Australian Wool Innovation Limited

MANAGING BREECH FLYSTRIKE

FEBRUARY 2019

TABLE OF CONTENTS

INTRODUCTION

Flystrike costs the Australian sheep industry $173 million annually. Reducing the risk of flystrike has immense benefits to the health and wellbeing of the sheep, the people who work with them and business/farm productivity.

Flystrike occurs when a blowfly lays eggs on the skin of the sheep and the emerging larvae create an open wound as they feed on the underlying skin tissue. Depending on conditions for the larvae, flystrike can quickly become fatal or result in a slow and painful demise.

Woolgrowers go to considerable lengths to improve the welfare of their animals and minimise the risks of flystrike. Treating and caring for flystruck sheep is an arduous physical and mental task. It affects their livelihood through the loss of struck sheep, the time and cost of treatment, and prevention of further strikes.

The blowfly was accidentally introduced to Australia in the late 1890s where it slowly adapted to the conditions over the following 20 to 30 years and spread across all woolgrowing regions.

Breech strike is by far the most prevalent type of strike, which led JHW Mules to develop the mules procedure in 1929.

Mulesing, where the skin around the lamb's breech is surgically removed, is one of several management options for the prevention of flystrike along with chemical treatments, crutching and breeding for low wrinkle sheep. It was so successful in reducing breech strike and improving lifetime welfare that there was almost 100 per cent adoption by Merino breeders by the 1980s.

The procedure is highly effective in improving lifetime welfare, but there is increasing pressure on producers to reduce their reliance on mulesing with consumers, governments, retailers and welfare lobby groups concerned about the lambs' welfare at the time of mulesing.

Mulesing has been the subject of animal activist campaigns, which has resulted in retail stakeholders seeking greater understanding of the issue, particularly in North American and European markets. Assisting woolgrowers and the industry to address and resolve this issue is the highest R&D priority for Australian Wool Innovation (AWI).

Woolgrowers have sought to find effective alternatives to mulesing, tail docking and castration for many decades. In 2005, AWI recommitted to an intensive research and development program to provide pain relief options and reduce the reliance for mulesing over time.

This publication, in conjunction with FlyBoss (www.flyboss.com.au), is designed to help woolgrowers reduce their flock's flystrike risk, develop an effective control plan and eventually move to a non-mules woolgrowing enterprise.

For the latest updates on the progress of the AWI Breech Strike RD&E Program visit the Breech Fly Strike page on the AWI website, "Latest Publications"

www.wool.com/flystrikelatest

01

FLYSTRIKE RISK FACTORS

BIOLOGY OF THE BLOWFLY

The Australian sheep blowfly, *Lucilia cuprina*, is responsible for initiating more than 90 per cent of sheep flystrikes in Australia.

Figure 1.1: Immature life stages 1, 2, 3 and 4 of *Lucilia cuprina*. *Photo:* S De Cat and J Larsen, The Mackinnon Project, University of Melbourne

Adult flies rarely live longer than a month, but in that month they are capable of laying up to 600 eggs. Eggs usually hatch into larvae in 12-24 hours and larvae grow from pin-head size to 10-15 mm in length in about three days (Figure 1.1). They then drop off the sheep to commence pupation a day or two later (Figure 1.2).

LIFECYCLE OF THE BLOWFLY

Larvae usually fall off the sheep at night or in the early morning, when ground temperatures are coolest, and burrow into the soil. This means that a large proportion will pupate and subsequently emerge as blowflies around sheep camps.

During their life, adult flies will normally not travel more than three kilometres from where they hatch. After hatching, the female fly needs feed rich in protein, usually from wounds, existing strikes and carcasses, for her reproductive organs to mature and become active. She needs a further feed of protein before egg laying will commence.

L. cuprina preferentially, but not exclusively, breeds on live sheep. Once *L. cuprina* has initiated a strike, the resultant skin damage may attract a number of other species of secondary flies, which usually cause more severe damage and can even lead to death of the animal.

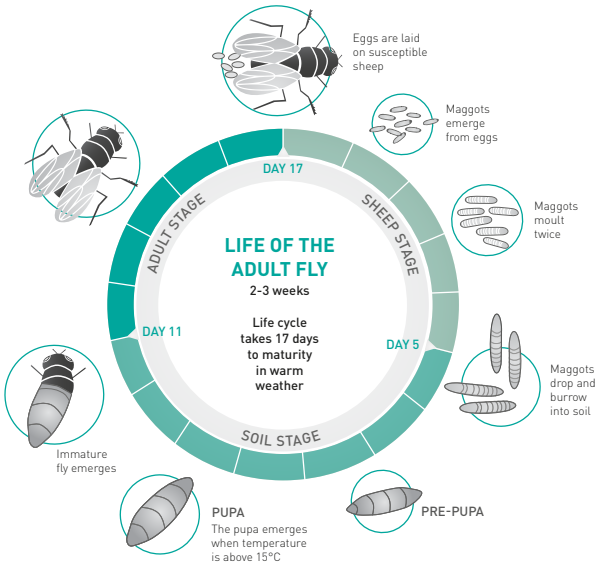


Figure 1.2: The lifecycle of *Lucilia cuprina*, the Australian sheep blowfly. *Source:* Levot (1999)

ENVIRONMENTAL FACTORS

Blowflies need optimum temperature, wind, moisture and predisposed sites in order to strike. Climate differences between regions and from year to year strongly influences the risk of flystrike. Altitude, distance from the coast, timing of prevailing winds all impact on temperature, wind and moisture. These factors can also vary from year to year on the same property.

Temperature

Studies have shown that the blowfly is relatively inactive below 15°C. It is most active between 26°C and 38°C. The longer the temperature remains above 15.5°C, the greater the chance of egg laying and the risk of strike. Egg laying and fly activity decline when the temperature reaches 38°C and cease completely above 45°C.

Wind

Wind can affect the risk of flystrike in two ways: wind speeds above 9 km/h will reduce flight activity and when wind speed exceeds 30 km/h all activity ceases. Wind also affects the speed at which sheep dry with stronger winds accelerating the drying of predisposed sites. Thus depending on the amount of shelter, different paddocks can vary dramatically in fly activity.

Rain (moisture)

Moisture is critically important for flystrike, and rain increases the risk of flystrike dramatically when there is enough to keep the sheep's skin moist for longer than two days. Moisture trapped between wrinkles can support a strike while urine and faeces provide moisture as well as attracting blowflies.

The relative risk of flystrike in a summer and winter rainfall period is shown in Figures 1.3 and Figure 1.4. High rainfall and warm temperatures in a summer dominant rainfall region means the highest risk period is in spring through to early autumn (September to May).

In a winter dominant rainfall region the highest risk is in late spring and early Summer (September to December), due to different periods of rainfall and warmer temperatures.

It is important to know the seasonal times when flystrike is most likely for your region as this will enable better planning to manage the risk of flystrike through strategic timing of events such as shearing and crutching.

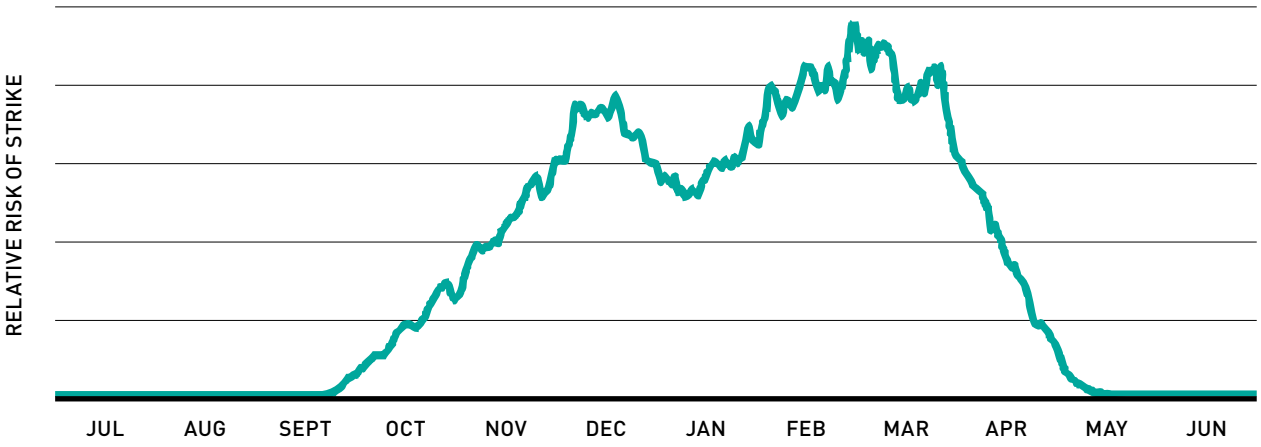


Figure 1.3: Typical risk of all types of flystrike in a summer rainfall area. *Source:* Flyboss

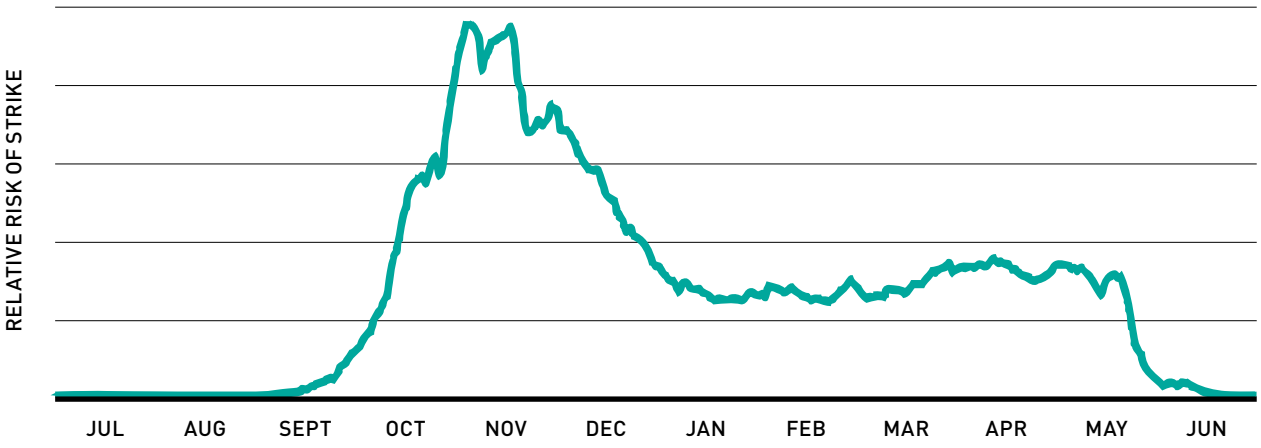


Figure 1.4: Typical risk of all types of flystrike in a winter rainfall area. *Source:* Flyboss

