	57	26.43	73	70
Blue Daze	113	83	2.02	69	78	1.39	69	72	34.65	70	75
Meadow Rue	111	80	0.65	73	62	0.1	73	51	22.33	74	67
Luneria	110	79	-0.32	67	46	0.5	67	59	24.87	68	69
Starfish Flower	109	77	0.87	68	65	0.16	68	52	7.44	68	55
Queen Anne's Lace	108	76	-0.02	61	51	-0.26	61	43	-13.26	64	31
Tea Tree	106	74	1.31	33	70	1.43	33	73	32.82	33	74
Speedwell	106	74	1.31	68	70	1.38	68	72	37.67	68	77
Golden Star	105	72	1.5	35	73	0.26	35	54	19.75	37	65
Portulaca	104	71	2.17	71	80	1.42	71	72	34.76	71	75
Tulip	103	69	1.48	16	73	0.88	16	65	13.15	16	60

PROD Index (milk production)

- For dairy producers who do not do milk component analysis
- Aim to increase the milk production

The index integrates two traits. The EBV milk yield for the first parity weighs for 1/3 while the EBV milk yield for later parity represents 2/3.

COMP Index (milk components)

- For dairy producers who do milk component analysis
- Aim to increase fat and proteins

This index integrates four traits. The fat and the protein weigh both half of the index. For each component, EBV for the first parity weighs for 1/6 of the index while EBV for later parity represents 1/3.

So the % COMP index would be the ranking of the animal in the database out of 100, with 100 being the top, correct? *Yes, percentile ranks the animal within its breed group from 0 to 100%. 0 is the bottom of the group and 100% is the top.*

What does the number under COMP Index mean though? *It is the value of the index. The index is a combination of EBVs (see graph above) and has no unit (as many traits are combined together). The index value is then used to rank animals against each other using the percentile value. You can see it as the final note of the animal (or a global note) according to trait of interest your are looking for. Animals with higher index value have also higher genetic merit.*

For the components: EBV fat is the added kg of fat from that ewe over the average; Acc Fat would be the accuracy of the EBV, % Fat would be the ranking out of 100. Correct? *Yes*

EBVs indicate the genetic merit of an animal (how many kg of fat it will produce more than a animal having an EBV of 0 (EBV of 0 represents the average of the dairy population). It is not always directly linked with the real production because the environmental effects in your barn may improve (if you have good environment) or decrease (if you have poor environment) the performance of the

animal. It is an indication of the genetic merit : how much more it can do in a genetic point of view.

PERFORMANCE = GENETIC (EBVs) + ENVIRONMENTAL EFFECTS

In other words, genetic values will help you ranking animals within your farm as it measures the difference of production within the same environment. They can also be compared with other flocks if you have genetic links (buy/sold rams/ewes from/to other flocks) and have similar environment. An animal with high EBVs in a farm may have low performance in another farm if the managements are quite different. I don't have specific example for dairy producers, but an animal with very nice growth fed with concentrate may have poor performance if the new owner is doing pasture as he was selected for growth in concentrate and not to valorise forage.

kg2 vs kg1 -- is that parity 2 and parity 1?

Yes, kg2 refer to parity 2 (all subsequent lactation) and parity 1 refers to the first lactation. Parity 1 is the first lactation recorded in GenOvis. Ewes are compared by group of age as the first lactation recorded in GenOvis can be the 4^{th} lactation for the ewe. All subsequent lactations will be considered as parity 2.

A distinction is made from parity 1 and parity 2 (or subsequent parities) as they have significant differences in performance between the first lactation and the later lactations. In index, more emphasis is put on parity 2 traits.