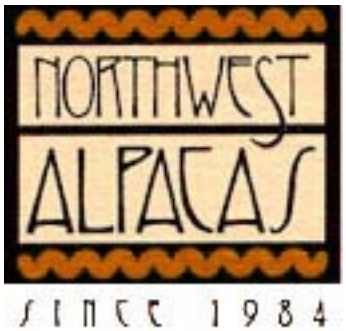

Alpaca Breeding for Genetic Gain

By Mike Safley

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Mother Nature was surveying the long Andean backbone of South America. She watched the Vicuna in Peru run like the wind and the Guanacos of Patagonia roam the fertile plain. Everything was beautiful. Her plan was working. But , as she looked up the coast to North America, trouble was on the horizon. The first men were making their way down the continent. Soon they would discover the wild camelids.

Mother nature hatched a plan. She encoded the Vicuna with a blueprint for the Alpaca. She could see a time when certain Vicuna would evolve and become known as Alpaca. The genius of her vision was Alpacas, with fleece as soft as an angel's wings. No one would kill these docile, productive creatures. The wild vicuna would not be necessary for their pelts and could live in peace. As an extra measure of insurance, Mother nature added a few chromosomes for density and fineness for the Alpacas' new owners to uncover.

The Incas unlocked nature's Alpaca plan and prospered mightily. Alpacas with fine dense fleece were grown in abundance, supporting their entire kingdom. Then came the Spanish. These were men that Mother nature apparently didn't contemplate. They wreaked havoc. Alpaca breeding became disorganized and the animals' fleece became hairy as a result of crossbreeding with Llamas.

But Mother natures genius is still locked inside the Alpacas. Every once in awhile a cria is born with fleece finer than angel's hair. We, as an industry, can again solve natures puzzle. We need to get organized. We need a plan.

The traditional livestock industry employs a number of breeding systems which can be successfully employed in raising Alpacas. The systems discussed below provide an organized approach for Alpaca breeding that can be useful to large and small breeders. It is also important to understand how genetics, heritage, and the environment can influence the quality of our bloodstock. Understanding which genetic traits are present in the Alpaca you are considering for purchase and what selection criteria to employ for individual animals can be valuable to both beginning and experienced breeders.

The business plan at Northwest Alpacas is based on breeding Alpacas which produce low micron fiber in high volumes. This strategy should enable us to compete effectively at several levels: 1) The textile market, which pays a significant premium for fine fiber; 2) With sheeps wool, the bulk of which is coarse; 3) The South American Alpaca fiber producers, who select their breeding stock and sell their fiber based on volume, not fineness; and, 4) With other ranches selling bloodstock that produces Alpacas having coarse hair and lower fleece weights. We are also looking to produce a uniform, "typey" Alpaca which does well in the show ring. Alpaca fiber is known as a specialty fiber. In fact every fiber, other than sheeps wool, is known as a specialty fiber. Wool is grown world wide in huge quantities -- 432,000 tons in 1994 alone (source: Wool International). Specialty fiber production totals only 142,000 tons per year. Of this, only 4,000 tons are Alpaca. Scarcity or rarity is one of Alpacas' major competitive advantages.

R.C. Couchman, a well known Australian fiber expert, authored an extensive series of articles for Llama Life about Alpaca fiber. He made the following point many times over -- "Fineness is what specialty fiber is all about." Alpacas shouldn't compete with sheep, which produce large volumes of coarse fiber, when they have an excellent potential to produce fine, soft fiber and receive a significant price premium upon sale. Fiber density on the animal or the weight of a shorn fleece is an important component of an Alpaca's value. Every Alpaca costs about the same to maintain. An animal which produces twice the fleece in a given period will be twice as valuable, all other things being equal.

BREEDING SYSTEMS

Ranchers who breed a wide variety of domestic livestock employ a large number of breeding systems to improve their stock. I have summarized these different systems below:

Random Mating: This is the simplest mating system; it means that any male in a mating group has an equal chance to mate with any female in the same group. In the simplest form of random mating, also called "syndicate mating," a group of males is put with a group of females; the male parentage of offspring is then unknown.

Like to Like - Genetic Inbreeding: Animals related by ancestry are mated, such as father-daughter, half-sibs, etc. Inbreeding is used in an attempt to capitalize on an individual animal's superiority and to develop inbred lines for later crossing, to exploit heterosis (hybrid vigor).

Genetic Outbreeding: This involves the deliberate mating of unrelated animals. It might be used to avoid or correct the deleterious effects of inbreeding, or in the crossing of populations to introduce genes (migration) or to exploit hybrid vigor. Like to Like Mating Assortative - Phenotypic: This involves mating animals with similar characteristics; if sires and dams have been selected on high fleece weight, for example, there might be further subdivision so as to mate sires with the heaviest weights to dams with the heaviest weights, and so on down the line.

Unlike Mating - Disassortative - Phenotypic: Here animals with dissimilar characteristics are mated; in practice, it is sometimes called "corrective" mating. For example, dams with coarse fiber might be mated to sires with low micron counts, to obtain cria with finer fiber. This, of course, assumes that the effects of the genes are strictly additive.

