Breech Strike Genetics

This Project is a collaborative research effort of CSIRO Animal, Food and Health sciences, Armidale, NSW and Department of Agriculture and Food WA supported by Australian Wool Innovation Limited

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In our last newsletter we reported that AWI continued to provide funding support for Breech Strike Genetics. Recently AWI approved funding until June 2015 to continue investigating breech indication traits with a focus on odour that repels and attracts flies.

In this newsletter we summarise results of the last two years — looking at;

- ***the flock restructure,***
- ***recent flystrike results***
- ***breech traits changes in breeding ewes over the course of a year,***
- ***components of breech wrinkle,***
- ***Selection line production results***

We also summarise new work on breech strike genomics and tail docking methods that is in progress at the moment.

Call for sires for 2013

The breech flystrike Resistant and Susceptible selection lines will be continued for at least the next several years.

We are looking for 2-3 external sires for the Armidale flock for use in 2013 to provide genetic links with industry flocks. So, If you have

a) a low breech wrinkle and/or low breech cover sire,

b) of superfine or fine wool type,

c) that has progeny recorded in Sheep Genetics,

c) and with semen either already collected or to be collected soon,

Please let us know (contact details on the back page).

Flock Restructure

The original aim of this breech strike genetics work was to evaluate a range of indicator traits including wrinkle, breech cover, dags, and many others, for their effectiveness as selection criteria for breech flystrike resistance in Merinos. The results showed several of these traits to be important and useful to Merino breeding programs, and that the most appropriate indicator traits varied with environment and the sheep type. However, there was also evidence that there were other, as yet unknown factors affecting breech flystrike resistance. For this reason, research in this area is continuing and in 2011 the flock structure was adjusted to better accommodate that further work.

The original Breech Strike Genetics research flocks (2005-2010) comprised 3 selection lines — Intense Selection (selection on ewes and sires), Commercial Improvement (predominantly selection on sires), and an Unselected Control. Selections were based primarily on the breech strike indicator traits of breech and crutch cover, breech wrinkle and dags. Half the sheep in each line were mulesed and half remained unmulesed, and the sheep represented a wide range in wool types.

Late in 2010 the flock design was changed to comprise Resistant and Susceptible lines. Ewes were selected firstly on actual flystrike records collected over the previous 5 years and then on the indicator traits. The wool type was restricted to superfine and fine wool types. None of the sheep born after 2010 are mulesed.

A range of production, wrinkle and breech traits continue to be measured, along with the collection of flystrike records. Results reported upon here are drawn from the Resistant and Susceptible selection lines. Production figures in 2011 for the breeding flock of selected Resistant and Susceptible lines are shown in Table 1 and current ASBVs, which reflect the production figures are shown in Table 2 (see pg5).

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Flystrike Results in 2011-12

As in previous years, the sheep have been managed under flystrike challenge conditions —there is no use of preventative chemicals. Flystrikes occurred between mid October 2011 and mid May 2012—compared to most other years of the experiment, this was quite late and occurred because there were only a few very light frosts until the first week in May. Rainfall during the 2011-12 flystrike season (637mm) was approximately 200mm above the long term average for the period (422mm). However, temperatures were lower and average wind-speed was higher than the long term averages for the flystrike season.

The overall breech flystrike rates in 2011-12 were 14% in the breeding flock and 13% for weaners (compared to average over the life of the project to date of 9% and 15% for breeding ewes and weaners respectively).

