

Grasping the Nettle

- Grading Up: Should We or Shouldn't We?



The Louise line in the Berkshires was graded-up in the 1990s using Large White genes.

Photo by Simon Tupper

Part I The Case For Grading-up:

By **D. Phillip Sponenberg, DVM, Ph.D.**

As members of the RBST and conservationists, we have in our care the genetic heritage of the breeds designated as 'rare'. One of the tools used to help conserve many livestock breeds has been grading-up, i.e. introducing genes from another breed to try and ensure that some aspect is improved. However, a number of authorities condemn this means of breed improvement - why?

Our American sister organisation, ALBC, carried an article earlier this year in their newsletter by D Phillip Sponenberg in favour of the practice and we reproduce this here. In the next edition, to counter the argument, Dr Ian Gill, will present a piece representing the Trust's view explaining why this is really only the tool of last resort. There will also be an article by Richard Lutwyche from the marketing perspective explaining why there is no longer any need for grading up. So, please read both and draw your own conclusions. Your reactions in the pages of Forum will be welcome.

Grading Up Can Breed Results

Grading up has a lot of positives, a few negatives, and several facets that make it an interesting biological phenomenon. As a backdrop to this issue, it is important to reflect on the character and utility of breeds. Certain combinations of genes are repeated throughout a breed, and it is this consistent genetic makeup that makes a breed reasonably predictable. Predictability is key to a breed's value, for without predictability it is impossible to match a breed to place, purpose, and system. Therefore, anything that conserves the aspect of breeds as consistent genetic packages is beneficial, and, likewise, anything that detracts from it is detrimental to the breed's survival.

Often, grading up is seen as a threat to purebred stock, but in fact, it can ensure breed survivability over long centuries of purebred breeding. Understanding what grading up is and how it affects a breed genetically are extremely important issues for breeders of all purebred animals.

Grading up is the sequential use of pure-bred animals with grade animals over a series of generations to provide a "nearly purebred" result. The usual sequence is that a purebred sire is used on females that are either crossbred or of another breed. The resulting offspring are 1/2 the pure breed of the sire. The daughters are then mated back to another purebred sire, providing offspring that are 3/4 pure. The next generation provides offspring that are 7/8, the next 15/16, then 31/32, 63/64, 127/128, and so forth.

Grading up has been widely used in a number of livestock species, especially with recently imported breeds. It allows for rapid numerical expansion of the breed, and also provides a demand for purebred males for crossbreeding.

Traditionally, grading up involves the use of purebred sires on grade dams, but it is also biologically valid to use purebred dams for this process. In light of current knowledge of the unique genetic contributions of females

(mitochondria, for example), it may be best to insist on the use of both purebred males and females in at least some of the generations, in order to assure that sex-specific genetic material, such as Y chromosomes and mitochondria, have come from the purebred pool.

Both Sire & Dam Provide Genetic Material

In other words, both the sire and dam have the potential for providing genetic material that is not in the original pure breed. How much, and what this means as a practical issue, is important. Grade animals usually closely resemble the purebred at levels of 3/4 to 7/8 purebred influence. At these levels, however, they still include a good deal of genetic material that is not from the breed in question. (Realize that in all of this we are talking averages. Individual animals could be found that are either a lot more or a lot less "pure" or "pure looking".) This means that selection for breed type is especially important in grading up programmes - although, even though such selection is important in any pure breeding population, it is frequently overlooked.

At higher levels of grade, which for my thinking certainly includes 31/32 or anything higher, the influence of outside genetic material is minimal. At this level, the animals are performing and breeding like most purebreds. These upgraded animals may have a slight advantage in overall vigour, and offer breeds enough fresh genetics to be a great boon to some of the very rare breeds. At the same time, these upgrades pose a minimal threat that any of the genetic uniqueness of the breed will be lost. This hearkens back to the principle that breeds are valuable because they are consistent and predictable. Any breeding practice that does not threaten the consistency and predictability of a breed does not threaten its status as a breed either, and that certainly includes grading up.