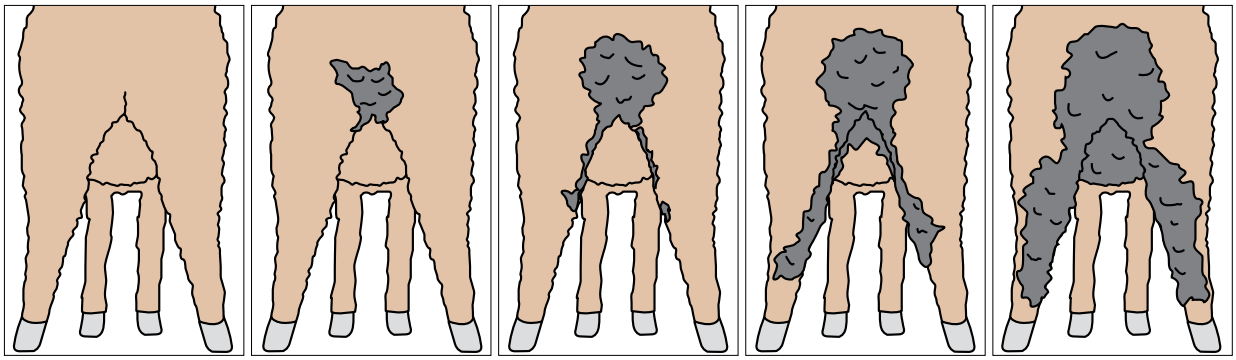


Figure 1.5: Dag scores. *Source:* AWI/Meat & Livestock Australia Visual Score Guide

PREDISPOSED SHEEP TRAITS

Evaluating your flock is an important step in determining your sheep's susceptibility to flystrike. Key indicator traits can be used to evaluate the flystrike risk and determine the overall susceptibility of body and breech strike in the flock. Research has shown that susceptibility to flystrike is dependent on a number of indicator traits. The importance of each individual trait in determining the risk of flystrike depends on your region.

BREECH STRIKE

The most important traits in determining the risk of flystrike are:

1. Dags
2. Wrinkle

Followed by

3. Urine Stain
4. Breech Cover
5. Wool Colour

While high dags and high wrinkle are the two main risk factors, significant interactions with and between the other risk factors can occur which will increase the risk of flystrike of the flock. Dags are not normally found in the low rain wheat-sheep, pastoral areas and summer rainfall areas, but care does need to be taken because once in every 10 years, conditions can lead to a significant presence of dags, which will require special management strategies.

In some areas, where the risk of dags is high (high winter rain and high rainfall wheat-sheep areas), the risk of strike is impacted by both high risk factors, dags and wrinkle (source: AWI funded study in south-east Australia).

In areas where diarrhoea/scouring and dags are prevalent, dags can be the most important factor in determining the risk of breech strike. A dag score 4 animal (Figure 1.5) can be up to seven times more susceptible to breech strike than a dag score 1 animal in the same mob. Breech cover is also an important contributing factor of breech strike in winter rainfall areas.

At Avondale, a Department of Agriculture and Food, Western Australia research station, dag scores and breech strike incidences were recorded in a high fly-pressure year. Using this information, the relative risk of breech strike was determined for dag score 2, 3 and 4 lambs. Compared to dag score 1 (no dags) lambs, score 2 lambs were twice as likely to be struck whilst score 3 and 4 lambs were, four- and seven-times more likely to get breech strike. This highlights the importance of controlling dags and worms in non-mulesed sheep in this region.

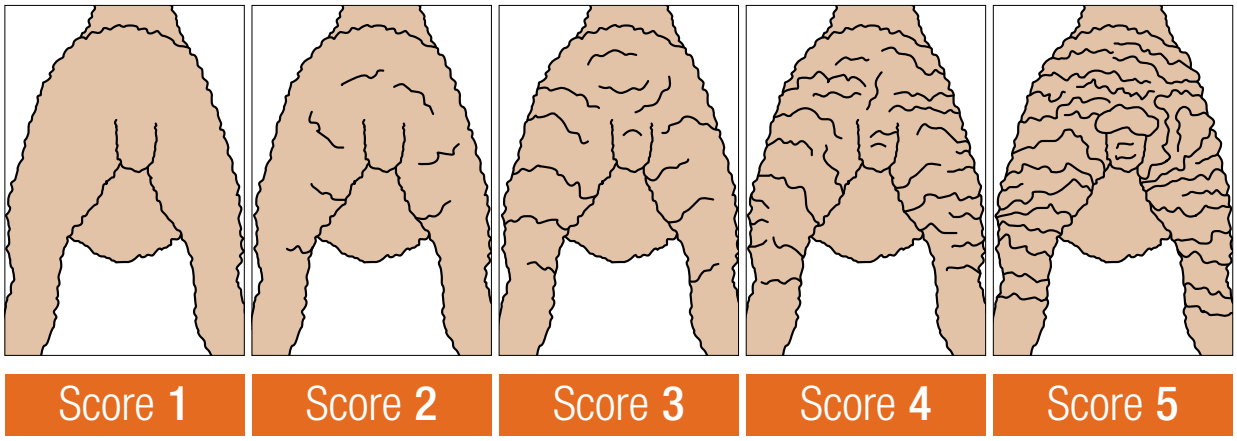


Figure 1.6: Breech wrinkle scores. *Source:* AWI/MLA Visual Score Guide

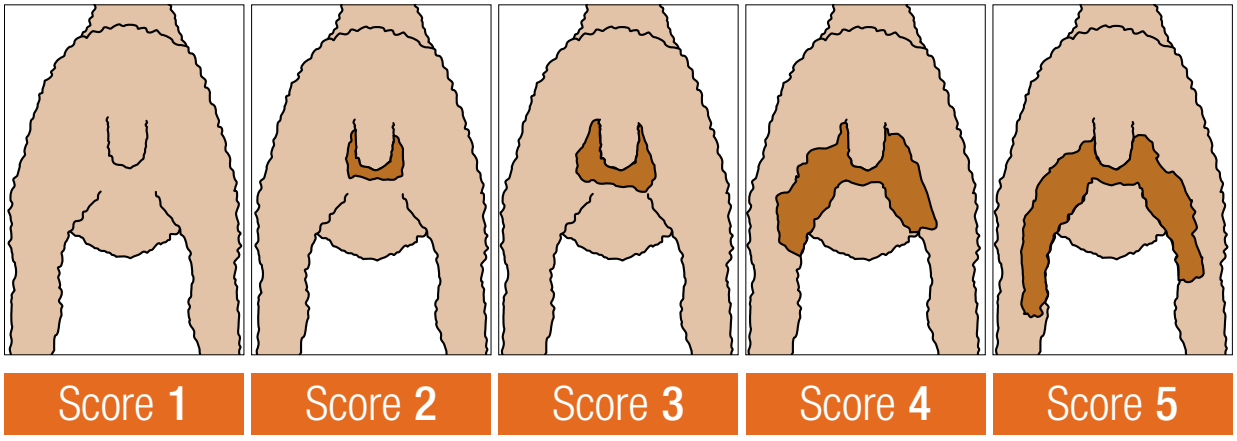


Figure 1.7: Urine stain scores. *Source:* AWI/MLA Visual Score Guide

Breech wrinkle (Figure 1.6) is the most important indicator trait in the low dag areas. The risk of breech strike increases significantly as wrinkle score increases.

Therefore reducing your flock's average breech wrinkle score will decrease your flock's susceptibility to breech strike (Figure 1.8).

Having daggy sheep will increase your risk of flystrike.

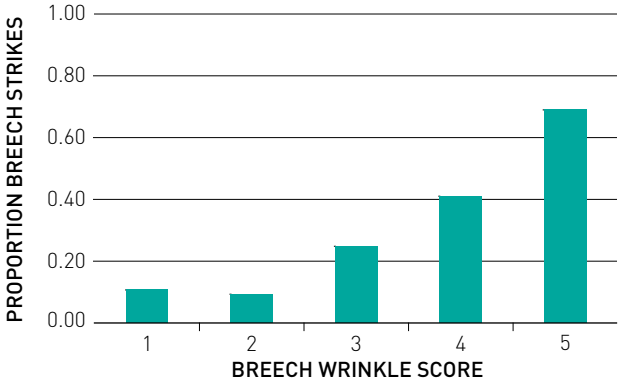


Figure 1.8: Proportion of breech struck animals from a summer rainfall area post weaning and their corresponding breech wrinkle score. *Source:* CSIRO and AWI Breeding for Breech Strike Resistance Project.