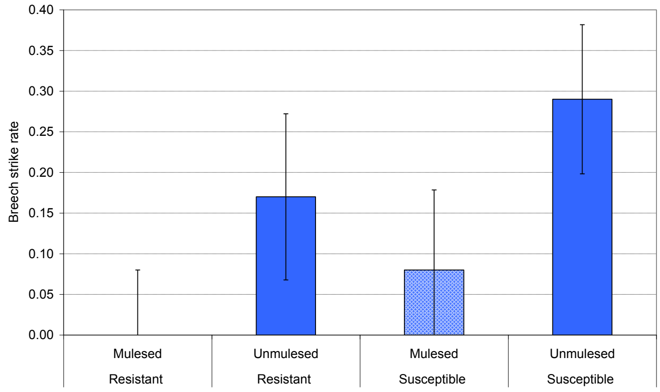

Figure 1. Selection line and mulesing group effects on breech strike rate in breeding ewes in 2011-12

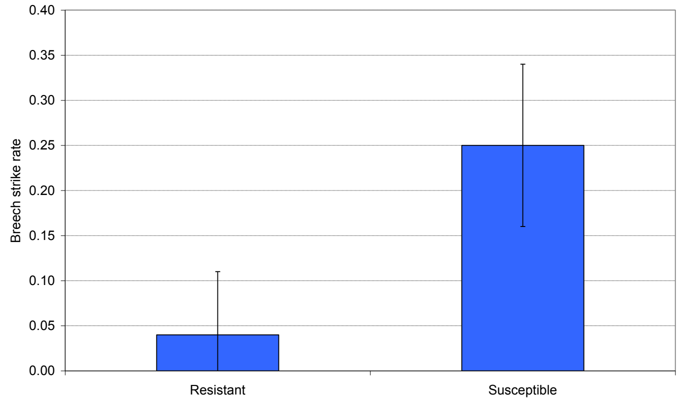

Figure 2. Selection line effect on breech strike rate in 2011drop weaners

Breeding ewes

Effects of mulesing and selection line were consistent with previous years — unmulesed Resistant line ewes were intermediate between mulesed and unmulesed Susceptible line sheep in breech strike rate (Figure 1). ***Of the ewes that were breech struck in 2011-12, they were 78% more likely to come from the Susceptible line than the Resistant line***, and were 92% more likely to be unmulesed than mulesed. Although the differences between groups are not statistically significant, there is a clear trend that animals selected to be resistant to breech flystrike are so. Ewe age, fertility and lambs weaned were all non-significant effects on breech strike rate.

2011 drop weaners

No sheep were mulesed in the 2011 drop. Those in the Resistant line exhibited lower breech strike rate than the Susceptible line (Figure 2). ***Of the 2011 drop weaners that were breech struck, they were 87% more likely to come from the Susceptible than the Resistant line.*** Males were less likely to be breech struck than females (Males 0.05 ± 0.08 versus Females 0.21 ± 0.09). Birth-rearing type, age of dam and management flock were all non-significant effects on weaner breech strike.

Figure 3 shows weaner breech strike rates in the Mulesed/Unmulesed and Intense Selection (Resistant) and Unselected Control (Susceptible) lines in each year since the flock was started. ***In all years when mulesing was conducted (i.e. up to and including 2009), unmulesed Selected animals exhibited breech strike rates comparable to mulesed controls.*** Control (or Susceptible) line animals consistently showed significantly higher breech strike rates than those in the Intense Selection (or resistant).

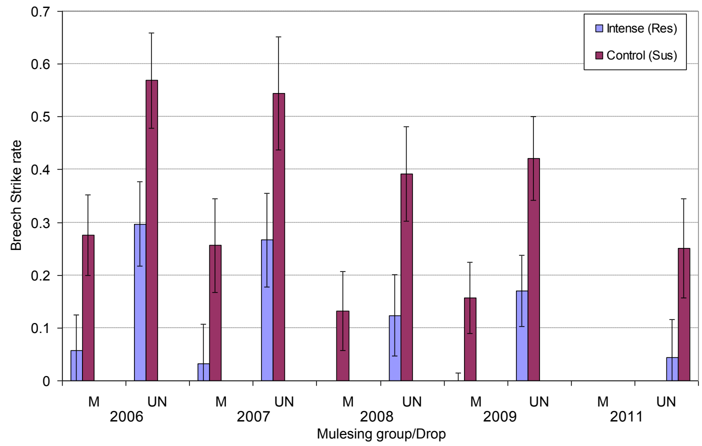

Figure 3. Breech strike rates in mulesed (M) and unmulesed (UN) weaners in the Intense selection (Resistant) and Unselected Control (Susceptible) selection lines.

