BREEDING FOR BREECH STRIKE RESISTANCE PROJECT

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This is a collaborative research project performed by the Department of Agriculture and Food Western Australia and CSIRO with funding provided by AWI

Editorial

The AWI funded "Breeding for Breech Strike Resistance project started in 2005 at the Mt Barker Research Station of the Department of Agriculture and Food WA to determine the indicator traits for breech strike resistance in the Australian winter rainfall environments. A similar project is carried out by CSIRO at Armidale NSW with fine wool sheep in a high summer rainfall environment.

The initial flocks and design of the experiments have been described in previous newsletters; these can be found on the AWI website under publications (http://www.wool.com/Publications.htm?cat=Breeding).

This newsletter focuses on the results from the first four years and will show the relationships between the indicator traits and breech strike and which traits can be used to indirectly breed for breech strike resistance. Then we will also briefly indicate some of the new areas of research that we are planning to identify other potential indicator traits that could be useful in breeding programs for breech strike resistance.

Summary of first four years

The project started in 2006 with rams and ewes sourced from different flocks. During the trial no preventative blanket treatments such as crutching and jetting were applied to protect the sheep from getting struck as the aim was to allow the sheep to express their natural resistance to breech strike. In order to obtain this information we ensured the necessary recourses were available for the early detection and treatment of struck animals to prevent any adverse welfare on the sheep.

Eighty-one sires were progeny tested for breech strike resistance from 2006 to 2010. The rams were sourced from industry and from experimental flocks such as the Rylington Merino and Katanning Base flocks of the Department of Agriculture based on their ability to resist getting strike. As strike and production data became available, sires were progressively selected from within the flock using the 7% dual purpose index and considering the resistance level against breech strike. In 2010 all sires used were born in the experimental flock.

The average incidence of breech strike were 27%, 22%, 40%, 33% and 38% in unmulesed sheep from birth to hogget shearing for animals born in 2006, 2007, 2008, 2009 and 2010, respectively. Large differences were detected between sire progeny groups in breech strike resistance. In the 2008 drop only 2.5% and 8.9% of the two most resistant sires' progeny were struck compared to 94% and 103% for the two most susceptible sires, see Fig. 9. Note that these results show the true susceptibility when the risk is not mitigated by preventative management and treatments.

Relationship of Individual traits

The following five charts show the relationship between incidence of breech strike and the indicator traits; dags, breech cover, urine stain, breech wrinkles and wool colour. It is important to note that the wool traits tend to be better visualised in long wool while the skin traits are better visualised in short wool.

In a winter rainfall environment scouring (diarrhoea) as measured by dag score reached its peak in the winter/spring green feed period, especially in hoggets. Age does play a part in that mature sheep are better able to cope with worms while weaners are more prone to scour due to high worm burdens.

The following graphs show that the prevalence of breech strike increases as the average dags score (Figure 1), breech cover score (Figure 2) and wool colour (Figure 5) of the flock increases. Contrary to general observation, no relationship was found between average breech wrinkle score and breech strike (Figure 4). This occurred because the presence of dags completely overrides the importance of wrinkles (Figure 4) and urine stain (Figure 3). Furthermore, our flock is relatively plain with very few animals greater than wrinkle score 2.5. But we do know from other research and from results from our sister trial carried out by CSIRO in Armidale, NSW that wrinkles, are an important key indicator trait.

