Breech Strike Genetics

This Project is a collaborative research effort of CSIRO Livestock Industries, Armidale, NSW and Department of Agriculture and Food WA funded by AWI

Issue 2 Armidale August 2008

Introduction

Jen Smith, Ray Honnery and Heather Brewer talking to the ABC Landline crew in May 2008

Welcome to Issue 2 of the newsletter based on the findings of AWI's Breeding For Breech Strike Resistance project that is run by CSIRO Livestock Industries at Armidale, NSW.

Since our first newsletter we have run a field day in December, selected some industry sires for use in the breeding program which was carried out by artificial insemination in April 2008, and conducted post-weaning breech trait scoring of both the breeding flock and the weaners themselves.

Importantly, we have managed well through a high challenge flystrike season which spanned October to March, a snapshot of the results of which is reported in this issue. For those who didn't make it to the field day, also reported in this issue are preliminary associations between breech strike indicators and wool production traits.

Jen Smith
Leader, Breeding For Breech Strike Resistance project, CSIRO Armidale

What age to assess breech traits?

One of our tasks in developing best-practice guidelines for breeding for breech strike resistance is to work out the most appropriate age to assess animals for the indicator traits such as breech and crutch cover, wrinkles and dags. Evidence so far indicates a couple of important points:

1. Variation in breech cover increases with age.
2. Assessments vary in wrinkle score (both body and breech) with wool growth and perhaps age.

The implications for these changes in variance lie in the rate of *response to selection* which is dependent upon (among other things), phenotypic variance – the more the better. So it is best to delay scoring breech cover for as long as practically possible (i.e. off shears as yearlings). And, score wrinkles at a time when wool length is short e.g. at lamb-marking, or off-shears as yearlings (but not at weaning or post-weaning unless you tip-shear weaners).

The first issue (No. 1) of this newsletter outlined the project background, objectives, design and breech strike incidence and results for the previous summer (2006-07). If you didn't receive a copy and would like one, please contact Tim Dyall using the details on Page 5.

Inside This Issue

Australian Wool Innovation Limited

CSIRO Livestock Industries

Department of Agriculture and Food Government of Western Australia

Flystrike results in 2007-08

337 flystrikes were recorded between October and March, about ¾ of which were on the breech.

The high rate of 'repeat strikes' supports earlier evidence that there is value in culling struck sheep.
Or adopt this suggestion which I picked up on a recent trip to Tasmania… 'at least make judgement about whether it was your fault or that of the sheep'.

Table 1. Flystrike incidence (% of flock) by sheep class 2007-08

Class	Body (%)	Breech (%)	Repeats (%)[#]
Breeding ewes (n=600)	5.0	23.8	24.6
Ewe hoggets (n=207)	3.3	7.6	16.7
Ram hoggets (n=176)	3.2	0.7	14.3
Lambs/weaners (n=243)	6.3	9.9	30.3

[#] of struck animals, % that got struck (breech or body) more than once

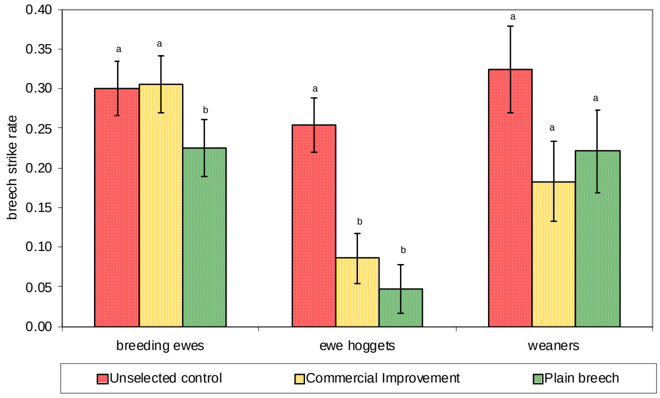

Figure 1. Breech strike rates in 2007-08. Within sheep classes, different superscripts indicate significant differences among selection lines. (P<0.05)

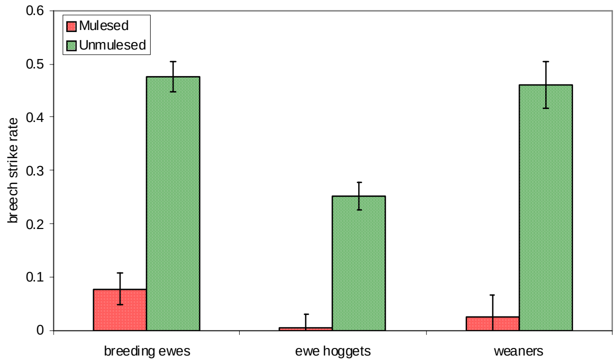

Figure 2. Effect of mulesing on breech strike rate (within sheep classes mulesing resulted in significantly lower breech strike rates, P<0.001).

Table 2. Selection line means for breech strike indicators.

