



GENE CHECK, INC.

SCRAPIE AND CODON 171

Part 2: The painless way to RR

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The main purpose of this article is to describe a pathway to make your flock scrapie resistant without losing any good genetics in the process. Assuming that you were convinced after (or before) reading Part 1 that it is a good idea to have a flock of RR sheep, you may want some suggestions on how to get there. We will begin with some comments/rules about selecting for "R" in sheep:

1. Determine the genotype of (test) all rams you intend to use or purchase. No matter what other testing you do, it is absolutely necessary to test rams. If you know the genotypes of the rams, you can make "worst case" predictions for the genotypes of the offspring (see Rule #2).

2. Do not cull good females based on codon 171 genotype. Because we are dealing with a trait ("R") that behaves in a dominant fashion, that is, only one copy of the gene is necessary to convey resistance to scrapie, any ewe can produce resistant offspring provided she is bred to a resistant ram. If a QQ animal is bred to and RR animal, all of the offspring will be QR and resistant.

To understand how all this works, it is important to remember that a sperm or an egg contains only one copy of each chromosome. This means an RR sheep will produce only R sperms or eggs, a QQ sheep will produce only Q sperms or eggs and a QR sheep will produce both Q and R sperms or eggs (in roughly equal numbers). How can you predict the genotypes of offspring? An easy way is to use a Punnett square. In these squares, the sperm and egg

genotypes of the sire and dam are shown outside the square on the top and left, respectively. Inside the box are the potential genotypes of the offspring. The inside genotypes are formed by combining the genotypes of the sperm and egg above and to the left of each individual inside box. A Punnett square of a RR x QQ mating will look like this:

		SIRE	
		R	R
DAM	Q	QR	QR
	Q	QR	QR

Note that every inside box is QR. 100% of the offspring of a RR x QQ cross will be QR.

Even if you only use a QR ram on QQ ewes, half the offspring will be resistant (QR). The Punnett square:

		SIRE	
		Q	R
DAM	Q	QQ	QR
	Q	QQ	QR

3. If you breed sheep in North American, you probably do not need to test at codon 136. Evolution was good to sheep breeders in that it appears that the "R" allele arose relatively recently and arose on a chromosome that was "A" at codon 136 ("A" is the good allele). Therefore, chromosomes that have an "R" at codon 171 will have an "A" at codon 136.

Why does it matter if you are a North American breeder? Again, those of us breeding sheep on this side of the Atlantic

are fortunate. Strain A scrapie, which is controlled by codon 136, has never been confirmed in North America. If you are in the UK or Europe, strain A scrapie is a problem and AV sheep are sensitive. (Only AA sheep are resistant.) Whereas a US breeder can basically ignore codon 136, particularly if the sheep are QR or RR at codon 171, UK breeders must be alert to the fact that their QR sheep may still be at risk and may want to test more extensively for codon 136 genotypes, particularly if their flock is exposed.

If there is an exception to the codon 136 rule, it is that anyone who is testing only rams may want to test QR rams at codon 136 to insure that no VV QQ offspring can be produced. The VV QQ genotype is so susceptible that it is probably a good idea to avoid it.

These are the only really important rules, everything else is a matter of individual preference and almost everything depends on individual circumstances. Everyone should begin by following Rule #1 and testing all rams that have been or will be used to sire replacements or that you intend to purchase. Let's consider two possible outcomes to testing your rams:

1. You are loaded with "R" (nothing but QR and RR rams). It is probably a good idea to begin testing all of your lambs to begin selecting for RR replacements. Remember, once you are breeding RR rams to RR ewes there is no reason to continue testing since such a cross can produce only one kind of offspring. The Punnett square:

		SIRE	
		R	R
DAM	R	RR	RR
	R	RR	RR

2. You have no "R" or almost no "R" in your rams. In this case you need to begin looking for a ram with some "R". There are several ways to go about this: (1) if you have any "R" at all in your current rams, you can consider concentrating on their offspring for future rams, (2) you can test your best

ewes and see if there is enough "R" in them to allow you to produce QR rams to use on the rest of the ewes or (3) you can begin looking for good QR or RR rams to purchase.

Buying some "R" may be simplest, but can also be expensive. Although there will be increasing numbers of RR rams available, today they are still in short supply and can be pricey. However, if you find an RR ram that you would love to use even if he weren't RR, he is probably worth the money and will certainly save you money in the long run by minimizing the amount of testing you will need to do. On the other hand, no one should sacrifice other good traits just to get an RR ram. In other words, if the ONLY reason you are considering using a ram is because he is RR, you probably shouldn't use him. Fortunately, there are a lot of good QR rams available. Even before anyone was testing, QR sheep made up about 40% of the black face sheep population in North America, so you should be able to find plenty of QR rams that complement your breeding program.

If you are: (a) starting with QR rams, (b) suspect that you have very little "R" in your ewes and (c) are relatively patient, it probably makes most sense to test only rams and a limited number of ewe lambs for at least a couple of years. You may want to test those good lambs that you might consider keeping or selling in order to avoid selling any "R" too early in the game.

In the second year of using QR rams you should begin making some RR sheep. If you breed the QR offspring of your first QR ram (at least half will be QR) to another QR ram, 1/4 of the offspring will be RR and only 1/4 will be QQ. The Punnett square:

		SIRE	
		Q	R
DAM	Q	QQ	QR
	R	QR	RR

One key message of this article is that you should be extremely careful to keep the positive traits you have worked to breed

into your sheep. It is not necessary to give up other important qualities just to get "R" into your sheep. Remember how hard it is to get good quality sheep (much harder than getting an "R" into a sheep!). If you sacrifice quality to get an RR, you may take longer to reach the goal of good RR sheep than if you kept the quality high and added the "R" more slowly. Patience may be a good idea.

There are circumstances where the advice to be patient may not be best. In particular, if your sheep have had scrapie or have been exposed to scrapie, it may be best to get "R" into your sheep in a hurry (and even consider culling QQ sheep). When you need resistance in a hurry, a good RR ram may be worth whatever you need to pay for him. If you can't get an RR ram, you may want to test most of your lambs to be certain you keep only resistance replacements. Under these circumstances, it is also important, both to you and to your customers, that you sell only resistant animals for breeding purposes.

It is very important to remember that, if one of your sheep ever dies with scrapie on someone else's farm, your flock will be considered a trace back or source flock. By far the safest approach for anyone selling sheep is the policy contained in the Michigan Scrapie Risk Reduction Program (possibly the best scrapie management program in the US - certainly the most producer friendly): sell no QQ sheep except for slaughter.

Building a scrapie-resistant flock is both desirable and possible without any loss of the good genetics currently in every sheep breed. Codon 171 genotype should not be used as a tool for culling but rather as a tool for selection. In a nutshell: keep your productive females - just be sure you breed them to produce resistant offspring. And to be really safe - only sell QR or RR sheep for breeding stock.