Figure 1. Dag Scores

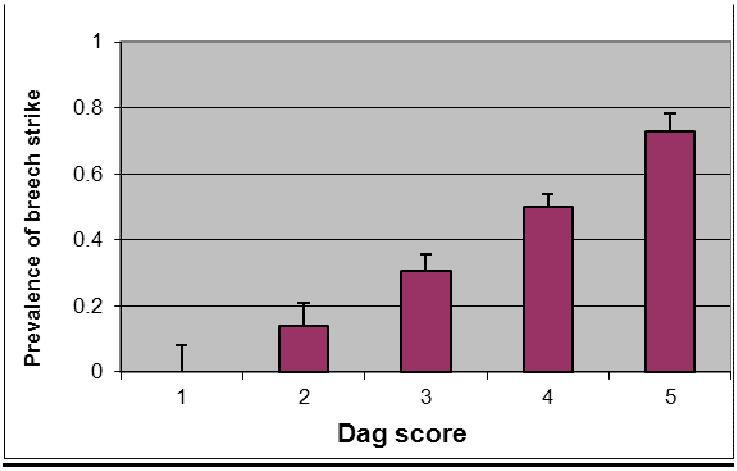


Figure 2. Breech Cover Scores

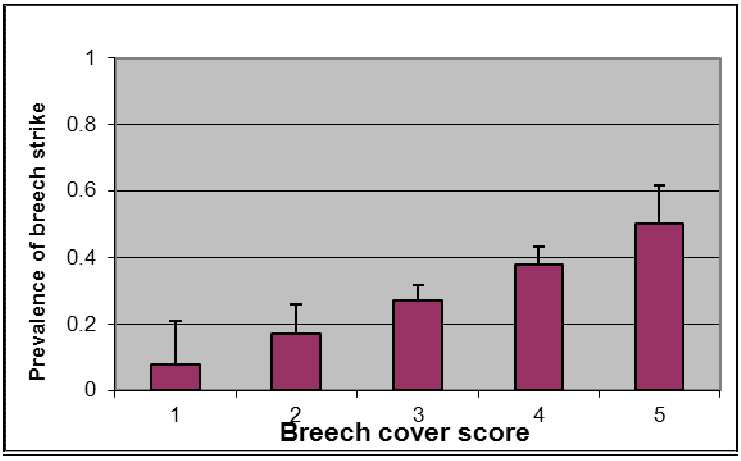


Figure 3. Urine Stain Scores

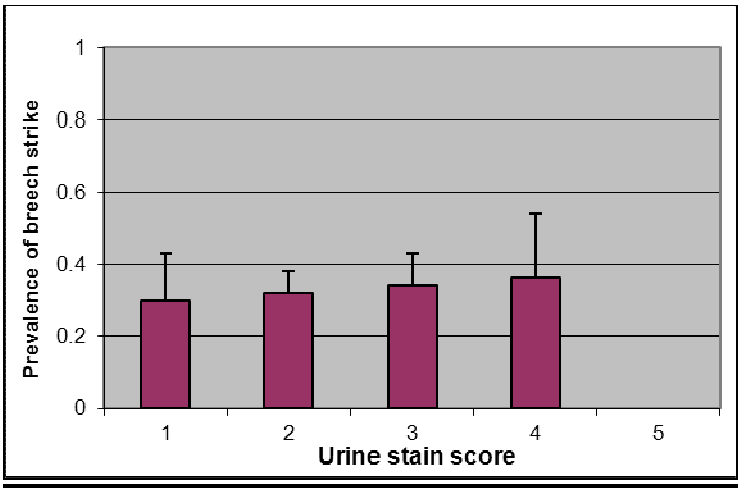


Figure 4. Breech Wrinkle Scores

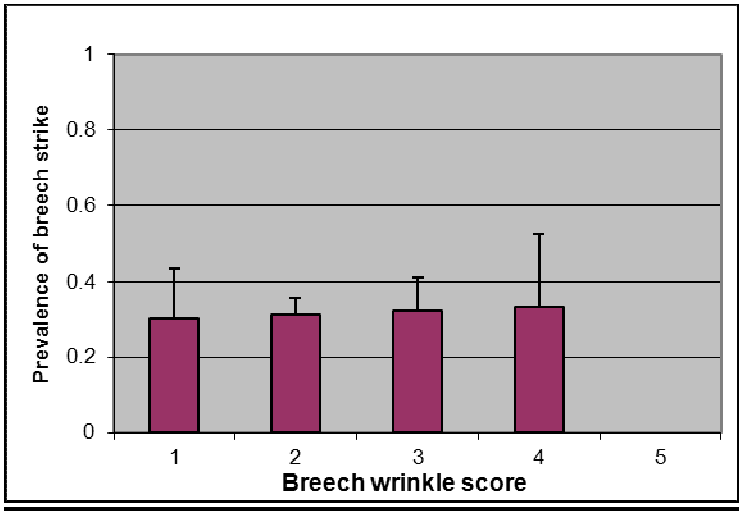
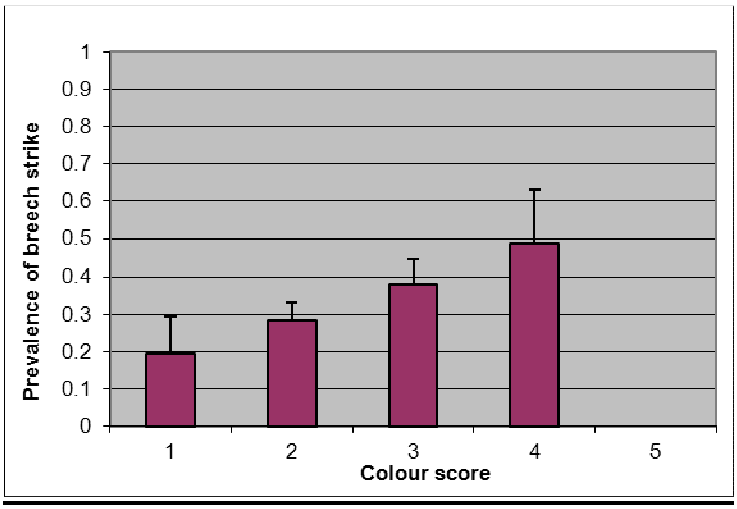