Trait	Control	Commercial	Plain
2007 drop weaners (post weaning 5 months)			
breech cover	4.6	4.2	4.0
crutch cover	3.5	3.2	3.1
breech wrinkle	3.0	2.3	2.1
2006 drop ewe hoggets (yearling)			
breech cover	4.4	4.0	3.8
crutch cover	3.9	3.3	3.4
breech wrinkle	2.6	2.1	2.1
2005 drop breeding ewes (pre-lambing, 2yo)			
breech cover	4.2	4.2	4.1
crutch cover	3.5	3.5	3.4
breech wrinkle	2.8	2.8	2.3

All indicator traits scored 1-5 where 1 is 'best'

2007 drop unmulesed ewes showing variation in breech wrinkle

The differences among selection lines in breech strike rates (Figure 1) and indicator traits (Table 2) suggest that reducing the average breech wrinkle of the flock by about 0.5 - 1 score can make a sizable (30-50%, and statistically significant) difference in breech strike rates. As a guide, to reduce the average breech wrinkle score of an unselected flock by 0.5 score (say from 3.0 to 2.5) would require a cull rate of 30%.

Although not detailed here, there is evidence that body strike rates do not reflect breech strike rates. That is, the Selected lines have body strike rates similar to, or even higher than the Control line. This suggests that simply changing ram source (bloodline) may not be an answer for everyone. That is, introducing a new ram source to reduce breech strike may have adverse implications for fleece rot and subsequently, body strike rates. For example, this may be important for ram introductions into high rainfall regions.

Preliminary results - associations among breech & fleece traits

At this stage we don't have very precise information on the relationships between breech wrinkles and wool production traits. However, we do have very good information on the associations between body wrinkles and wool production in fine and superfine wool sheep arising from CSIRO's Fine Wool Project (a very large genetic evaluation of fine/superfine wool sheep that ran throughout the 1990's) and our Toward 13 Micron Flock.

Body and neck wrinkles are moderately heritable and highly correlated (Table 3). This probably means we can safely extrapolate to breech wrinkles and expect that they will also be moderately heritable and highly correlated with neck and body wrinkles. Unfortunately, this also means there may not be much scope to reduce breech wrinkles whilst maintaining body wrinkle.

In this flock the phenotypic correlations between wrinkles and both breech and crutch cover are low (less than 0.20)

Our current heritability estimate for breech wrinkle is 0.38 (0.18) and the phenotypic correlation between body and breech wrinkle is 0.47 (0.05), but note the higher associated errors than those for neck and body wrinkle (in Table 3). This is because at this stage we have insufficient data to precisely estimate genetic correlations.

Table 3. Heritability (bold), phenotypic (above diagonal) and genetic correlation (below diagonal) between neck and body wrinkle in fine/superfine wool sheep.

	Neck wrinkle	Body wrinkle
Neck wrinkle	**0.37 (0.02)**	0.53 (0.01)
Body wrinkle	0.83 (0.02)	**0.33 (0.02)**

Table 4. Phenotypic correlations between yearling fleece and breech traits

	Body wrinkle	Breech wrinkle	Crutch cover	Breech cover
Greasy fleece wt	0.14	0.20	-0.07	-0.09
Clean fleece wt	0.15	0.21	-0.04	-0.09
Yield	0.08	0.04	0.08	0.02
Fibre diameter	-0.16	-0.12	-0.15	-0.06
SD fibre diameter	0.28	0.29	0.10	0.04
CV fibre diameter	0.33	0.33	0.16	0.07
Curvature	-0.03	-0.07	-0.00	0.07
Staple length	-0.27	-0.28	-0.05	0.01
Staple strength	-0.01	-0.02	0.02	0.06
Yearling body wt	-0.20	-0.26	-0.25	-0.15

Low and unfavourable correlation

Moderate and favourable

Favourable or unfavourable depending upon your attitude to staple length

Favourable correlation

Not that familiar with some of the terms used here?

See below for definitions and some explanations – we'll use these terms a fair bit over the next couple of years

Genetic terms - definitions and explanations

Phenotype – the observed level of a particular trait, combined genetic and environmental factors – what you see
Genotype – the genetic makeup of an animal as distinguished from its physical appearance (phenotype)
Phenotypic variance – how much the animals in a population (flock) vary due to combined genetic and environmental factors
Genetic variance – variation within the population due to inherited genetic factors
Heritability – the proportion of variation in a trait that can be attributed to inherited genetic factors – what gets passed from 1 generation to the next (a number between 0 and 1 where <0.20 is low; 0.2-0.4 mod.; 0.4-0.6 high; and >0.6 very high)
Phenotypic correlation – observed relationship between two traits within a population (flock)
Genetic correlation – relationship between two traits attributable to genetic factors, often 'masked' by environmental influences

Correlations are numbers between -1.0 and +1.0 and the further away from 0.0 (in either direction), the higher the correlation. *Negative* correlations indicate relationships that move in opposite directions – as the value of one trait increases, the value of the other decreases. *Positive* correlations are those where the two traits move in the same direction. Both positive and negative correlations can be favourable or unfavourable – it just depends on the traits involved.