Changes in Breech Traits in Breeding Ewes during the year

Evidence from industry indicates breech traits change with physiological state of breeding ewes. This is of interest in respect to using indirect indicators for breeding for breech flystrike resistance. In industry, most measurement of breech traits for selection purposes is conducted on young animals (less than 18 mths of age). However, at least in the New England NSW summer rainfall environment, breeding ewes are the second most susceptible class of sheep after weaners. A preliminary study was conducted to evaluate changes in breech traits over the annual reproduction cycle of Merino ewes.

Methods

The 400 ewes of he Armidale Breech Strike Resistance resource flock were repeat measured during 2011 for several breech traits. Measurements were taken pre-mating in March 2011; off-shears, late pregnancy in July 2011; and after their lambs were weaned in early January 2012. The breech traits of interest were breech wrinkle, crutch cover, breech cover ((all 1-5 scale), as well as measured breech bare width (mm) and breech bare depth (mm). Bodyweight was also recorded.

The reproduction characteristics for the flock were fertility (pregnant/not), fecundity (number of lambs born) and number of lambs weaned for each year that a ewe was in the breeding flock. Ewes ranged from 1.5 years to 5.5 years at mating in April 2011. Both the 2008 and 2009 drop ewes were maidens in 2011 as the flock was not joined in 2010. Reproduction performance in previous years (all years previous to 2011 for which a ewe was in the breeding flock, range 0-3) and in the current year (2011) were examined, and were a combination of fertility and rearing ability (lamb(s) weaned).

Results

Reproductive performance in the current year (2011) .

was a significant effect on all of the breech traits except breech bare width. Reproduction in previous years had no effect on any of the breech traits, but no mating was conducted in the immediate previous year, so this warrants further investigation.

Figure 1 shows breech wrinkle changes among reproduction classes during 2011. Initially, ewes that did not become pregnant were the most wrinkly group, but during the period of lactation (of the wet ewes) those dry ewes became relatively less wrinkly than ewes that had either lambed and lost or reared a single lamb. This may be due to body condition and/or abdominal dimensions in that late-pregnant ewes -

Conversely, at weaning, dry ewes, which were more likely to be in better condition at that time (having not been under the pressure of lactation) appeared less wrinkly than those that had reared 1 or lambed and lost. Breech wrinkle in ewes that reared twins changed little over the year. This was inconsistent with those that reared singles and the reasons for this are unclear. ***This result indicates that reproduction effects on breech wrinkle are transient and are associated with body condition or dimensions at the time.***

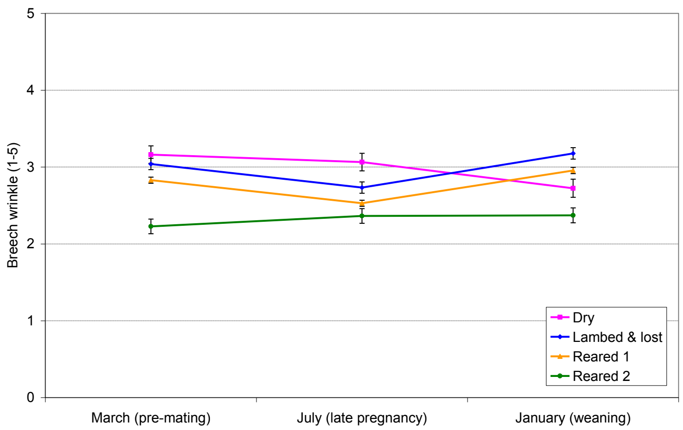

Figure 1. Effect of pregnancy and lactation on breech wrinkle

At the start of the reproduction year in March, and in July, ewes that went on to rear twins exhibited lower crutch cover than the other three groups (all of which were not significantly different at those time-points (Figure 2). However, by the end of the lactation period, ewes that reared at least one lamb (i.e. had maintained a lactation) exhibited crutch cover scores significantly lower than those that were either dry or had lambed and lost. ***This result indicates that crutch cover, or loss of wool fibre in the inguinal and udder region is associated with lactation rather than pregnancy.***