Figure 5. Wool Colour Scores



Interaction between wrinkles, dags and breech cover

As mentioned previously, Figure 4 shows that no relationship exists between wrinkles and breech strike. However, that does not mean that wrinkles are not important. The main reason for this unexpected trend is that a complex set of interactions exist between breech wrinkles, dags and breech cover. Figures 6 and 7 show the interactions between the incidence of breech strike and breech wrinkle with scores 1 and 2, dag scores with scores 2, 3 & 4 and breech cover with scores 3 & 4. Figure 6 shows clearly that for sheep with a wrinkle score of one (all plain-bodied sheep), breech strike increases as dag score increases and breech cover increases. Figure 7 shows that for sheep with a wrinkle score of 2 (all slightly wrinkled) the incidence of breech strike increases as dag score increases for sheep with a breech cover score of 3. However, when breech cover score increases to 4, there is a significant increase in breech strike in sheep with a relatively low dag score. The incidence of breech strike is higher for wrinkle score 2 sheep with lower dag and cover scores compared to wrinkle score 1 sheep, but not for higher dag and cover sheep. As the combined score from these individual traits increases there is an increase in the incidence of breech strike but at different stages. It is clear that the focus should be to reduce the average score of these three indicator traits in all flocks. During 2010 Sheep Genetics released breeding values to assist breeders to identify genetically superior animals for these three indicator traits.

Figure 6. Incidence of breech strike in animals with breech wrinkle score = 1

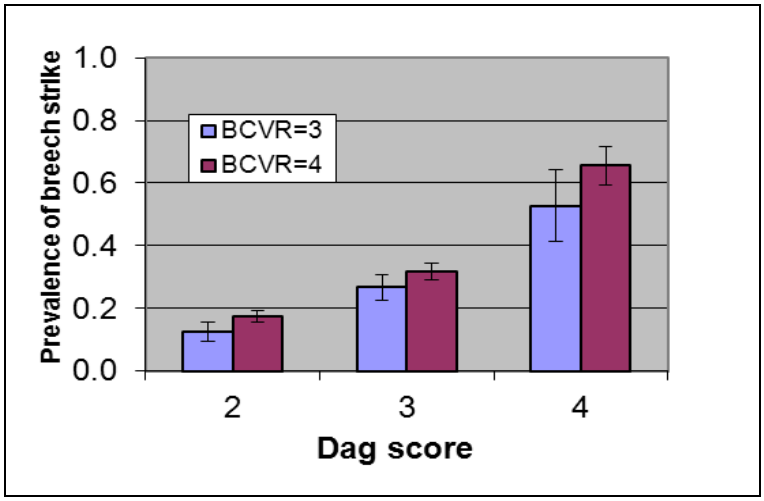
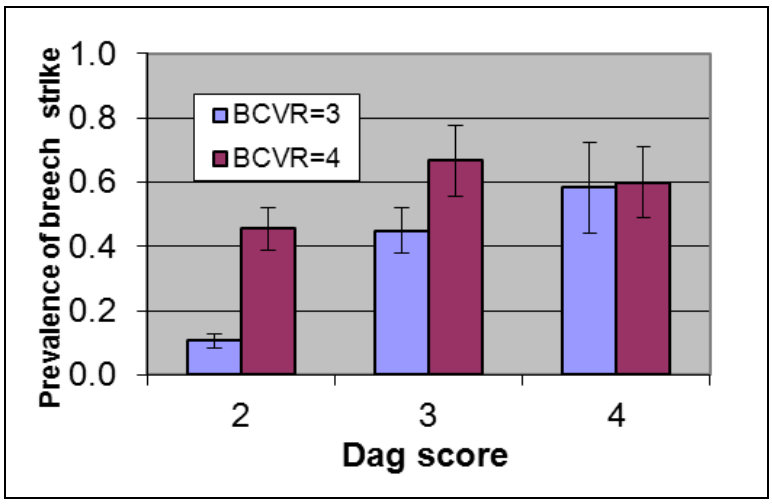


Figure 7. Incidence of breech strike in animals with breech wrinkle score = 2



Note the increased risk of strike for score 2 animals compared to score 1 animals as dag and breech cover increases to score 2 and 3. When dag scores are 4 the risk of score 1 and 2 animals are similar.

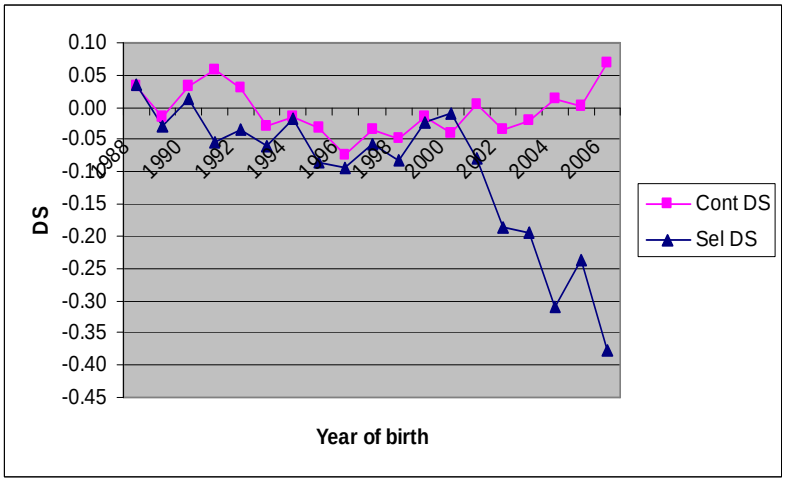
Dags the most important indicator trait in the winter rainfall environment