News from WA
Independent culling levels and Indicator Traits

Johan Greeff, DAFWA South Perth, John Karlsson, DAFWA Katanning

Research to date has shown that the important indicator traits for breech strike resistance/susceptibility are;

- wrinkles,
- wet daggs (in the winter rainfall regions of southern Australia),
- breech cover and
- urine stain.

Of these, wrinkles because of its high general prevalence in most industry flocks represent a good starting point for culling.

When selecting animals for these traits there are two main issues to consider in that the selection can't be done for each of the traits at the same time and the proportion to be culled for each trait needs to be estimated in advance, based on how many replacement ewes are needed.

The problem is how to determine how many animals should be culled on each indicator trait at each stage of the selection process. A solution is to follow an independent culling level approach. This means that animals above a specific value are culled at the time of measurement, independently from measurement of the other traits.

Using this method requires knowledge of your flock's fertility and some experience with trait expression in your flock. The breeding objectives you have set for your flock will also influence the number and proportion of animals to be culled for each trait.

An example:

If ~65% of ewes need to be retained to ensure flock size and you have 1000 older ewes and 400 ewe hoggets, you will need to retain 250 ewe replacements. This means you have (400 - 250 =) 150 hogget ewes that can be culled. Assuming that 50 older ewes and 50 maidens will be culled for other traits such as udders, mouths, wool etc, it leaves 200 older ewes and 100 maiden ewes that can be culled on the new traits such as wrinkles and dags.

Decide how much emphasis to place on each trait i.e. how many animals should be culled on each trait so that 65% is selected in the final stage. To determine the proportion available to be culled on each trait, the equation below can be used where a = proportion culled on trait one, b = proportion culled on trait two, c = proportion culled on trait three, etc.

Proportion selected = [(1-a)*(1-b)*(1-c)….]

A possible option is to cull 20% on wrinkles, 10% on dags and 10% on breech cover. This would result in

[(1-0.2 for wrinkles) * (1-0.1 for dags) * (1-0.1 for breech cover)] = 0.65

The same result will be obtained if 20% is culled for breech cover and 10% for wrinkles and dags. Alternatively cull 15% on each trait which will result in about 0.62. Many other options can be followed.

The big benefit of this approach is because culling information becomes available at different times. Wrinkles may be scored at marking, while breech cover is scored at weaning and dags at yearling age. Using this approach allows culling at each stage so that the more susceptible animals are removed from the flock at the earliest convenience without the threat that not enough animals are available at hogget age after shearing. Even if there is an over expression of one trait at a particular stage then following this approach will prevent over culling too many animals for any particular trait.

A note on response to selection – short term goals add up to long term

It is well recognised that selective breeding (for breech strike resistance or any other characteristic for that matter) is a long-term process, but keep in mind that although the gains made are gradual, they are ***cumulative and permanent***.

Selective breeding for breech strike resistance is not an 'all-or-nothing' thing. Although it may take years of perseverance to get where you want to be, incremental changes arising from selection in your flock will help – especially if you are combining this with other means of reducing breech strike such as grazing and flock management to reduce dagginess, an extra and well-timed crutch, and well timed preventative chemical treatment.

Also remember, the aim with selective breeding should be to produce animals that can achieve the same result in terms of flystrike resistance that mulesed animals can – not necessarily animals that look like they've been mulesed.

The rate of change you observe in your flock with selective breeding will be dependent upon things like

1. how many traits in your breeding objective (i.e. how many traits you are trying to change at the same time) – more traits generally means slower progress in each;
2. the relative 'weighting' on those traits – it is likely some traits are 'more important' so you are trying to change those more or faster than others;
3. the relationships among all of the traits you are interested in – whether or not they favourably correlated;
4. the heritability of the traits of interest- the higher the better;
5. selection intensity - the higher the proportion of your young ewes and rams you need to select as replacements in the breeding flock, the lower the selection intensity and the slower the rate of change;
6. generation interval in your breeding flock – faster turnover (i.e. younger average age) reduces generation interval and increases response to selection;
7. whether you are introducing 'outside' genetics to help get you there faster, or simply selecting within-flock;
8. The more the selection decision is based on an animal's genotype rather than phenotype the faster the rate of gain.

Staff Profile – Heather Brewer

Heather is a Research Project Officer for the Breeding For Breech Strike Resistance Project – she manages the data, contributes specialist technical support to field work and conducts preliminary data analysis.

Heather's entire working life has been dedicated to livestock breeding research projects. She has spent many years in both technical support for wool and meat research projects and managing data for Merino breeding initiatives such as CSIRO's Finewool Project and Towards 13 Microns Project, Merino Superior Sires and the New England Sire Evaluation Scheme.

Away from work Heather is a keen gardener, loves the outdoors and rural Australia and enjoys touring the outback and bush walking.

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Breech Strike Genetics is produced by CSIRO Livestock Industries, Armidale NSW.

Your feedback and thoughts are welcome.

Please send to tim.dyall@csiro.au or contact Tim on 02 6776 1463

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