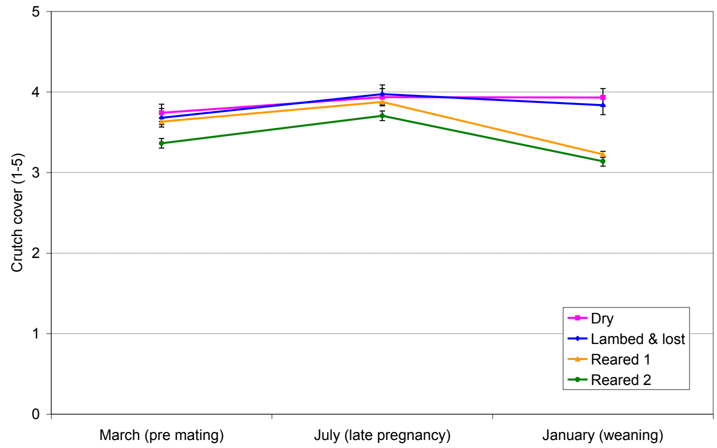

Figure 2. Effect of lactation on crutch cover

Results relating to breech cover tended to reflect those for crutch cover, but were less clear-cut.

Breech Wrinkle Components

Pre-mating in 2011 the breeding flock ewes were assessed for the standard breech traits, including wrinkle as well as a set of wrinkle components;

- 'Horsehoe' (curved wrinkle over the butt of the tail),
- 'Bat-wings' (loose skin on the lateral surfaces of the tail),
- 'Inner folds' (wrinkle running dorso-ventral immediately adjacent to the vulva),
- 'Outer folds' (wrinkle on the outer regions of the breech
- Docked tail length was also measured at this time.

The aim was to evaluate whether any particular wrinkle components contributed more to breech strike susceptibility than others.

Results

All four of the breech wrinkle component traits were significantly different between mulesed and unmulesed ewes and between Resistant and Susceptible ewes. Ewes in the Resistant and Susceptible lines were similar to mulesed and unmulesed ewes respectively in terms of (overall) breech wrinkle. Overall breech wrinkle was most closely correlated with 'outer-folds' (0.71), followed by 'horseshoe' (0.63), 'inner-folds' (0.48) and bat-wings' (0.42). This may simply reflect the wrinkle that is most obvious when wrinkle scoring.

When breech wrinkle and the four wrinkle components were tested independently for associations with breech strike, all were statistically significant. Breech strike was most closely correlated phenotypically with overall breech wrinkle (0.26), followed by the 'horseshoe' (0.23) and 'outer-fold' (0.21) components.

Further analysis revealed that no single component added any information to better predict breech strike resistance, over and above that provided by the overall breech wrinkle assessment.

Thus, there does not appear to be any particular component of breech wrinkle that would be superior to the beech wrinkle assessment method currently used by industry for use as an indirect selection criterion for breech strike resistance. This indicates that the breech wrinkle scoring method currently used in industry is sufficient and appropriate.

Average docked tail length of the ewes was 59 mm and the range was 20 —95mm. This is indicative of the variation that exists despite the aim of tail docking to the tip of the vulva and is probably not surprising given a) that the 2005 drop ewes were tail docked by 12 different operators (as they were purchased from industry), b) from 2006 onward different operators did the tail docking in different years, c) and different implements were used in different years (cold knife, hot knife and te pari patesco hot knife). However, there was as much variation in docked tail length within years as between.