Dags is clearly the most important indicator trait for breech strike in a winter rainfall environment and is mainly caused by sheep worms under normal grazing conditions. The industry currently manages dags mainly through different worm control methods, crutching and surgical mulesing.

However, although scouring is mainly caused by worms, it is important to note that there are two sub-types of diarrhoea, 1) “high worm burdens” and 2) low but increasing numbers of immature larvae leading to a “hypersensitivity” reaction.

A large population of developing and adult worms in the sheep “high worm burdens” will cause gut damage resulting in excessive faecal moisture. This, plus increased gut motility, will result in fluid faeces. This form of scouring is associated with a high faecal worm egg counts (WEC or FEC).

Figure 8. Selection response to Dag Scores (DS)



More recently we have recognised that some sheep can also develop diarrhoea even when the flock has a low WEC count. Initially this was thought to be due to high water content plants such as cape weed. We now know that it is also due to an allergy-like "hypersensitivity" gut reaction in some individual sheep due to the ingestion of the immature worm larvae from the pasture.

Genetic selection for low WEC will reduce high WEC scouring over time but not the low WEC "hypersensitivity" scouring syndrome. Therefore the latter form has to be considered as a separate trait because it has been shown that a small number of immature larvae can cause scouring. In practice we recommend treating both WEC and scouring (dags score) as independent traits in breeding programs and both traits need to be selected to reduce flystrike.

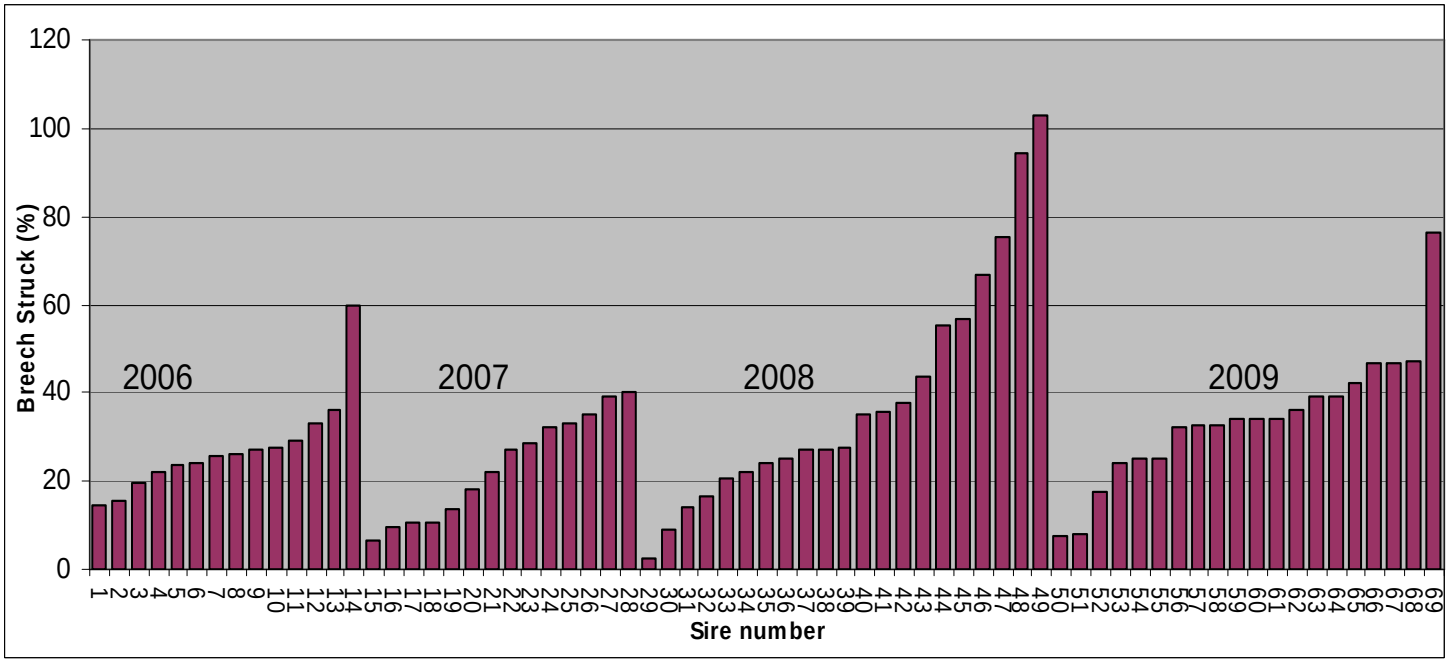
We have previously shown that selecting for reduced dag score can be effective in reducing dags. Figure 8 shows the selection response in the Rylington Merino flock which has been selected for low dag scores since 2001. Dag scores have decreased in the selected line compared to the unselected control line which shows that good progress has been made since selection started in 2001. This confirms that dag score is a heritable trait and that selection against dags is effective. Sheep Genetics publishes ASBV values of sires that have been evaluated for dag score.