The careful reader has noticed that the preceding discussion designates

the 7/8 grades as generally not sufficiently purebred, while the 31/32 grades are. This leaves in question the 15/16 animals, which are about 94 percent purebred. Breed associations will differ on whether these animals are sufficiently purebred or not, and the answer to this question has some legitimate leeway as different breeds are discussed. These 15/16 animals are generally "purebred enough" to be considered breed members, but in some breeds with reasonable levels of genetic diversity it may be wise to proceed to higher levels of grade before considering the graded animals purebred. It is important to remember, though, that if a very high level of grade is required (63/64 for example) the potential genetic benefits of grading up will be largely lost to the breed. Unfortunately, there is not a magic grade-up number we can designate to ensure breed conservation or breed vitality.

Breed Purity is Assumed to be Absolute, Inviolable, and Ancient

Breed purity, and grading up, have taken on some political overtones in many breeder circles. Breed purity is assumed by many to be absolute, inviolable, and ancient. The truth is, the origins of most breeds are fairly recent. Breed formation was simply a response to a need for predictable animals of a given type. Most origins were fairly broad, so that genetic viability was assured. As herd and flock books were closed and matings were only within the narrowly defined breed, the genetic character of breeds changed from somewhat open to absolutely closed. Some breeds are now suffering varying degrees of inbreeding depression from restrictive matings only within the purebred population.

Dairy goat breeding may illustrate some of these issues. Most dairy goat breeds include a purebred section, in which all matings are between members of the registered breed. Grading up is also allowed and results are documented in a section of the registry called "American". For example, a Nubian is a purebred Nubian; an American Nubian is a grade animal. Breed politics are such that grade goats do not meet with the market success of the purebreds. Many American goats, however, outperform their purebred counterparts, so those commercial producers may actually prefer the American counterpart to the purebred. In this situation, the safeguarding of the breed resource as a closed genetic pool has decreased its utility as a viable commercial entity - which is counter to the original aims of breed development!

While pure breeding and purebreds are important, the issue of grading up does need to be evaluated as to whether it has a place in breed maintenance, management, and conservation. If carefully managed and operated, grading up does not threaten the status of any breed as a genetic resource. This is at variance with the politics of many breeds, and so

grading up is likely to remain rare. With many international breeds, it is also important to fit policies and procedures into those accepted in other countries, and generally, the most restrictive country is going to call the shots on this issue. Eventually, all breeds are going to need to address the issue of grading up versus absolute breed closure. The downside of completely closed populations is slowly being played out in breeds such as the Thoroughbred horse and in many dog breeds. This will give many people cause to evaluate what a breed is, why it is valuable, and how best to manage its genetic status.

Any grading up programme must be carefully monitored to assure that appropriate levels of grade are achieved before inclusion into the purebred breed. At the same time it is important to recognize the value of grades to the viability and production of the breed. For a breed to fully reap the benefits of grading up, (numerical expansion, increased market for breeding males, some gain in genetic vigour), the grade animals must be considered as full members of the breed, not second-class citizens. That is where breed politics come into the picture, and breed politics frequently do not have an answer in biology.

In the past, I considered that grading up had a legitimate and important role in some breeds, (notably landraces or recently developed breeds), but had little, if any benefit to some older, long-established breeds. After pondering the issue for many years I have switched my thinking somewhat, and believe graded-up animals offer pure breeds a real opportunity for both vitality and viability.

Grading up allows breeds to avoid the problems of a tightly closed gene pool, and at the same time safeguards the genetic predictability of breeds. This is not one of the issues about which I generate huge amounts of passion since some breeds have little to gain from grading up, but none has much, if anything, to lose. At the same time it has been interesting to observe my changed thinking on the subject. These thoughts are shared only to stimulate thinking and discussion. The final determination of the appropriateness of grading up for any breed is going to be determined by tricky issues such as breed politics and reciprocity between national herd books, which is an absolutely essential issue for international breeds. Grading up does, however, make good genetic sense for nearly every breed, and graded up animals should be included as full members of the breed.

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Remember - this is one man's view and a counter argument by Dr Ian Gill will appear in the next edition.

Champion Beef Shorthorn, Huntsham Jupiter at the 1995 Show & Sale. Recorded as 87.5% pure with Maine Anjou genes having been introduced into much of the breed in a grading-up programme.