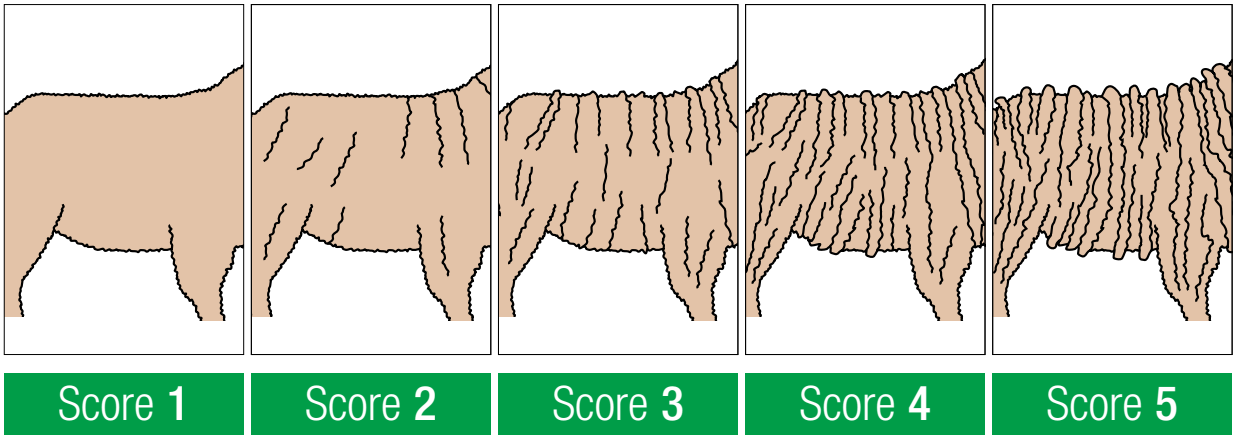


Figure 1.9: Body wrinkle scores. *Source:* AWI/MLA Visual Score Guide

In addition, wrinkles around the breech area can increase the amount of urine and dags retained and therefore further increase the susceptibility of flystrike.

However, it can be difficult to score breech wrinkle in full wool sheep, but as breech, body and neck wrinkle are highly correlated, body wrinkle (Figure 1.9) and neck wrinkle can be used as predictors of breech wrinkle.

BODY STRIKE

Fleece rot and fleece colour are all predisposing factors for body strike. Animals susceptible to fleece rot and particularly those already with fleece rot, are much more likely to be affected by body strike.

Fleece rot is most common in areas where warm temperatures occur during periods of rainfall. The moisture and bacterial growth that are associated with fleece rot provides an ideal environment for blowflies to lay eggs.

The scoring system in Figure 1.10 should be used to determine your flock's fleece rot susceptibility, with higher scores being more susceptible.

Growers have been breeding for lower micron and less variability of micron (by using the coefficient of variation of fibre diameter) and this has reduced the incidence of fleece rot and thus body strike.

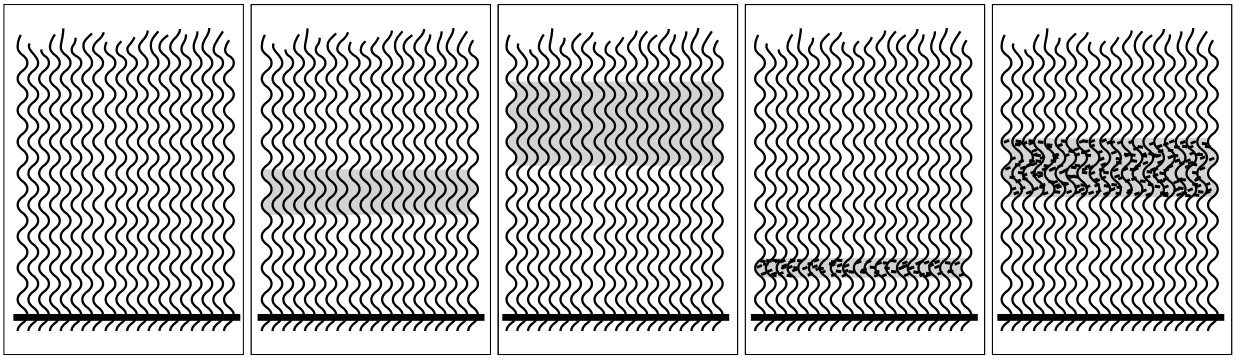
Body wrinkle is not strongly related to body strike.

SCOURING AND WORM CONTROL

Scouring and dags have long been recognised as one of the most significant risk factors associated with breech strike, even in mulesed sheep. Severe scouring can significantly decrease the productivity of your enterprise. High production grazing systems with improved pastures and higher stocking rates have contributed to the prevalence of scouring and its importance in breech strike risk.

There are generally five main types of scouring and their prevalence varies by region and farm (Table 1.11).

Scouring can be the most important factor associated with breech strike.



Score 1	Score 2	Score 3	Score 4	Score 5
No bacterial colouring or staining.	Band of bacterial staining <10mm wide with no crusting.	Band of bacterial staining >10mm wide with no crusting.	Band of bacterial staining <5mm wide, with or without bacterial staining.	Band of bacterial staining >5mm wide, with or without bacterial staining.

Figure 1.10: Fleece rot scores. *Source:* AWI Visual Score Guide

TYPE OF SCOURING	RISK	CLASS OF SHEEP
High worm burden	Winter rainfall areas – moderate to high, depending on rainfall	Immature sheep and lambing ewes are most susceptible. Sheep in poor condition are also susceptible.
	Summer rainfall areas – low to moderate, depending on rainfall	Immature sheep, lambing ewes and sheep in poor condition are more susceptible.
Larval challenge (hypersensitivity)	Inter rainfall areas – moderate to high (occurs in winter)	Susceptible from about 12 months of age, mostly in mature sheep.
	Summer rainfall areas– nil to low	
Pastures/feed changes	Very specific to some pasture types	All
Coccidiosis	Occasional*	Very young lambs, occasionally older sheep in stress situations.
Bacterial infections	Sporadic	Mainly seen in young sheep and lambing ewes.

*Coccidial infection occurs in almost all sheep but visible problems are not common

Table 1.11: Type of scouring, risk and class of sheep most susceptible

High worm burdens

High worm burdens are the most common cause of scouring in sheep, especially in winter rainfall areas. Adult 'scour worms' (black scour worm – *Trichostrongylus spp,* and the brown stomach worm *Teladorsagia circumcincta,* formerly known as *Ostertagia*) damage the gut and reduce feed intake, which can eventually result in the visible signs of wasting and diarrhoea.

High worm burdens are the most common causes of scouring and lambs are most at risk.

Lambs and weaners are at the highest risk as they have less immunity. Ewes suffer a temporary drop in immunity around the time of lambing and early lactation and therefore are impacted more by worm burdens at these times. Except in high worm regions, adult wethers usually don't have significant worm burdens due to higher immunity but can if they graze in heavily contaminated pasture, or are in poor body condition.

Larval hypersensitivity is commonly found in winter rainfall areas in sheep older than 12 months predictable.

Larval challenge

Larval 'hypersensitivity' is another worm-related condition that is more common in high winter rainfall environments. The problem is not the physical damage from the larvae developing to adult worms but rather an unfortunate immune response from worm larvae. This is seen as an inflammatory reaction that damages the gut and leads to scouring. This form of immune response is repeatable from year to year, i.e. a sheep that scours in one year is likely to scour the next.

Larval hypersensitivity is most commonly seen in hogget and young adult sheep in Mediterranean regions. Sheep start to consume larvae infected pasture after a period of low exposure, such as over a hot, dry summer. Testing sheep for faecal worm egg count will show no or very low levels. This is typically seen in winter to early spring. Drenching has little effect. This phenomenon has a strong genetic basis but it is not easy to select for. It then progresses through a mob, with a portion of the sheep actively scouring at any one time, and that can last up to a month. Individual animals will cease scouring after a week or two, after which a new batch of sheep will start to show signs. Sheep suffering from this condition are usually not visibly ill.

Nutritional causes of scouring

Nutritional factors, including rapid feed changes and some pasture species, have been reported as causes of scouring. Grazing green oats and other species with high moisture and digestibility may also cause scouring. Cape weed is also often implicated in scouring but research has shown that while it may increase the severity of scouring, other factors need to be present to incite the scouring.

Use worm egg counts to determine if worms are causing your sheep to scour.

Digestive upsets such as acidosis from grain overload or highly mineralised bore water can also cause scouring, but these events are sporadic rather than regular seasonal events. Occasionally, severe mineral or trace element deficiencies, such as selenium or salt toxicity, can cause sheep to scour.

Bacterial/coccidial infection

There are several other infectious or toxic agents that can be associated with scouring in sheep.

Bacterial, viral and protozoal agents, such as *Yersinia, Salmonella, Giardia, Campylobacter* and *Cryptosporidium*, are often found in the environment and can affect susceptible sheep quite severely. Signs include fetid or blood stained scouring, fever, weakness and even deaths as the disease outbreak progresses. These situations are not common, but can be extremely significant primarily in younger and/or immuno-compromised and stressed animals. See http://www.wormboss.com.au/worms/other-occasional-parasites-of-sheep-and-goats/coccidia-and-cryptosporidium.php

Fly traps can determine fly presence but shouldn't be used to reduce fly numbers.

Major problems with breech strike occur when worms begin to take hold in winter rainfall areas. On one property near Beverly, WA, pregnant ewes began to show signs of scouring in July and faecal worm egg counts revealed moderate worm burdens (an average of about 500 eggs per gram). Ewes were drenched in mid-August, when checking of the lamb worm egg counts also commenced (and averaged over 500 epg). Lambs were treated with an effective drench and jetted in mid-September but intensive fly problems persisted up to and beyond shearing in mid-October. About 10 per cent of the weaners showed fresh dags during the weeks after shearing and so another drench was required. The weaners were then put into clean paddock with good stubbles and the levels of strikes and scouring declined. Worm monitoring and closer control earlier in the season may have reduced the worm contamination of the paddocks by the ewes and hence reduced the impacts of worms, scouring and subsequent flystrike in ewes and lambs.