Sire progeny group differences in breech strike

Breech strike is a heritable trait which implies that some animals are genetically more resistant than others. The most accurate method to identify genetically resistant animals is through a progeny test. Figure 9 shows the progeny test results of the prevalence of breech strike over four years. In the high challenge year of 2008 the most resistant sire group (sire 29 on the graph) had only one of its 40 progeny struck (2.5%) over two seasons from birth the hogget shearing. In the most susceptible sire group (sire 49 on the graph) virtually all its progeny were struck, some more than once, hence recording over 100% for breech strike.

The results in Figure 9 clearly show that there are sires in industry flocks that are quite resistant to breech strike. On average it appears that approximately 1 out of every 10 sires we have tested so far is quite resistant in that less than 10% of their unmulesed progeny will be struck by flies, similar percentages to mulesed animals in this experiment. The main challenge for industry is how to identify these resistant sires at a young age without lengthy and intense challenge periods. For both economic and ethical reasons it would be impossible for breeders to challenge their animals with breech strike to identify genetically resistant animals. Thus, breeders need to undertake indirect selection for resistance by using the known indicator traits as well as culling any flystruck sheep.

Figure 9. Prevalence of breech strike for different sire progeny groups from birth to hogget shearing born from 2006 to 2009.



What is the effect of the indicator traits on other traits?

Reducing the expression of the indicator traits may be of economic value separate to breech strike. This is especially the case for dags as it implies extra crutching costs and wool losses. High wrinkle score is associated with reduced fertility, increased lamb mortality, increased shearing time and more skin cuts than plain-bodied sheep. However, when it comes to fleece weight there are divided opinions in the industry regarding the number of high fleece weight low wrinkle animals and how best to find them.

Some sectors of the industry have a very strong belief that it is very difficult to find high cutting 'plain' sheep with an open face. It is true that there is a positive correlation between wrinkle score and fleece weight, and between breech cover and fleece weight. Research has shown that this relationship is about the same as between fibre diameter and fleece weight (a correlation of 0.2). However, research has clearly shown that ram breeders can reduce or maintain fibre diameter whilst at the same time increasing fleece weight by using an appropriate selection index. The same principle applies to wrinkles and fleece weight, and to breech cover and fleece weight and therefore ram breeders should be able to find increasing numbers of Merino rams that are below average for wrinkle and for breech cover but above average for fleece weight across all micron categories as more ram breeders adopt Breeding Value technology.

Many high performing rams with desirable breech traits are listed on the Merino Select website

http://www.sheepgenetics.org.au/

This is the best source of information on genetically superior sires for production traits in Australia. Sheep Genetics publishes Australian Sheep Breeding Values (ASBV's) for a range of economically important traits and ranks animals on different selection indexes to satisfy different breeding objectives.

Level of the indicator traits and their influence on the incidence of breech strike in unmulesed sheep compared to mulesed sheep

Introduction

An analysis was carried out to determine what combination of dag score (DAG), breech wrinkle score (BRWR) and breech cover score (BCOV) will result in a prevalence of breech strike equal to that in mulesed animals. The data from animals born from 2005 to 2009 in the Mt Barker Breech Strike flock were use for this study.

Methodology

Half of each drop was mulesed while the other half were left unmulesed to compare the incidence of mulesing versus non mulesing in different years. However, mulesing was terminated in 2008 to generate more data on unmulesed sheep.
The indicator traits DAG, BRWR and BCOV score were recorded at different ages but for this analysis, DAG in spring, BCOV pre-hogget shearing and BRWR post-hogget shearing were use as these measurements were closest to when the fly season is likely to occur at this site.
The breech strike data were analysed with a multiple trait model. This analysis adjusts the results for year, sex of the animal and whether the animals were mulesed. This then allows predicting the effect of different levels of DAG, BRWR and BCOV on breech strike.

Results

The average prevalence of breech strike between birth and hogget shearing was 6.9% in the mulesed sheep (n=548) and 32.6% (n=2393) in the unmulesed sheep born from 2005 to 2009. Most of the animals were struck during the three month period before hogget shearing at the end of November or in early December.