The American Alpaca gene pool is small by any standard, this makes inbreeding an inefficient method of improving herd quality. Line crossing is also difficult because there are few, if any, established bloodlines. Random mating is likely to have little qualitative gain, especially since rigorous culling is not practiced due to the small general herd size. Unlike mating is most effective when trying to eliminate undesirable traits within a population. Genetic Outbreeding is the norm on American and Australian Alpaca ranches.

Northwest Alpacas has organized their breeding program around the concept of like to like phenotypic mating with the added benefit of using line bred males. We have increased the likelihood of superior offspring by selecting females from diverse herds in Peru that have exercised selection pressure and culling techniques for many, many generations. The Northwest Alpacas breeding flock is 80% Peruvian and 20% Chilean. The females originate from Accoyo, Rural Allianza at Macusani, Numoa, and Huarapina. We have also collected choice females from Cohcatanqa and Sollocota in the Puno district of Peru. The stud males are primarily from the Accoyo plantel herd, with one from Rural Allianza.

We have chosen all our breeding males based on our view of Alpaca perfection. They have low micron counts and high fleece weights. Hemingway, our Rural Allianza male, is from their plantel herd located in Macusani. This herd is known all over Peru for its fine fleece. Don Julio Barreda's Accoyo males have been line bred in families for many generations and are consistently beautiful. It is by no mistake that Don Julio is called the world's finest Alpaca breeder. His males are proven and renown throughout Peru for their pre-potent genes.

The NWA breeding system allows the Accoyo males to add significant hybrid vigor to the unrelated, but phenotypically similar, females. We will use our Allianza male, Hemingway, to genetically outcross the Accoyo bloodline. Eventually, we will have developed our own distinct bloodline. Every livestock producer aims to improve the quality of their stock.

Historically, breeders chose animals phenotypically, or in other words, based on their physical appearance. More recently, genetic selection theory has been developed that allows breeders to make more informed decisions, which accelerates the improvement of their stock. Genetic theory is founded in math -- formulas, probability, and prediction. Bloodstock pedigrees are very important.

American Alpaca breeders have an additional resource in the form of pedigrees from the Alpaca Registry. The Registry registers Alpacas only after their bloodlines have been scientifically verified by the U.C. Davis Serology Laboratory. These pedigrees can be used to eliminate uncertainty when making breeding and selection decisions.

GENETIC GAIN

Genetic gain is defined as the increase in average levels of herd production from one year to the next due to the selection of superior animals for breeding. For Alpaca breeders, production is influenced by a number of economically important characters. In addition to type or appearance, these include fleece weight, fiber diameter, uniformity, and the absence of high micron guard hair.

In estimating genetic gain for one or all of these characters it is assumed that nutritional and management conditions remain constant. The rate of genetic gain in any production character is governed by three factors:

Heritability - the degree to which each characteristic may be inherited

Selection Differential - the superiority of selected breeding animals for each characteristic

Generation Interval - the average age of breeding animals

HERITABILITY

The problem with selecting breeding stock solely on the basis of phenotype is the effect that the environment plays in the visual aspects of a given animal. An Alpaca in Chile may have 20 micron fleece, but is it the result of genotype or nutrition? Imported Alpacas often produce much higher micron fleece after a few months on American soil and high protein diets. The environmental variable must be isolated before a breeder can be sure that the trait they are selecting for is heritable.

Once the environmental effects are accounted for, heritability must be established. Alpacas have had few breeding trials or genetic studies completed to determine the heritability of such genetic traits as fleece weight, fineness, crimp, staple length, or uniformity. Almost all other fiber bearing animals have established extensive heritability profiles. Cashmere and mohair goats, together with all breeds of sheep demonstrate high heritability indexes for such traits as fiber fineness, fleece weight, staple length, and clean fleece yield. Alpaca fleece characteristics should also be highly heritable or, as Couchman put it, “The heritability of total fleece production in almost all domestic fleece growing animals is around 0.3 or 30%. I would, therefore, expect to see similarities in Alpacas and Llamas.”

Thirty percent heritability is considered high and means that breeders selecting for specific fleece qualities can expect excellent gain. The amount of gain is greater when selecting for one characteristic. In other words, selecting just for fleece weight, for instance, will show more progress than attempting to also lower fiber fineness at the same time. In fact, some traits are non-complimentary and selecting for fineness may inhibit a breeders ability to also select for fleece weight.

SELECTION DIFFERENTIAL

Consider the following example where you are selecting to increase fleece weight. Within a selection of potential Alpaca herdsires from the same herd that have received same nutritional and management conditions, you might find a normal distribution of variation in fleece.

If you wanted to select the heaviest 5 percent of fleece cutters for replacement sires, the average fleece weight of these selected herdsires would be about 25 percent heavier than the average for the whole herd. This superiority above the average is called selection differential. The higher the selection differential, the higher the gain on average.