FLY TRAPS

Fly traps, for example Lucitrap™, are a useful tool to monitor fly activity, but under most circumstances, do not sufficiently reduce the occurrence of flystrike to be an effective control strategy. Trapping can reduce fly populations by up to 50 per cent with heavy and constant trapping but this is ineffective in reducing the number of strikes if predisposing conditions are present.

Traps need to have the right bait and shape to ensure that they attract fly species involved in strikes rather than benign species that may compete with *L. cuprina*. Secondary flies will also out-compete *L. cuprina* on carrion and hence sheep and other carcases are not a major contributor to overall flystrike levels.

Further information on Lucitrap™ is available at www.bioglobal.com.au/lucilure.html

02

MANAGEMENT

Management options, including strategic chemical use; timing of shearing and crutching; and the timing and spread of lambing, will significantly reduce your flock's susceptibility to flystrike.

STRATEGIC USE OF CHEMICALS (FLYBOSS)

Strategic chemical application can be very useful in reducing the risk of flystrike. When considering a chemical treatment check for withholding periods and intervals.

Withholding periods are mandatory with all registered veterinary products used to treat sheep for worms, flies or lice. These periods have been developed to indicate when the chemical residue that remains in or on meat and wool products will not exceed the maximum residue limit. These limits are set in Australia to ensure that; lamb and sheepmeat is safe to eat, wool is safe to handle and wool scour effluent is safe for the environment.

There are three withholding periods:

- The Meat Withholding Period (Meat WHP) is the time from chemical application to when an animal is slaughtered for domestic use
- The Milk Withholding Period (Milk WHP) is the time from chemical application to when milk can be taken from the animal for human consumption
- The Wool Harvesting Interval (WHI) is defined as the time from application of a chemical to when the wool can be harvested to satisfy Australian environmental requirements (also includes crutching)

Other important intervals that need to be observed:

- The Export Slaughter Interval (ESI) is the time from chemical application to when an animal is slaughtered for export
- The Wool Rehandling Period is the time between treatment and when wool/sheep can be safely handled without the need for protective clothing

For up to date information visit: www.flyboss.com.au

Strategic use of chemicals can decrease your risk of flystrike.

Choosing the right treatment:

- Choosing the right chemical
- Choosing the right application method
- Choosing the right time to treat

Choosing the right support tools:

- Flystrike Decision Support Tools
- Start the FlyBoss Tools
- Products – and then select the method of application

Always consult the product label and follow the directions for use.

See http://www.flyboss.com.au/treatment/choosing-the-right-chemical/withholding-periods-for-worm-lice-and-fly-treatments-for-sheep.php

Chemicals are registered to be used as either a preventative treatment or to treat struck animals so it is essential to use the correct chemical for the task.

Some chemicals only provide a protection period and will not kill maggots on already struck animals. For example, dicyclanil (e.g. Clik®) can give up to six months protection against flystrike but will not kill maggots.

Other products, such as ivermectin (e.g. Coopers Fly and Lice®) can be used to prevent flystrike, as well as treating existing strikes, but only provides protection for up to 12 weeks.

Sale of stock for slaughter will also affect the type of chemical you can use and the time of application.

Wool withholding intervals need to be considered as chemical options may be limited due to shearing time. It is important to plan for potential delays in shearing especially in wet seasons.

CONSIDER THIS:

A producer that lambs in early winter, has a high fly risk period over spring and plans to sell wethers for export at the end of the year. Previously a preventative chemical application at marking has been used, but the producer has found that it wore off prior to selling stock and they had very limited options to re-apply the chemical due to export slaughter intervals; as a result there are flystrike issues prior to the stock being sold.

ALTERNATIVE STRATEGY:

An option for this producer is to not apply a chemical at marking, and wait until weaning in late winter just prior to the fly risk period. The delay in application means that stock are covered over the full high-risk period.

Managing the ewes and wethers separately gives an additional option of applying two separate chemicals, a longer-acting one for the ewes, for which the export slaughter interval is not relevant, and a shorter-acting chemical for the wethers due to the export slaughter interval.

It is essential that you observe meat WHP, ESI and WHI.

Where fly prevention is needed at the time of mulesing, there are a limited number of registered chemical products available for application to the mulesing wound.

Wet weather will affect the protective period stated on product labels and they should be viewed as a guide only. The protective period can be shortened if persistent rain reduces the chemical concentrations in the wool or if there is extreme fly pressure in the paddocks (this watering down is different to resistance). Young lambs may also have a reduced protection period due to their wool having lower levels of lanolin, which reduces the binding and retention of the applied chemical.

When applying chemicals it is essential that the correct applications are used to ensure effective results. The optimum pressure for hand jetting is 550 kpa (80 psi) for short wool and 700–900 kpa (100–130 psi) for long wool.

All chemicals should be applied according to label recommendations. Wet weather can reduce their efficacy.

If hand jetting, it is recommended that a Dutjet® wand or similar be used. For more information on the correct application methods when applying chemicals visit http://www.flyboss.com.au/treatment/choosing-the-right-application-method.php

Regardless of the jetting method used, there must be sufficient quantity of chemical to penetrate the wool and wet the skin. In areas where the risk of body strike is low, it is likely that a jet application only on the breech of sheep is required. All jetting must be done according to label recommendations.

Although chemicals can be very effective, it is important that you use a mix of management strategies to minimise your reliance on chemicals. This ensures you limit your exposure to workplace health and safety concerns and reduces the risk of chemical residue and the potential for lavae resistance. You need to be aware of the possible dangers and side effects of the chemical, not only for yourself but also for your staff and family.

By treating only the mobs at moderate risk of flystrike, you will improve lifetime welfare as well as save money and decrease the possibility of creating residue and resistance issues on your property.

The following practices are known to increase the risk of residues:

- premature shearing of pesticide treated sheep
- re-treatment after failed initial treatment
- use of combinations of dipping chemicals
- plunge or shower dipping sheep with less than 6 weeks wool

Growers have a responsibility to follow the label directions judiciously and withhold any wool or stock that does not meet the relevant withholding period. Multiple applications of chemicals in a given season will increase the risk of residues.

Don't over rely on chemicals. Treat only animals that need treating.

TIME OF SHEARING AND CRUTCHING

Shearing and crutching are key management tools for controlling flystrike as the appropriate timing of these events can dramatically reduce the risk of flystrike.

Shearing and crutching can give six weeks protection from breech strike.

The timing of shearing and crutching is a compromise between many factors such as the best time to turn-off cast for age/sale stock, staple strength and position of break, lambing, joining, grass seed and vegetable matter management as well as shearer availability and other major events on the property.

Shearing and crutching can each give up to six weeks protection from breech strike. If sheep are scouring, this protection may be reduced to three weeks. In a non-mulesed flock the timing of crutching or shearing becomes more important.

Shearing or crutching time should be planned to coincide with the start, or just before the usual start, of the fly season, keeping in mind withholding periods and protection periods of chemical applications.

ENVIRONMENTAL INFLUENCES

Environmental differences and combinations of rain and warm temperatures at different times during the year mean that different regions will have different flystrike patterns and subsequent times of high risk.

The graphs below (Figures 2.1 to 2.5) have been developed using the FlyBoss tool (www.flyboss.com.au). The graphs indicate an overall risk of flystrike, which includes all types of strike. You can visit the FlyBoss website to obtain a relative-risk graph for your location. There is also the option to choose a non-mules enterprise and compare the change in breech strike risk relative to a mulesed enterprise.

Each region will have different flystrike risk periods.

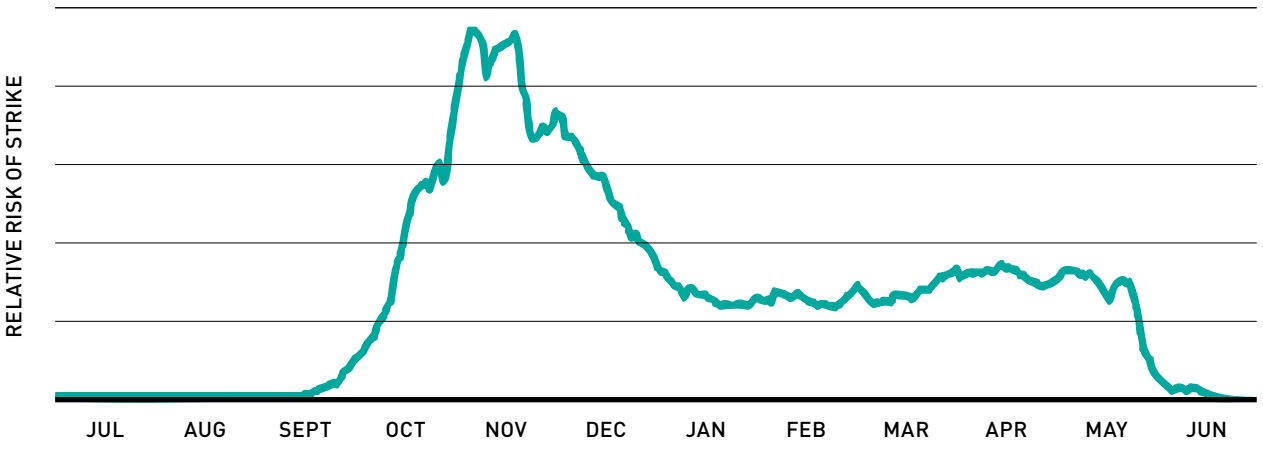


Figure 2.1: The relative risk of all types of flystrike in a winter rainfall area (Kojonup, WA)

In winter rain areas the risk period starts in early spring and peaks in mid spring. Over the spring and early summer months there is increased fly pressure due to the warmer temperatures and spring rainfall, making it an optimum time for flystrike. This risk levels out over the summer and autumn months due to high daily temperatures and little rainfall.

Appropriate timing of crutching can significantly decrease your risk of flystrike (Figure 2.2). The high peaks in October and November seen in Figure 2.1 have been decreased.