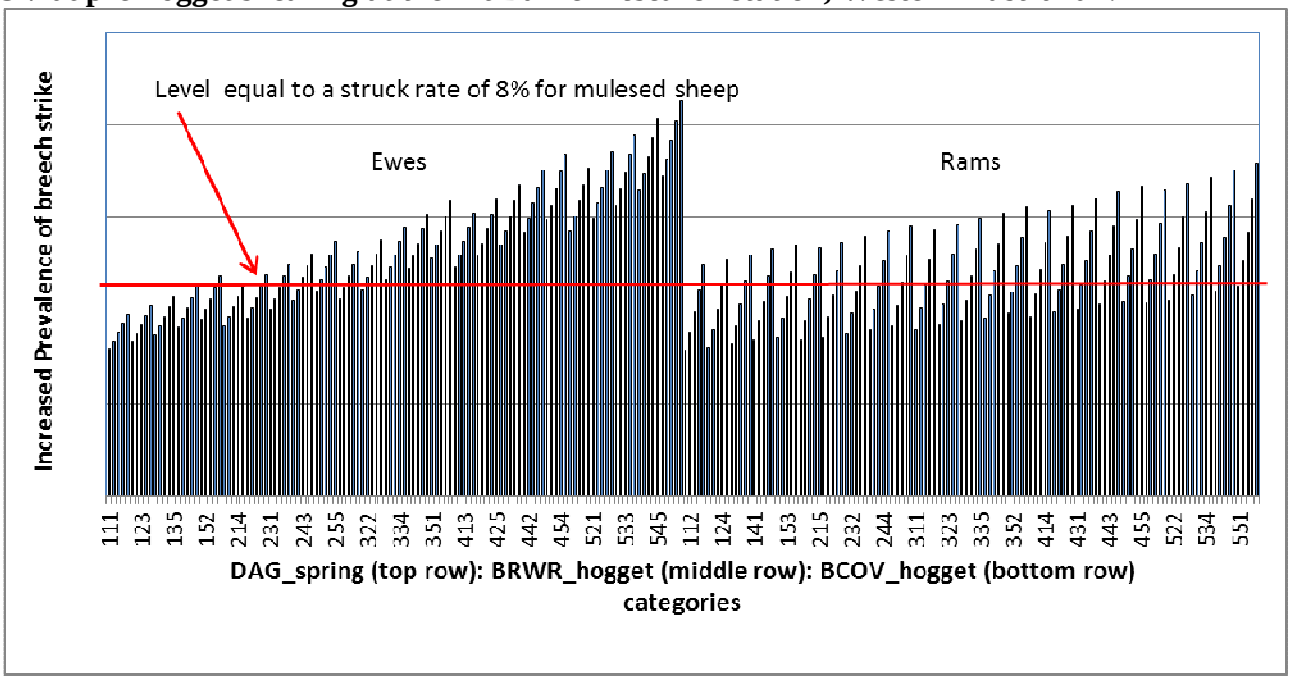
The average level of breech strike in mulesed ewes and rams born from 2005 to 2007 was very similar, ie. 6.7% (n=433) and 7.8% (n=115) respectively. However, over all the animals born from 2005 to 2009, breech strike in unmulesed ewes were on average 39.3% (n=1357) and 23.8% for rams (n=1036). Thus it confirms that ewes are more prone to be breech struck than males.

The prevalence of breech strike in unmulesed rams and ewes for different combinations of DAG, BRWR and BCOV scores between 1 and 5 using the AWI visual sheep scoring system is shown in Figure 10. Thus for a combination score of 5:5:5 (DAG:BRWR:BCOV) in ewes, it is predicted that 100% of animals will be struck, while ewes with a combination score of 2:2:2 will have the same strike rate as mulesed animals (Figure 10).

It is clear that ewes have a higher prevalence of being struck and that the prevalence increases more in females than males as the level of indicator traits increases.

The critical level for these three indicator traits at the Mt Barker research station appears to be about score 2 to 2.5. However, it should be noted that BRWR was not significant because dags override breech wrinkle in this environment. However, it appears that when ewes lie below a score of about 2 to 2.5 for DAG and BRWR and BCOV, then such animals will have a similar incidence of breech strike compared to mulesed animals in this environment.

Figure 10. Predicted prevalence of breech strike in unmulesed rams and ewes from birth to hogget shearing for different combinations of DAG score in spring, BRWR score post hogget shearing and BCOV at pre-hogget shearing at the Mt Barker research station, Western Australian.