Docked tail length was shorter among mulesed animals than unmulesed ones, but there was no difference between Resistant and Susceptible animals in docked tail length. ***In this instance, docked tail length was not associated with breech strike incidence, and this is in contrast to other reports in the literature.***

Horseshoe wrinkle (unmulesed)

Bat-wings (unmulesed)

Inner folds (unmulesed)

Outer-folds (unmulesed)

For comparison—mulesed ewe, low degree of all wrinkle types

Production figures for the breeding flock 2011

Table 1. Bodyweight, wrinkle and breech traits, and fleece traits for selected Resistant and Susceptible lines in the

Trait	Resistant line	Susceptible Line	P
Bodywt (kg)	47.1 (0.3)	45.2 (0.3)	**
Breech wrinkle (1-5)	2.28 (0.05)	2.91 (0.05)	***
Breech cover (1-5)	3.36 (0.05)	3.52 (0.05)	*
Crutch cover (1-5)	3.44 (0.04)	3.80 (0.04)	****
CFW (kg)	2.90 (0.04)	2.99 (0.04)	*
MFD (µm)	17.4 (0.1)	16.9 (0.1)	***
CVD (µm)	16.7 (0.1)	17.0 (0.2)	ns
CURV (°/mm)	97.5 (0.8)	99.5 (0.9)	ns
SL (mm)	87.9 (0.8)	83.6 (0.9)	***
SS (N/kTex)	40.3 90.6)	38.5 (0.7)	ns

*** P<0.001, ** P<0.01, * P<0.05, ns not statistically significant
Note: Bodyweight, breech wrinkle, breech cover and crutch cover records pre-mating (March) in 2011, fleece traits at shearing in 2011 (July).

Table 2. ASBVs for the selected Resistant and Susceptible lines and MERINOSELECT averages for Superfine types.

Trait (July 2012)	Resistant Line ASBV	Susceptible Line ASBV	Superfine Type Average ASBV
n	398	347	2011 Drop
wwt (kg)	0.2	-0.9	0.0
ywt (kg)	2.2	-0.3	0.0
yfd (µm)	-1.60	-2.23	-2.0
ycfw (%)	-6.7	-9.5	-3.3
ycvd (%)	-1.63	-1.01	-0.84
Yss (N/kTex)	2.9	2.7	-0.4
ysl (mm)	0.6	-5.7	-2.2
ycurv (°/mm)	6.7	10.5	6.2
Nlw (%)	0.01	-0.02	0.00
Ebwr (score)	-0.52	0.50	-0.02
Ebcov (score)	-0.08	0.02	Not available
Edag (score)	-0.08	0.08	Not available

Table 1: On average, Resistant line ewes are approximately .6 of a score less wrinkly than Susceptible line ewes. Resistant line ewes cut slightly less fleece weight than the Susceptible line. The Resistant line have higher bodyweight (larger body size, by about 2kg), longer staple length (by about 4mm) and broader fibre diameter (by about 0.5µm) than the Susceptible line.

Reproduction results 2012

Previously this flock has been mated predominantly by artificial insemination (AI) so we haven't looked much at reproduction results due to the biases that AI introduces. In 2012 the mating was entirely natural. The figures below (Table 3) are from the 2012 mating and lambing. All ewes were adults (i.e. no maidens as there was no mating in 2010 and hence no maiden ewes coming in) and the mix of 'new' and 'experienced' sires was similar in both the resistant and Susceptible lines. Lamb deaths were due to a variety of normal causes.

There appear to be some differences between the lines in dries, fecundity, and lamb survival to marking in favour of the Resistant line that are greater than would be expected just from a bodyweight effect (i.e. because bodyweight of the Resistant line is approximately 2kg greater than the susceptible line).

It should be noted that Table 3 is raw data from the selected lines. Large amounts of data is required to achieve significant differences to overcome what could be chance "sire effects", however the trends shown in this table are comparable with results from Mt Barker (see DAFWA Newsletter No 5).