Shearing in mid-March will further reduce your risk of flystrike (Figure 2.3). The risk period over the autumn months has now been significantly reduced.

There is still a large relative risk of flystrike over the later spring and summer months, which can be further reduced with a preventative chemical application (Figure 2.4) at the time of crutching. No extra yarding is required if the chemical is applied at crutching and the flystrike risk has significantly decreased over the summer months.

If applying a preventative chemical after shearing it is recommended to wait six weeks after shearing before application to gain the maximum benefit

Figure 2.2: The effect of crutching on 1 October in a winter rainfall area on the relative risk of all types of flystrike.

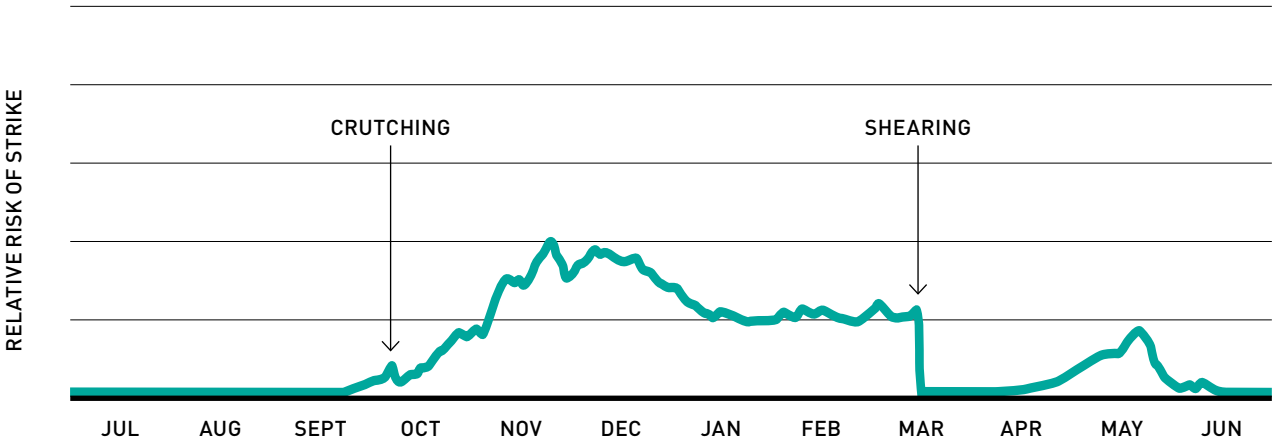


Figure 2.3: The effect of crutching on 10 October and shearing on 15 March in a winter rainfall area.

from shearing. However this may not be practical in all farming systems. In these cases, applying a preventative chemical straight off shears is recommended.

In Figure 2.5, shearing on 10 October, applying a three month preventive chemical six weeks post shearing and crutching prior to lambing on 20 April decreases the length of time at risk over the late summer and early autumn months. However, there are now two peak-risk periods in spring, unlike the previous example.

Time of shearing and crutching obviously needs to fit with other major events on the property such as seeding and harvest, but the likely impact on wool value should also be considered.

Fertility, grass seed and staple strength management should also be considered when changing shearing and crutching dates to lower the risk of flystrike.

In summer rainfall areas, shearing during spring and summer may place the position of the break in the middle of the staple which can increase the chances of incurring a price discount for low staple strength. It is important to plan when you can deal with higher risks of flystrike; each producer will have their own optimum time to shear and crutch.

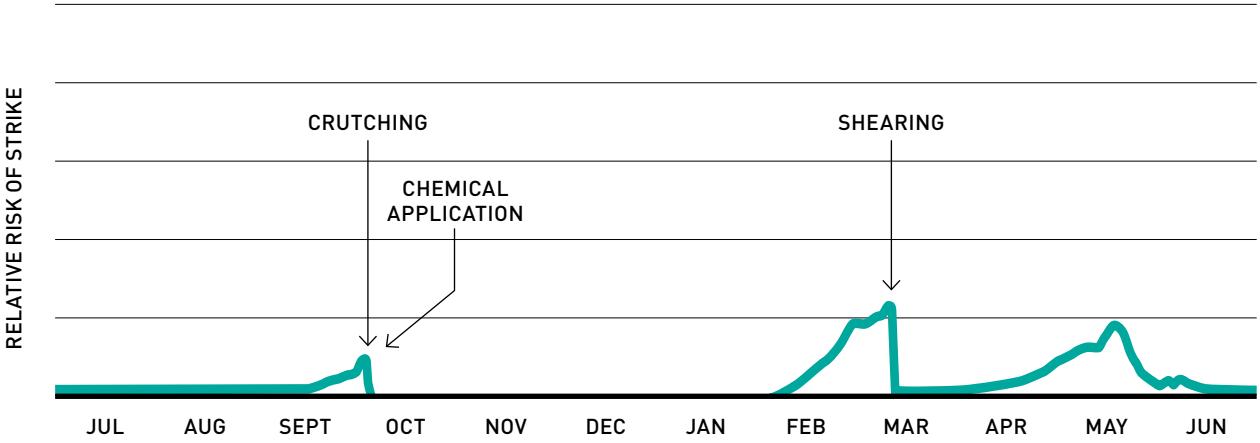


Figure 2.4: The effect of crutching on 10 October and shearing on the 15 March in a winter rainfall area, while applying a preventive chemical at crutching.

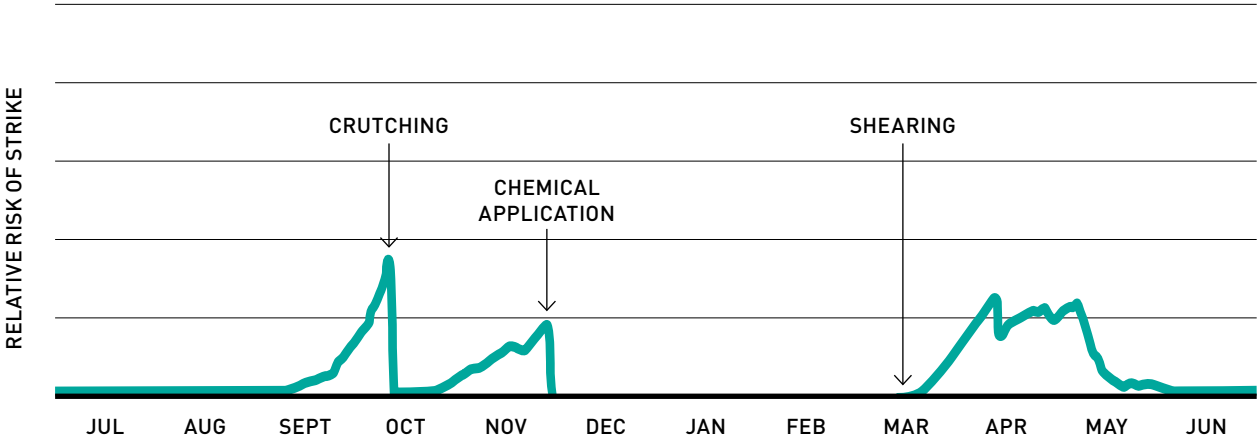


Figure 2.5: The effect of shearing on 10 October and crutching on 10 March in a winter rainfall area, whilst applying a preventive chemical six weeks after shearing.

Another important strategy is to time lambing so that it does not normally coincide with high fly pressure. If lambing during a high-risk fly period does occur, it is advisable to use a chemical preventative on the ewes prior to lambing as amniotic fluid from lambing (afterbirth) can attract flies.

Wool quality should be considered prior to changing shearing/ crutching dates.

Some producers minimise their risk by having a shorter lambing period which allows earlier access to the ewe flock after lambing in the event of high fly pressure. This strategy has additional benefits with less late-dropped lambs, which have a higher mortality rate and are less likely to achieve target weight at weaning. Others are finding that a shorter lambing period gives them options to shear every eight months to minimise the time when ewes and lambs cannot be mustered.

Tony and Richard Gee of Fingal Valley, Tasmania, run non-mulesed Saxon Merinos and encounter minimal incidences of breech strike. They began breeding for plain-bodied sheep in the 1960s with an emphasis on reducing excessive skin wrinkle. Their management system is based on careful timing of shearing and crutching.

The risk of flystrike is primarily managed through the timing of these operations. This includes a late spring or early summer shearing, which removes wool from sheep during the worst period of flystrike. Ewes may get crutched twice a year, once prior to lambing to reduce stain and then another, if needed, in later summer or early autumn. Richard reports that the quality of the wool has not been compromised by their management decisions as bright soft fine white wool has always been their first priority. The key to their success is that they have been able to balance that priority with reducing wrinkle.

SCOURING AND WORMS

Effective management of sheep scouring and dags can significantly reduce the risk of breech strike in mulesed and unmulesed sheep. The first step in the effective treatment and future management and prevention of scouring is the correct diagnosis of the cause of the problem.

Diagnosis of scouring due to large burdens of adult worms is generally relatively simple with a faecal worm egg count to help determine whether there is a large burden of adult worms.

Diagnosis and prediction of larval hypersensitivity scouring remains a challenge and is often made using the history of the problem and by ruling out other likely causes. As there are often few adult worms involved in this syndrome, typically sheep will have very low faecal worm egg counts. No drench would be recommended in that case, but a worm egg count is useful to detect cases where there are unexpectedly heavy burdens.

Diagnosis of other suspected infectious or toxin-related syndromes is best carried out in conjunction with your local veterinarian.

Treatment of scouring

Where high adult worm burdens are the problem, treating your animals with a fully effective broad-spectrum anthelmintic will remove the worm, stop the scouring and allow the gut to begin to regenerate.

Importantly, some judgement is needed of the likely worm levels in a paddock to avoid the need for frequent re-treatment. If sheep are simply returned to a paddock reasonably contaminated with worms then larval pick-up will commence again soon after a short acting oral drench and hence the syndrome may re-appear.