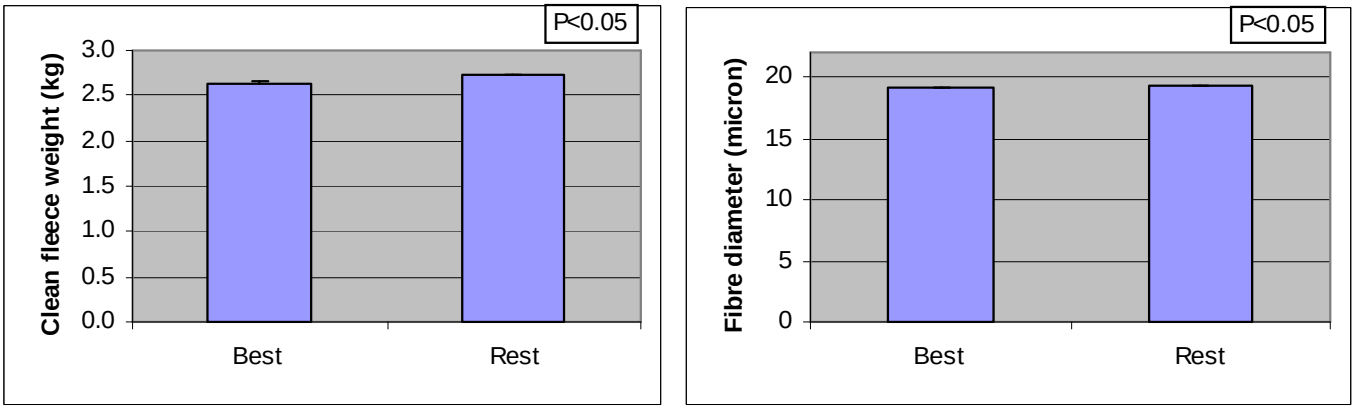


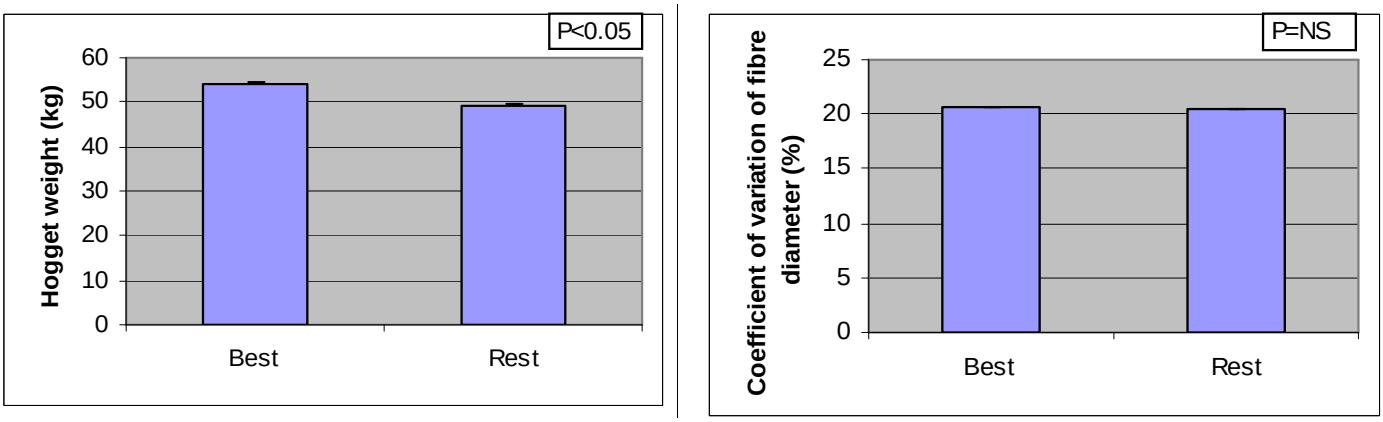
Production comparison between the more resistant and less resistant groups

It is now clear that animals that have the lowest scores for dags, breech cover and breech wrinkles are more resistant than the rest. Using a cut off point of 2.5 according to Figure 10 for each trait, the following graphs shows the differences in production between the more (less than 2.5 for dags, breech wrinkles and breech cover) and less resistant group (scores higher than 2.5 for dags, breech wrinkles and breech cover). For experimental reasons we have been giving half scores to our sheep where possible. Industry should use the AWI visual booklet guidelines which makes use of full score, which is adequate for industry purposes.

The following graphs (Figure 11) shows the differences in clean fleece weight, fibre diameter, coefficient of variation of fibre diameter, fibre curvature and body weight between the more and less resistant groups.

Figure 11. Differences between more and less resistant groups for different traits





