Ideal Alpaca Community

OPPORTUNITIES AND CHALLENGES IN THE GENETIC EVALUATION OF FIBER CHARACTERISTICS IN U.S. ALPACA

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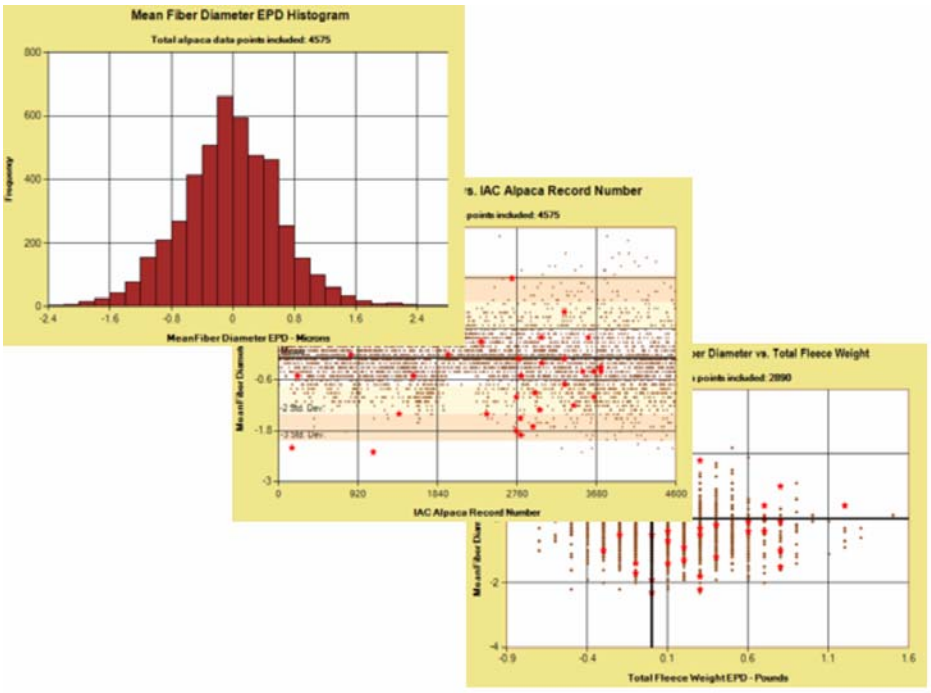
Introduction

The advent of Alpaca EPDs in the U.S. provides exciting opportunities to enhance rates of genetic improvement in fleece and fiber characteristics. The release of the first U.S. Huacaya alpaca EPDs for fleece weight and fiber diameter by the Ideal Alpaca Community in 2008 and the subsequent release of additional EPDs for fleece uniformity, staple length, percent medullated fibers, and curvature in 2009 provided an initial genetic characterization of over 5,000 Huacaya alpaca. Results include EPDs for a wide range of animals, including imported foundation animals, heavily used "Studmaster" sires, breeding females, and young stock. Extension of these evaluations to Suri alpaca is planned for late 2009.



Expected Progeny Differences measurements are becoming more accurate and accessible.

Principles of EPD-based Genetic Evaluations

EPD-based genetic evaluations of economically important measures of animal performance are the global standard for all important domestic animal species. EPD-based systems provide a mechanism to summarize large amounts of data on many animals in a way that provides unbiased predictions of future progeny performance. The principles of all EPD-based systems are relatively simple:

1. EPD systems utilize objective measures of animal performance, such as fleece weight and fiber diameter;

2. EPD systems recognize that genetic merit, or breeding value, can only be definitively assessed by measuring and summarizing the performance of an animal's offspring. The best example of this is in the dairy cattle industry where individual bulls, used in artificial insemination, can have literally thousands of offspring on several continents. The genetic merit of these bulls, derived from the milk production of those numerous daughters, is thus predicted with near-perfect accuracy and can be used to develop specific and individualized breeding objectives for individual breeders. While we will not generally have more than a few tens of offspring for alpaca males, we can compensate for this by the high heritabilities of fleece and fiber traits compared to milk production (see below);

3. EPD systems correct the reported measures for obvious non-genetic influences such as the age and sex of the animal, the age at shearing (for yearlings), and the interval between shearings (for adults) using widely accepted adjustment procedures;

4. EPD systems also correct for differences in the production environment by first normalizing records to the average of the "contemporary group" or "cohort". Thus in years when feed is plentiful and fiber diameters are perhaps increased as a result, animal records are first deviated from the mean of that year before they enter the EPDs system. The same holds for records from years when grass is short and fiber diameters are perhaps lower as a result. The actual records that enter the EPD system are thus not measurements per se, but measurements deviated from the contemporary group or cohort average. The underlying assumption is that animals with fine fleeces compared to their herdmates in good years will also be the animals with fine fleeces compared to their herd-mates in poorer years. Extensive studies with other species confirm that in most cases this is an acceptable assumption. (Note: the definition of the "cohort", though not very sexy, is a critical part of a successful EPD system, and merits additional attention in future articles.)