Table 3. Reproduction raw data outcomes for the selected Resistant and Susceptible lines in 2012

Sire group	Ewes joined	Scanned Single	Scanned Twin	Scanned dry	Total lambs scanned	Total lambs born	LB/EJ (%)	LM/EJ (%)
				Resistant				
2008C0370	48	21	27	0	75	77	160	148
2009C0011	48	24	21	3	66	66	138	127
2009C0192	48	20	27	1	74	74	154	142
2009C0497	48	25	23	0	71	73	152	131
	192	**90**	**98**	**4**	**286**	**290**	**151**	**137**
				Susceptible				
2005A3156	51	29	23	0	74	75	147	125
2008C0434	51	34	14	3	62	62	122	100
2009C0256	49#	16	24	9	64	59	120	96
2009C0295	49	21	21	7	63	65	133	86
	200	**99**	**82**	**19**	**263**	**261**	**131**	**102**

2 ewes died, 1 dry; LB = lambs born, LM = lambs marked, EJ = ewes joined,

What next?

Breech strike genomics

In 2012 we commenced a research program that will use the breech strike resource flocks that were developed at Armidale and Mt Barker to investigate genomic differences between flystrike resistant and susceptible animals.

Many of the animals produced in this research program over the last 7 years have blood samples in storage. Over the next 12 months we will be genotyping these animals using the Ovine 50K bead-chip. This will enable identification of gene markers on chromosomes that may be closely associated with breech strike resistance or susceptibility.

Some animals representing extremes (never struck and repeatedly struck) will be genotyped as individuals, while others will be genotyped in pools of 'like' phenotypes — groups of animals with similar breech wrinkle, breech cover and dag. The DNA pooling technique is a cost efficient way to genotype and compare the genetics of groups of animals varying in breech phenotypes.

Genome-wide analysis will then enable identification of SNP (single nucleotide polymorphisms—variations in the DNA sequence at a single site on the genome) that have ***significant associations with flystrike and 3 key breech flystrike indicators*** (breech wrinkle, breech cover and dag). Prediction equations will be derived for calculation of genomic breeding values for flystrike and the 3 indicator traits.

Genotype assisted selection potentially provides considerable enhancement to breeding and selection for flystrike resistance over that already developed through the quantitative genetic methods we have used to date. The biggest advantage would be that resistance or susceptibility could be determined early in life from a blood or tissue sample rather than recording indicators or flystrike on the animals themselves.

Effect of tail docking method on lifetime breech flystrike

At lamb marking in October this year we commenced a study to compare tail-docking methods in terms of resistance or susceptibility to breech strike throughout the sheep's life. The question is, ***"is any one tail docking method any better or worse for preventing breech flystrike in unmulesed sheep over their lifetime?"***

Lambs were assigned to 1 of 4 treatment groups balanced for selection line (Resistant/Susceptible), sire (4 sires/line), sex, age of dam and birth-rearing type. Prior to tail-docking the lambs were weighed and the 'usual' set of wrinkle and breech traits recorded. The tail docking methods being compared are elastrator ring, knife, 'regular' hot knife, and the te-pari patesco hot knife. As per previous years, flystrike records in the absence of preventative chemicals will be recorded for all animals over the coming flystrike season (weaner-post weaner age), and in all future seasons for as long as individuals are retained in the flock.

Sheep odour in relation to breech flystrike

Work on additional indicator traits for breech flystrike, particularly around the odours secreted by resistant and susceptible sheep that are attractive/repellent to blowflies is being driven by the DAFWA and Uni of WA team. Preliminary studies included training two dogs to differentiate between wool from resistant and susceptible sheep. This was done by Hanrob International Dog Academy and the results were encouraging. Research by others with hornflies in cattle has shown differences in the chemical odours secreted by resistant and susceptible animals (either repelling or attracting). If similar are also found in sheep then exciting breeding opportunities as well as novel control options may become available for blowfly strike in sheep.

Earlier issues of this newsletter outlined the project background, objectives and design, along with progress reports and interim results. Copies are available from Heather Brewer using details below or go to:

http://www.wool.com/Grow_Animal-Health_Flystrike-prevention.htm

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