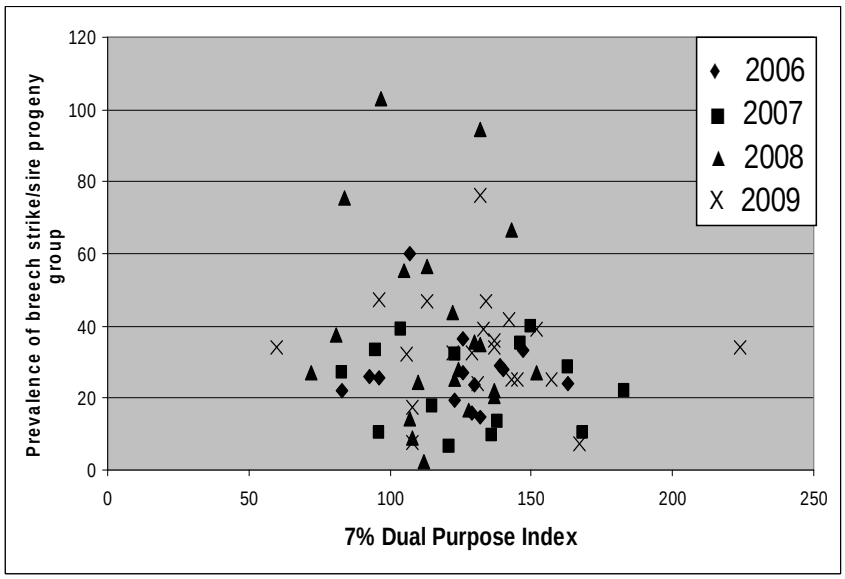
(NB graphs will be changed to show more and less resistant rather than best and rest. GL)

No significant differences were found between the More and the Less groups for coefficient of variation of fibre diameter and fibre curvature. Significant differences were found between the More and the Less for clean fleece weight with the More cutting 100 gram less wool that was 0.1 micron finer but were 4.5 kg heavier at hogget age.

Relationship between breech strike and production of sire progeny groups

Figure 12 shows the relationship between production as measured by the 7% dual purpose index and the incidence of breech strike in the sire progeny groups of the breech strike flocks over four years. The 7% dual purpose index allows for a balanced increase in body weight and fleece weight whilst also reducing fibre diameter at the same time

Figure 12. Relationship between breech strike prevalence and the 7% DP index for sire progeny groups in different years



It is clear that no relationship exists between genetic level of production as measured by the 7% DP index and breech strike prevalence. This indicates that high producing sires also can be resistant to breech strike and the industry needs to identify sires from the bottom right hand area of this distribution.

Future research requirements

Although the indicator traits are a very good start in the selection for breech strike resistance they don't explain all the variation in flystrike. In an attempt to identify other potential indicator traits the progeny of the two most resistant and the two most susceptible sires were investigated for a wide range of traits. The results are shown in Table 2 for the major indicator traits for the four progeny groups born in 2008. All these animals were born and raised under the same environmental conditions. Thus any differences detected can only be due to genetic differences between these groups. Although statistically significant differences were found for urine stain and wool colour the differences were practically insignificant. Examples of the groups are shown in Plate 1 and 2.

Table 2. Means of the indicator traits of the two most resistant and two most susceptible sire progeny groups at hogget age

Traits	Resistant		Susceptible		P-value
	Sire 1	Sire 2	Sire 3	Sire 4	
Breech strike%	2.5	8.9	102.9	94.3	
Progeny No's	41	44	35	32	
Dag score	2.1	2.4	3.3	3.3	0.22
Breech wrinkle	1.0	1.0	1.0	1.0	0.90
Breech cover	2.7	2.6	2.8	2.7	0.20
Urine stain	1.2	1.3	1.5	1.4	<0.01
Wool colour	2.5	2.7	2.8	2.7	0.03

Although there were differences in dag scores between the resistant and susceptible groups it was not statistically significant because of the large variation within groups.

An overall visual comparison of these two extreme groups is also remarkable for the lack of any other overt differences. In spite of the fact that this flock is relatively plain compared to some other strains, no significant differences were found between the progeny of these extreme groups for any other traits. This clearly shows that other as yet unknown factors contribute in making animals more or less resistant to breech strike.

Plate 1. Progeny from the most susceptible sire

Plate 2. Progeny from the most resistant sire

Given that there aren't any major differences in the traits we have examined so far for these sheep, what attracts the gravid female blowfly female more to one sire's progeny and less to the other sire's progeny? We hope to answer the question over the next 2 years.

The first two larval stages (instars) require a readily available liquid and well balanced food source to satisfy their development. They can literally double their weight in 24 hours. These conditions at the skin surface are associated with unique smells that the fly can detect to select sheep on which to lay their eggs.

Can use these odours as selection criteria to differentiate between susceptible and resistant sheep?

New research activities

Olfactory methods

It is well known that odour plays a big part in attracting blowflies to sheep. We plan to focus on odour and we have initiated some collaboration with the Forensic Centre at University of WA. They have unique facilities and skills to subject blowflies to wool and dag samples in a 'choice' test to identify potential odour attractants

Another approach will be to evaluate whether Custom security dogs can be trained to identify resistant or susceptible sheep using their extreme sense of smell.

Acknowledgement

We would like to acknowledge industry support both through AWI funding and individual woolgrowers contribution of genetic material, and the dedicated support provided by staff at the Mt. Barker Research Station

The staff at the Mount Barker Research Station, Ross Ramm, Neville Chittleborough, Dale Sutton and Colin Hamley for their ongoing support on the research station. A particular thanks to the technical staff attached to the project Noreen Underwood and Nicole Stanwyck for their day to day inputs into the running and maintenance of the flocks.

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