5. EPD systems account for the different heritabilities of the individual traits to recognize difference in the predictive value of different measurements. Thus fiber diameter has a relatively high heritability (approximately 50%), and a single measure of fiber diameter for an individual is a reasonably good predictor of genetic merit. In contrast, fleece weight has a somewhat lower heritability (approximately 40%) and a single fleece weight is a correspondingly

a somewhat poorer indicator of genetic merit. Finally, reproductive and fitness traits have very low heritabilities (generally 10% or less) and the outcome of a single mating (pregnant versus not) is a very poor (thought not worthless!) predictor of the genetic merit of the females for fertility and reproductive competence (which is why these traits are not currently a part of the alpaca EPD program). For comparison, the heritability of milk production in dairy cattle is only about 20%, yet with large numbers of progeny, dairy bulls can achieve highly accurate predictions of breeding values;

6. EPD systems utilize the principle that a measurement taken on an individual provides information about the genetic merit of all that animals records. Thus if I find that an individual yearling alpaca has a very fine fleece, I can infer not only that that individual is somewhat superior to the average of the population in genetic merit, but also that his relatives (who share some of the same genes) deserve some credit as potentially genetically superior. The beauty of the EPD-based systems is that they combine measurements from *ALL* relatives to provide a single estimate of genetic merit. Each individual measurements is weighted by the extent of the genetic relationship to the animal in question, so that individual and progeny performance are most influential, and records of distant relatives (for example, a grandparent) receive progressively less weight in deriving the EPDs. Thus the EPD system is relatively simple in that it utilizes all available records on related animals and weights each of those records appropriately based on the closeness of the genetic relationship;

7. EPD systems are continually updated and become progressively more accurate as new information is recorded. Thus, a newborn cria gets an EPD based on fleece records from his parents, previously recorded full- and half-siblings, cousins, etc. When the cria's first fleece is evaluated, that information is added to the system (along with additional new fleece records from other relatives) and the EPD is updated with the new information. Future fleece samples result in additional adjustments to, and greater accuracy of, the EPD. If the cria produces progeny, the EPDs are modified again as those records enter the system. If the cria becomes a sire, large numbers of progeny records are expected to result in a highly accuracy and increasingly stable EPDs. So, *EPDs DO CHANGE* as more information accumulates (just as our subjective, visual assessment of an animal evolves as the animal matures). Changes in EPDs are sometimes frustrating and sometimes gratifying. In either case, they provide increasingly more accurate assessments of genetic merit.

In summary, EPDs are predictions derived from available objective data on animals and their relatives. They are contingent on the data available in the system and on the specific animals reporting data. They will change as more information becomes available, becoming increasingly accurate and stable.

Challenges in the Development of EPD-based Systems of Genetic Evaluation

The primary challenges in developing successful EPD-based systems of genetic evaluation are operational rather than theoretical. The methods of deriving EPDs from fleece and fiber records are

relatively straightforward and generally quite uniform among different countries or genetic evaluation centers.

Attention in program development thus must center on the critical issue of data acquisition and management in order to capture large volumes of accurate information. The U.S. alpaca industry is fortunate in that the histograms and other measures of fleece quality that are regularly obtained on both young stock and adult breeding animals. These measurements are derived at a small number of highly respected laboratories using established and carefully validated methods. The resulting large volumes of data are literally a treasure-trove of genetic information.

A number of more mundane issues require attention. For example, methods of reporting fleece weight need to be standardized (whole fleece vs. blanket), contemporary or cohort groups must be clearly defined, adjustment factors for things like animal age and sex must be derived for each measurement, heritabilities and genetic correlations must be estimated, etc. These will have more to do with the success of the program than the specific software used to derive the EPDs. Simple and straightforward methods for submitting data (for example, directly from the fiber laboratories to the EPD system) will encourage participation. Careful data checking and data management protocols are essential.