Treatment to reduce larval hypersensitivity scouring is less clear-cut and more research is required to provide practical solutions to reduce the impact. In the long term, genetic selection

offers a solution, however apart from treating sheep with a long-acting drench capsule, little can be done to prevent it.

To reduce the development of drench resistance in worms it is important that sheep are not drenched unnecessarily. An extra crutch may be useful to reduce dag build up if hypersensitivity is a significant problem.

Long-acting worm treatments are often used successfully by producers to control worms and scouring. However, there is a significantly greater potential to increase levels of anthelmintic resistance compared to short-acting drenches if these products are used routinely and on a widespread basis.

Long-acting products should only be used according to a worm control plan that aims to reduce this risk. Treatment of other infectious or toxic scouring diseases can include antibiotics and other supportive therapies if warranted.

Work with your local animal health expert to determine your drench resistance status and the most effective treatment for your sheep.

Grazing management

Planning grazing management after drench treatment is necessary to minimise re-infection of sheep with worms. Paddocks need to be spelled for at least three months in winter and four or more weeks after pasture dries off, to minimise re-infection.

Long acting treatments have greater potential to increase levels of anthelmintic resistance.

Prepare low-worm-risk paddocks for high risk mobs. Low-risk paddocks can be recently cropped, spelled for more than three months, grazed by cattle for greater than three months or have been grazed by low-risk sheep such as adult sheep in good condition.

Longer-term management of scouring

A small number of adult sheep scouring, while the majority of the flock are clean, usually indicates a genetic basis, and these sheep should be culled.

Genetic selection of sheep, typically at the hogget age, that are less susceptible to larval hypersensitivity scouring is another long-term strategy to assist with dag management.

A planned, effective worm control program will assist you in reducing the risk of scouring outbreaks. Conducting regular worm egg counts to identify significant worm burdens before clinical signs become obvious will assist you in preventing problems before they have an adverse impact.

General sheep worm control information is available at www.wormboss.com.au

Use an effective drench, grazing management strategys and genetic selection to reduce your flock's susceptibility to scouring.

03

BREECH MODIFICATION

Breech modification is a tool for decreasing the susceptibly to breech strike that includes tail docking and mulesing.

TAIL DOCKING

Tail docking decreases grass seed, dag formation, urine stain and tail strike. The current recommendation is that lambs should be docked at the third palpable joint (Figure 3.1), or to the tip of the vulva in ewes.

Docking at the correct tail length has a significant benefit in reducing stain around the breech area, as well as other advantages, particularly in lambing ewes. It diverts excretion flow from the breech area and thus can reduce dag formation.

The rate of rectal prolapses increases when sheep are docked very short or 'butt tailed' because of the impact on the surrounding muscles. Some studies have demonstrated that tail docking at shorter lengths reduces the ability of sheep to 'twitch' their tails which reduces the effectiveness of deterring flies. When tail docking, it is also important to make sure that the tail covers the vulva to reduce incidences of cancer.

It is recommended that tailing is done by a cold knife, gas knife or by using elastic rubber rings. There is inconclusive evidence that one method is better than the others in terms of reduction of flystrike and welfare outcomes. Factors include, age and width of tail, other practices which may occur at the same time (mulesing) and suitability of pain relief options. Whichever method is used, the key is docking at the correct tail length to reduce susceptibility to flystrike.

Docking at the incorrect length makes your sheep more susceptible to dags, flystrike and other health issues.

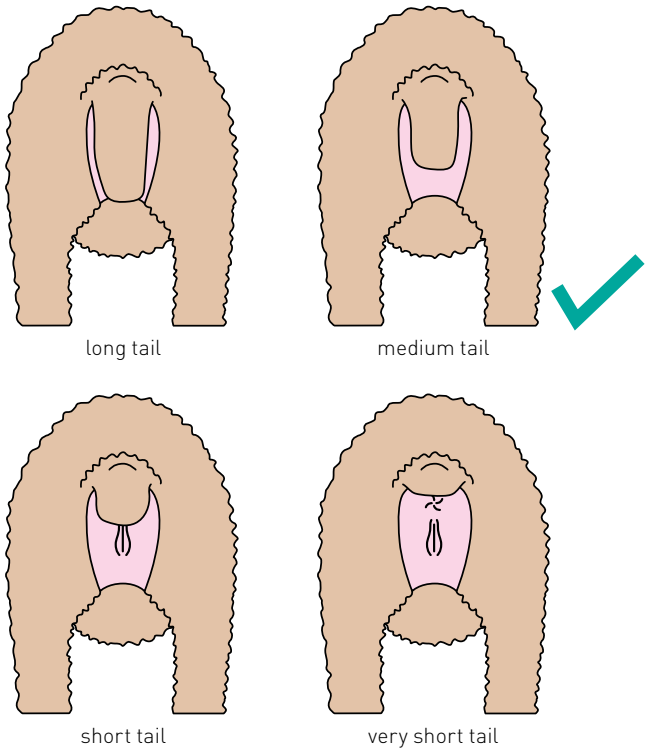


Figure 3.1: Tail docking is recommended at the third palpable joint, or to the tip of the vulva in ewes and at a similar length in wethers. Source: Lloyd J, 2012, "Tail Length in UnMulesed Australian Merino Sheep". www.wool.com/painrelief

There are two versions of a gas knife; the standard gas knife and the Te Pari Patesco knife (Figure 3.2). The Te Pari Patesco knife is a gas knife that sears and removes the tail and stretches the woolly skin producing a bare area on the top of the tail. It works in a similar fashion to normal gas knives, except for a rotating anvil system that extends the skin on the woolly side of the tail before cutting, which results in more bare skin on the dorsal tail surface and tip of the tail. This leaves a greater bare area, where wool would normally grow and may reduce urine stain and dags, and thus flystrike.

Figure 3.2: The Te Pari Patesco knife with a rotating anvil

Clayton South of Wagin, WA decided in 2008 to reduce mulesing and 2010 was his first year of having a 100 per cent non-mulesed lamb drop. Clayton made the decision to cease, based on weaning weights and production differences between mulesed and unmulesed sheep. Clayton used a conventional docking iron in 2008 on 1500 non-mulesed lambs. However he found as the tails healed, wool would heal back over the tip of the tail leaving them more prone to flystrike and making them more difficult to crutch. In 2009 Clayton used a Te Pari knife when marking 2500 non-mulesed lambs with the aim of reducing the amount of wool on the tip of the tail. He has been pleased with the amount of bare skin the knife left and will continue using the Te Pari knife in future years as a tool assisting him with the transition from mulesing. However, it is important to use the docking iron correctly, following the manufacturer's directions, to ensure effective results.

The 2016 **Australian Animal Welfare Standards and Guidelines for Sheep** (Chapter 6 Tail docking and Castration) state;

S6.1 A person performing tail docking or castration must have the relevant knowledge, experience and skills, or be under the direct supervision of a person who has the relevant knowledge, experience and skills.

S6.2 A person must not tail dock sheep that are more than six months old without using appropriate pain relief and haemorrhage control for the sheep.

S6.3 A person must leave a docked tail stump of a sheep with at least one palpable free joint remaining.

S6.4 A person must not castrate or use the cryptorchid method on sheep that are more than six months old without using appropriate pain relief and haemorrhage control for the sheep.

Further information at www.animalwelfarestandards.net.au/sheep/

MULESING

Preferably lambs should be marked by 12 weeks of age and mulesed at the same time, except where marking at this age coincides with drought or a high fly risk period. It is essential at all times to maintain a high standard of hygiene and use sharp, clean equipment.

The National Mulesing Training and Accreditation Programme is currently being updated by WoolProducers Australia, Livestock Contractors Association and Animal Health Australia. It includes best practice tail docking, castration, mulesing and use of pain relief.

Growth rates of lambs for several weeks post mulesing can be lower than their non-mulesed counterparts. In good seasons, where the dam is milking well and there is good green feed for the growing lamb, the impact on body weight is low. When the quality of feed for the dam and lamb deteriorates, the impact of mulesing on the lamb can increase. In drought conditions mulesing may be deferred until after weaning when feed conditions have improved.

If mulesing when the risk of strike is moderate, or during times when there are other irritants such as the black fly, consider a preventative chemical application at the same time. Where fly prevention is needed at the time of mulesing, there are a limited number of chemical products available that are registered for application to the mulesing wound.

Apply a preventative chemical if mulesing during high fly pressure.

When using flystrike prevention chemicals at the time of mulesing, the low volume treatments should be used in preference to those of larger volumes to prevent excess run off and dilution of the pain relief product. The chemical needs to be applied to the wool around the edge of the mules to retain effectiveness. You should note that most blowflies are at least partially resistant to organophosphates (OP).

It is important to ensure that your lambs are not disturbed, handled or mustered for at least four weeks after mulesing and or castration and tail docking to allow the wounds to heal.

Mulesing of prime lambs has largely ceased with the advent of longer-active fly treatments (up to 6 months) protecting lambs until sale and there is a market preference for unmulesed prime lambs.

The 2016 **Australian Animal Welfare Standards and Guidelines for Sheep** (Chapter 7 Mulesing) state;

S7.1 A person performing mulesing must have the relevant knowledge, experience and skills, or be under the direct supervision of a person who has the relevant knowledge, experience and skills.

S7.2 A person must not mules sheep that are less than 24 hours old or more than 12 months old.

S7.3 A person must not mules sheep that are 6-12 months old without using appropriate pain relief.

S7.4 A person must not mules sheep showing signs of debilitating disease, weakness or ill-thrift.

S7.5 A person mulesing sheep must only remove wool-bearing skin.

Note: Mulesing does not include nonsurgical approaches that deliver analogous outcomes for the sheep such as clips, intra-dermal injections of chemicals or other future, non-cutting technologies.

Further information at http://www.animalwelfarestandards.net.au/sheep/

PAIN RELIEF

There are several pain relief products available for use at lamb marking.