GENERATION INTERVAL

Generation interval is simply the average age of dams and sires in the breeding herd. For example, if females first produce a cria at two years and are bred a total of five times, then the average age of dams in the herd at any one time will be:

$$\frac{2 + 3 + 4 + 5 + 6}{5} = 4 \text{ years}$$

A breeder can make a similar calculation for males. The two intervals are then averaged to determine the generational interval for a given herd. The longer the generation interval (that is, the longer dams and sires are kept), the smaller the genetic gain in production from one year to the next. This is because the breeding population will contain proportionally fewer of the younger, more improved breeders.

There is no doubt that breeders can benefit by studying genetics. The bottom line is that careful breeding will produce superior results. For genetic gains to be fully understood and used to achieve further progress, the breeder needs to measure his success in objective fashion. Fleece histograms, the recording of fleece weights, measuring staple length, and tracking animal body weights are all important measures of a successful program.

COLOR

Color is another very important element of fleece and animal value. Peruvian breeders select almost exclusively for white, Chilean animals are not as highly selected, but come in many colors. Color is one way American breeders can compete in the fleece market. There is often a market premium paid for natural colors in short supply and high fashion demand.

At Northwest Alpacas, our goal is to breed primarily for four colors: black, white, light fawn, and dark fawn. We are aiming to produce uniform color over the entire animal. We are not breeding for pintos, grays, roans, or fancy Alpacas. This goal is not meant to demean other colors, but is our method of reducing color variables in our breeding program. Alpacas which have been selected for color over time by mating white to white, fawn to fawn, will have a higher likelihood of throwing true to color cria.

MEASURING SUCCESS

At Northwest Alpacas, we have achieved a uniform group of Alpacas free of leg faults and bad bites. All of our Alpacas are conformationally correct and exhibit strong Alpaca type. In past years, when the conformation of the domestic herd was generally defective, we worked very hard to eliminate flaws in conformation. Today, our primary focus is fleece quality.

Fleece production can be objectively measured. Fleece testing is becoming wide spread, where only a few years ago no one fleece tested their Alpacas. Fleece histograms are used to illustrate four major elements of fleece quality.

Micron Count - The average diameter of 66% of a sample, which includes 2,000 measured fibers, is reported as micron count. In Alpacas, average micron count can range from 15 to 45 microns. For an adult Alpaca, 25 microns or less is desirable. (Source: The Average Micron of Grade Superfine, Bolivian and Peruvian Alpaca Manufacturers.)

Standard Deviation (SD), the first measure of uniformity, is calculated by determining the range of fiber diameters making up the average. A fleece sample with an average micron count of 20 and a SD of 5 microns would be composed of fibers varying by 10 microns. In other words, half the sample would average 5 microns below 20 and half would average 5 microns above 20. Acceptable standard deviations are dependent on the micron count of the fleece being tested. For instance, fleece with a micron count of 17 should have a maximum SD of 4.25, while 25 micron fleece should have a maximum SD of 6.25. (Source: Cameron Holt, Melbourne Institute of Textiles)

Coefficient of Variation (CV) is the second measure of uniformity and is expressed as a percentage. The above example of a 20 micron average and a SD of 5 would have a CV of 25% (SD divided by micron count equals CV). CV allows for the comparison of uniformity among animals with differing micron counts. A CV of 25% or less is desirable. (Source: Cameron Holt, Melbourne Institute of Textiles) Percent of Fleece Over 30 Microns - This expresses the percentage of coarse fleece in the sample. Five percent or less is desirable. (Source: Angus McColl, Yokum-McColl Testing Laboratories)

You may want to consider using the following formula when evaluating animals from your herd for fleece quality and production value. The lower the micron count and the higher the fleece weight, the higher the relative score and the better the animal. The formula's primary value is for comparing one animal to another on a relative base.

Fleece Weight

----------= Individual Alpaca Rating Factor

MC-(CV-25:5)

Fleece weight or density is maybe the most important quality contributing to the value of an individual animal's fleece production. Rural Allianza in Peru culls their females if they do not produce 5.5 pounds of fleece annually. Don Jullio Barreda looks for 8 pounds on females and over 10 pounds on males.

I accounted for uniformity in this equation by using Cameron Holt's formula for "spinability" as expressed on the histograms produced by the Melbourne Institute of Textiles. A more uniform fleece is said to have better "spinability." A fleece with a coefficient of variation that is 5% less than a fleece of comparable micron count will spin a yarn that performs and feels as if the fleece was one micron finer.

ALPACA TYPE

Alpaca type is a more subjective measure of value, but holds great importance in the show ring and has significant influence on buyer preference. At Northwest Alpacas, where we specialize in Huacayas, we pay particular attention to the shape of an Alpaca's head, the strength of its wool cap, and the fiber coverage on its face. All of these features are indicative of the animal's breeding and fiber coverage over the body. I also look for an animal which will fit into a square, not too long in the body nor too tall. All of this contributes to a pleasing look for the animal.

Don Julio Barreda designed his Accoyo ranch logo based on his vision of the ideal Huacaya Alpaca. It is very hard to argue with the components of type illustrated by Don Julio. Perfect harmony.

Each breeder needs to make their own decision about the goals for their breeding program. Most livestock industries award quality. The best animals bring extraordinary prices. Quality and constant improvement are the best hedge in ensuring a prosperous future.