Multiple EPD Systems

A particular concern surrounds the potential to have multiple EPD programs in the U.S. alpaca industry. I hope you now understand EPDs are reflections of the data reported into the system. If two or more systems coexist, utilizing data from different animals, the result will be that widely used sires with progeny and other relatives in all the systems will get *DIFFERENT* EPDs in each system. None of them will be “right” or “wrong”. They will simply be different because they are based on different records from different animals. How “different” will they be? That depends on the amount of data available for each animal in each system. For young animals, or breeding animals with few progeny, they may be quite different. For progeny-tested sires, they should become consistent, but if some sires are highly represented in one system but poorly represented in another, consistency of EPDs can be quite poor.

We have seen this situation emerge in other species. In the 1980’s, breeders of Hereford cattle in Canada had the choice to participate in a Canadian national government program, an Ontario-based program, or the U.S. Hereford breed program. Different breeders made different choices, and as a result, widely used sires often had three different EPDs circulating in the industry. Again, none was “right” or “wrong”; each was just based on different data. Human nature being what it is, owners of those bulls chose to merchandize them based on their “best” EPDs, even as other owners were promoting their own animals based on EPDs from a different system. The result was chaotic and the systems have now thankfully merged into a single system. A single system now not only produces consistent EPDs but also produces maximally accurate EPDs because the system has access to all available records.

Today, alpaca EPDs for U.S. animals are available only through the IAC. However, an ARI program is under development. The relationship that emerges between these two programs is critical to the future

of genetic evaluation in U.S. alpaca. I have enjoyed providing genetic evaluation services to the IAC. I sense these initial alpaca EPDs are having a strong impact on the industry. However, my purpose here is not to attempt to compare, or otherwise promote, one program over another. I do believe, however, that it is critically important that the U.S. have *ONE* alpaca EPD program. *ALL* data needs to flow into one system in order to maximize the accuracy of the resulting EPDs and, more importantly, to avoid production of apparently (though not truly) inconsistent EPDs across the systems. *Thus, I encourage all interested alpaca breeders to come together to develop a single comprehensive U.S. system for alpaca genetic evaluation.*

It is also particularly important that we focus on the positive aspects of EPDs and not become paralyzed or overly negative about potential limitations of the system. We can raise concerns over many of the details of any genetic evaluation system. For example:

1. Are differences among animals in fiber diameter in high-feed versus low-feed years, or in the west versus the east, really consistent?

2. Is "micron blowout" (the tendency for some animals to increase fiber diameter as they age while others do not) a heritable trait, and can we select against it?

3. What is the relationship of body size to fleece characteristics in alpaca? Should we calculate body weight EPDs? If we do, how should we use them?

4. Do dark-colored animals necessarily have coarser fleeces than their lighter-colored relatives? Are there any limitations to developing colored animals with extremely fine fleeces? How do we consider fleece color in genetic evaluation?

We don't have much (if any!) data on these questions for alpaca. But, I would argue from results in other species that these concerns are unlikely to invalidate the value of EPD as tools for genetic improvement. Perhaps most importantly, the establishment of an EPD system is probably the best possible strategy for developing answers to these questions.

The Past and Future

Over the past 10 years, I have been actively involved in the development of EPD systems for the U.S. sheep industry. In that role, I have strongly promoted the concept that development of a successful EPD system is an ongoing collaboration among breeders, breed associations, educators, and others. We do not know, today, everything that we need to know about the genetic evaluation of alpacas. However, answers to many of our questions will emerge from the data that we collect and accumulate in useful and readily accessible data sets. Experience with other species has shown that EPDs are a powerful positive force for genetic improvement. But equally important has been the potential of the EPD datasets to provide information for development of new and better EPDs, and to allow for updating of protocols based on that new information. We cannot answer all the questions we might have because we do not have the data required in a readily accessible form. However, we are building such a data set.

In summary, *the future for genetic evaluation of alpaca in the U.S. is incredibly bright.* The traits of interest are highly heritable, so accuracies of evaluation will be high. Because of the relatively recent introductions of foundation animals from South America, genetic relationships exist among animal across many herds, making separation of true genetic differences from contemporary or cohort effects relatively easy. Sires are, in many cases, used widely across herds, also enhancing genetic relationships among the herds and allowing the evaluation of progeny in many production environments. Data is, in most cases, coming from highly reputable laboratories and can be imported directly into the EPD databases. These characteristics all contribute positively to the development of an EPD system for alpaca in the U.S.