They are Tri-Solfen®, a topical post-operative anaesthetic, Buccalgesic® a buccal (paste in the cheek cavity) pre-operative meloxicam-based analgesic and Metacam 20 an injectable pre-operative meloxicam-based analgesic.

The registration status of these products is constantly evolving and it is important that you consult your local veterinarian.

Pain relief products improve the welfare of your animals and they send an important message to the supply chain about your on-farm practices and your response to their feedback.

Producers should use a pain relief treatment well suited to their chosen method of tail docking, castration and breech modification. It is recommended that mulesing, castration and tail docking is performed by an accredited operator.

Visit www.wool.com/painrelief

It is important to consult your local veterinarian to choose the best pain relief products for your husbandry practices.

AWEX NATIONAL WOOL DECLARATION FORM

BROKER	FARM BRAND	**WOOLCLASSER'S SPECIFICATION** Page ( ) of ( )
Wool No. / Delivery Centre	**Trading Details** Trading Name…… Contact Name…… Postal Address…… ……P/C…… Ph/Mob……Fax…… Email……	**Proceed Instructions** By Cheque (Y/N) ……OR A/C Name…… Bank……BSB…… A/C No…… **Offering Instructions** 1st Available (Y/N)…… Other……
ABN……GST Reg (Y/N)….		**Shearing Details** Is this Shearing Complete (Y/N)…… No. of Bales in this Consignment…… Est. No. Bales in this Shearing…… Date Shearing Completed……/……/…… Qual. Scheme(s)…… **Remarks**

Office Use Only Lot / Sale	AM	No. Bales	Bale Description	Bale Numbers 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Mob Numbers	Bin Code	Classer's Comments
TOTAL BALES																					

NWD V7.0, 1st July 2017

Mulesing Status (for each Mob):
NM: No sheep in this mob has been mulesed.
M: Some/all of the sheep in this mob have been mulesed.
PR: All sheep in the mob were mulesed using a registered Pain Relief product

The **National Wool Declaration (NWD)** ***must be completed/signed by Owner/Manager.***
CM: Wool from sheep where mulesing has ceased on the property. No lambs born on this property in the last 12 months have been mulesed. No purchased sheep are mulesed.
Has Mulesing Ceased on this Property? YES ☐ or NO ☐ (Tick Box)

WOOLCLASSER DETAILS
Registration No.
Name ……
Signature ……
Phone/Mobile ……

Mob No.	Mob Break/ Bale Ranges	Mulesing Status (circle answer)	Age Code	Breed Code	Sex Code	Contact with Shedding Breeds (Y/N)	Mob Crutched (Y/N)	Crutched within 3 months prior to Shearing (Y/N)	Wool Length (mm)	VM (Lo, Med or Hi)	Comments / Matching Mob Info
		NM M PR									
		NM M PR									
		NM M PR									
		NM M PR									
		NM M PR									

By signing this declaration,I warrant that (a) I am authorised to complete this declaration and confirm that all details contained in it are true and correct, (b) I authorise the selling agent to submit this document to AWEX (if requested) for the purpose of the Integrity Program and (c) I understand that I may be subject to random desk audits and on farm inspections, the results of which may be made available to the buyers of the declared wool and the selling agent. Details of the AWEX Integrity Program and Privacy Policy are available on the AWEX website: www.awex.com.au.

PIC ☐☐☐☐☐☐☐☐ **Owner/Manager Name**……**Signature**……**Date**……/……/……

Fax This End First

National Wool Declaration (NWD) Definitions

1 Mulesing	The removal of skin from the breech and/or tail of a sheep using mulesing shears. *Source:* Australian Animal Welfare Standards and Guidelines for Sheep.
2 Ceased Mulesing (CM)	Wool from sheep where mulesing has ceased on the property. No lambs born on this property in the last 12 months have been mulesed. No purchased sheep are mulesed.
3 Non Mulesed (NM)	No sheep in this mob has been mulesed.
4 Pain Relief (PR)	All sheep in this mob have been mulesed using a registered Pain Relief product. ***Note:*** PR must be declared separately for each mob (it is not a property declaration).
5 Mulesed (M)	Some/all sheep in this mob have been mulesed.
6 Shedding Breeds	Breeds that shed fibre (e.g. Afrikaner, Australian White, Awassi, Damara, Dorper, Karakul, Meatmaster, Persian, Van Rooy, Wiltipoll, Wiltshire Horn).
7 Contact with Shedding Breeds	Mated to, or run in the same paddock as shedding breed sheep/lambs or their crosses.

How to Complete the NWD

- To declare the DMFR and/or Mulesing Status for each mob (and each line of wool) the **Owner/Manager,** in consultation with the **Woolclasser**, must:
  - Answer the question **"Has Mulesing Ceased on this Property?"**
  - Complete all the **NWD Mob questions** (Mob No., Mulesing Status, Age, Breed, Sex, Shedding Breeds and Crutching History).
  - **Sign** and **Date the declaration.**
- The **Woolclasser** will complete the remainder of the Classer's Specification, **including filling in the Mob Numbers against all lines of wool (both fleece** and **oddments).**

NWD Codes

Age/Shearing Code		Breed Code		Sex Code	
1st Shearing	1	Merino	M	Ewes	E
2nd Shearing to 2 years	2	Afrino	FO	Wethers	W
3 years	3	SAMM	SM	Rams	R
4 years	4	Corriedale	CD	Mixed (E/W)	M
5 years	5	Crossbred	XB		
6, 7, 8 years etc.	6, 7, 8....	Downs	DN		
Mixed, e.g. 3 to 5 years	3 - 5	Shedding Breeds	SB		
NWD V7.0, 1st July 2017		Carpet Wool	CW		

NATIONAL WOOL DECLARATION

The supply chain for wool is increasingly interested in the husbandry practices of their suppliers. Australian Wool Exchange (AWEX) created a Mulesing Status section on the voluntary National Wool Declaration (NWD) in 2008 and the number of bales being declared by woolgrowers is steadily increasing.

The NWD is managed by AWEX and available for all wool sold by auction in Australia. The scheme is audited by AWEX, is relatively low cost and focused on specific wool contamination and mulesing status. It is recommended that you consult your wool broker regarding completion of the declaration.

Increasingly clients are asking for wools of certain NWD categories, so growers are encouraged to declare their wool regardless of whether they mules or not. There are variable, small, but increasing premiums for all declared categories.

There are other more detailed schemes that woolgrowers can also choose, run by wool brokers and businesses providing quality assurance schemes.

Visit www.awex.com.au/publication/national-wool-declaration-nwd/ for more information and to download the form.

BREECH MODIFICATION ALTERNATIVES TO MULESING

AWI is currently reviewing arrangements with two R&D projects, one using SkinTraction (sodium lauryl sulphate) the other Liquid Nitrogen.

Skin Traction involves the application of the active ingredient (sodium lauryl sulphate) to the breech and tail skin using a needle free applicator (Figure 3.4).

The applicator uses pressure from an air compressor to deliver the solution into the skin. Once in the skin, the solution denatures protein in the surrounding areas, which results in tissue necrosis (death of the tissue), including pain sensing cells and blood vessels.

Figure 3.4: Needle free applicator being used on a lamb at marking. *Source:* Cobbett Technologies

Figure 3.5: A lamb on the day of treatment (day 0) and the result 53 days after effective application to its breech during an early trial.
Source: Cobbett Technologies

A dry scab (or eschar) forms, which eventually lifts off, leading to a tightening of the newly formed skin underneath. This enables the wrinkles to be removed and reduces wool cover i.e. increases the natural bare area (Figure 3.5).

More than 90 per cent of any unreacted solution is metabolised by the liver quickly, within eight hours of treatment, and excreted from the animal. In terms of welfare, lambs exhibit similar behavioural responses to untreated lambs, however there are some differences in physiological parameters. Temperature and blood markers may stay at higher than normal levels for several days after treatment, indicating a healing process.

Further R&D is required before commercialisation can take place.

Intradermal treatment increases the breech and tail bare areas and removes wrinkles.

Liquid Nitrogen is another R&D project where the excess skin is lifted and treated with liquid nitrogen. The skin cells are burst by the expanding water in the freezing process and when they subsequently thaw, the tissue dies. The skin will then tighten in the breech region when it heals, making the area less prone to flystrike.

Further R&D is required before commercialisation of this treatment can take place.

See AWI website www.wool.com/intradermals

If commercialised, these alternatives are likely to be more expensive than mulesing but they will provide a means whereby not mulesed woolgrowing enterprises can avoid the significant discounts that exist in the restocker saleyard for unmulesed animals.

04

BREEDING FOR BREECH STRIKE RESISTANCE

Breeding for resistance to breech strike offers the best long-term non mules solution to lowering the risk of breech strike and minimises the reliance on chemicals, particularly for dual purpose type merinos. Any animal that is struck should be culled as it is likely to be struck again and likely to pass on its susceptibility to any offspring.

INDICATOR TRAITS

Research shows that certain traits are associated with breech strike, although the relative importance of each trait differs between regions, they are:

- dags
- breech wrinkle
- urine stain
- breech cover (or alternatively bare area)
- wool colour

Low wrinkle, dags, and breech cover are important individual traits but are increasingly valuable when all three are present in the same sheep. The interaction between traits can impact on the susceptibility of sheep to flystrike.

There is a positive and strong relationship between the indicator traits of dags, breech wrinkle, breech cover and wool colour at hogget age and the incidence of breech strike (Figure 4.1).

The graphs show the traits that contribute to breech strike susceptibility. Understanding their inheritance is important in order to breed towards flystrike resistant sheep.

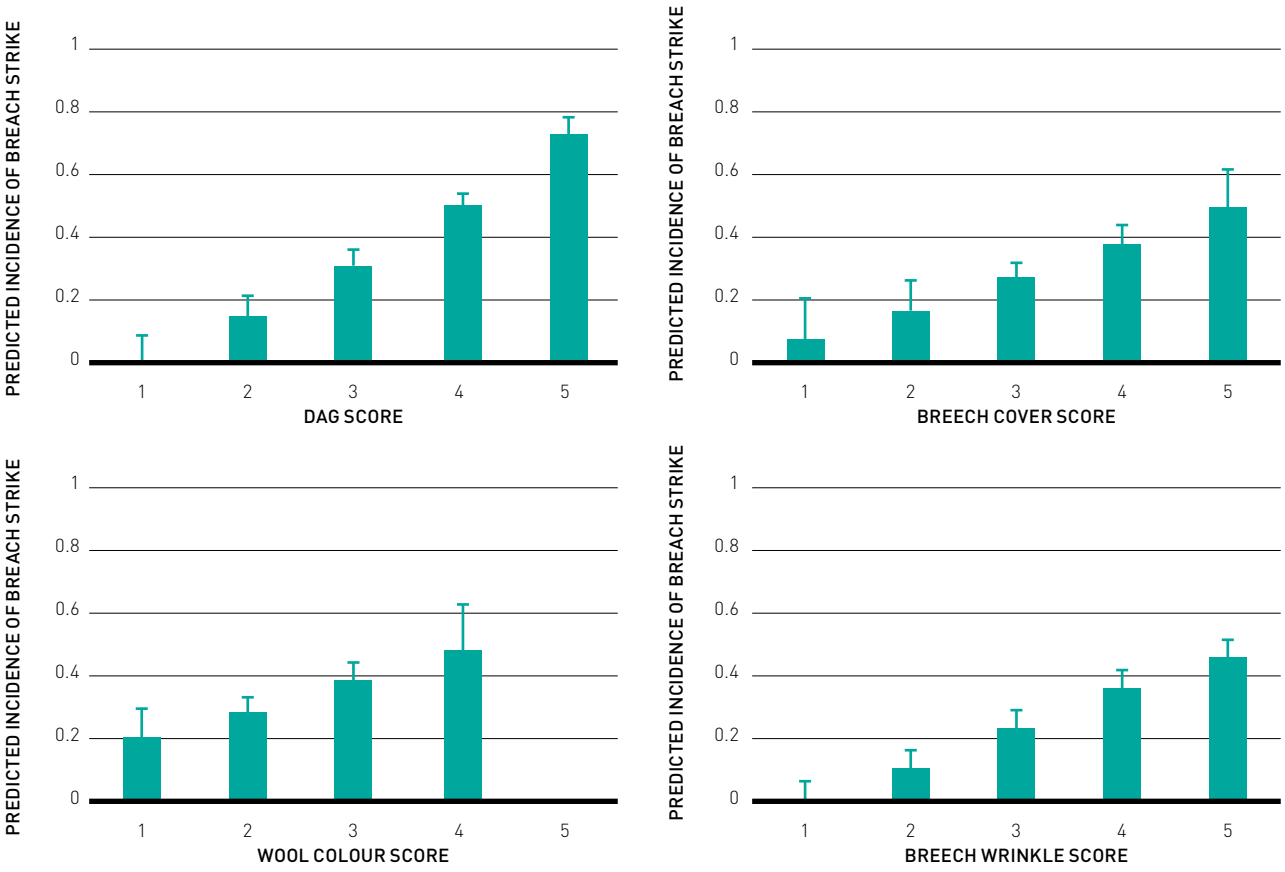


Figure 4.1: Relationships between incidence of breech strike and dags, breech cover and wool colour scores (Mt. Barker, WA) and breech wrinkle (Armidale, NSW)

INHERITANCE OF INDICATOR TRAITS AND BREECH STRIKE

The indicator traits are all either slightly or moderately heritable (Table 4.2) and selecting for these in a breeding program will result in genetic change. The table shows the heritability of the important indicator traits, measured at hogget age.

	WINTER RAINFALL (WA)	SUMMER RAINFALL (NSW)
Breech strike	**	**
Breech cover	***	**
Breech wrinkle	****	**
Wool colour	****	**
Dags	**	*
Urine stain	**	*

Figure 4.2: Heritability estimates of breech strike, breech cover, breech wrinkle, wool colour, dags and urine stain. Amount of stars represent how heritable each trait is in a winter and summer rainfall environment. *Source:* AWI Breeding for Breech Strike Resistance Project at Mt Barker, WA and Armidale NSW

Select against dags, wrinkles and other key traits for your area.

Research results from both sites show that the reproduction rate is higher for plainer sheep (Figure 4.3). The number of lambs weaned per ewe joined decreases as the ewes breech wrinkle score increases.

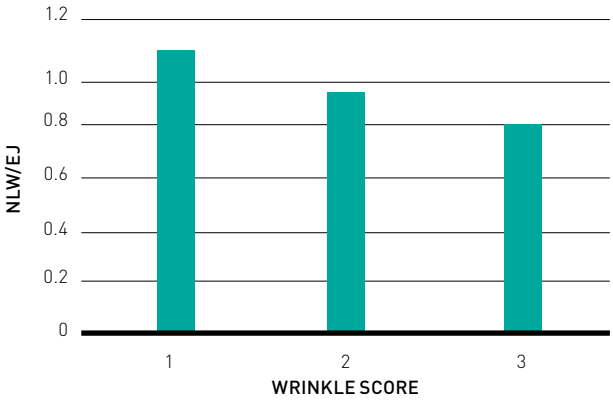


Figure 4.3: Number of lambs weaned per ewe joined in a winter rainfall environment at Mt Barker, WA, for ewes with different breech wrinkle scores at hogget age.

USING THE INDICATOR TRAITS TO BREED FOR BREECH STRIKE RESISTANCE

Dag score

In a winter rainfall environment where dags can be a sizable problem, dag score is an important risk indicator for breech strike. However, breeding directly for reduced dags can be difficult from a management perspective as the flock has to be allowed to develop dags, while at the same time not becoming fly struck.

Use AWI/Meat & Livestock Australia Visual Score Guide to ensure a standardised scoring system.

Ram breeders are reluctant to allow their animals to become daggy, but they can decide on an acceptable level of dagginess and then take measurements and crutch before sale. For example you could decide to allow 25 per cent of the flock to develop dags up to a dag score of three. When this level is reached, you can score the individuals in the mob and then crutch and drench the whole mob. The same logic applies to

Worm Egg Count (WEC) as it is important that the animals experience an adequate challenge to express their genetic superiority. Some worm resistant animals can have increased scouring due to their immune response to the presence of worms. By measuring the rams' pedigreed sisters, important progeny test information can be obtained that will also increase the accuracies of the ram's assessments.

Dag score and worm egg counts will allow breeders to:

- Cull rams and ewes that scour
- Select replacement ewes for both low worms and low dag score

Breech wrinkle score

Selecting sheep on breech wrinkle score is best done after crutching or shearing or at marking. Where animals to be purchased are in full wool, assessment of neck wrinkle can be a guide as it is strongly correlated to breech wrinkle.

Wrinkle score is reasonably consistent through a sheep's life and although it may change over time due to nutrition and lactation, an animal's rank on wrinkle score within management groups will be fairly consistent. Flocks in good nutrition areas and climates can average 0.5 to 1.0 of a breech wrinkle score higher than those in more normal environments. Within an environment, single lambs will be at least 0.2 of a score higher than a twin born lamb due to additional nutrition from their dam.

Lactating ewes tend to have less wrinkle than dry ewes and have less wool on their points (face legs and breech). Lambs born in a drought will have less wrinkle than lambs born in good seasons.

These effects are not genetic and will not be passed onto their progeny so it is important to recognise these differences and select within groups that have had a similar nutritional, pregnancy and lambing history.

SELECTING A SIRE

Selection of resistant sires is the most effective method for a commercial sheep producer to reduce the susceptibility of the flock to flystrike. Many studs have clear selection practices to breed superior sires by selecting rams based on the important indicator traits for their environment.

To gain the most rapid genetic change in your flock, choose a ram source that has the same objectives and select replacement animals on indicator traits that are important in your environment. Before purchasing rams or selecting a sire source:

Use a selection index that incorporates all traits that are important to your enterprise.

- Choose a ram seller who is in a similar environment, particularly if you are in a high dag region
- Ask the breeder for their breeding objectives and whether they measure and select for resistance to flystrike
- Choose productive rams with accurate assessments of breech strike traits
- Make a decision using all available information such as visual structural correctness, wool quality, the important individual trait measurements for your environment, and your chosen breeding index

Ram breeders who obtain Breeding Values through Sheep Genetics have animals for sale that have ASBVs for breech strike traits such as breech wrinkle, worm egg counts, dags and breech cover. Figure 4.6 shows the trait leaders for breech wrinkle score ASBVs. Sires with a negative figure for early breech wrinkle (EBWR) will produce progeny that are plainer than those with positive figures.

For a list of the current top low-breech-wrinkle sires please visit the MERINOSELECT website at www.sheepgenetics.org.au

ASBV TRAIT LEADERS FOR BREECH WRINKLE, FLEECE WEIGHT AND MERINO PRODUCTION PLUS INDEX

ANIMAL ID	NO OF FLOCKS	PROGENY NO	YWT Kg	AWT Kg	YEMD mm	YFAT mm	YCFW %	AGFW kg	YFD Micron	YDCV %	YSL mm	YSS (N/Kt)
Sire A	5	258	12	12	0.1	-0.1	32	20	0.1	-0.9	17	5.1
Sire B	18	1068	11	10	2.1	0.8	22	10	-0.1	-1.2	13	3.7
Sire C	5	505	9	8	-1	-0.5	26	15	-1.2	-1	13	3.6
Sire D	7	741	7	9	-1.8	-0.5	23	17	-1.1	-0.4	10	2.6
Sire E	1	133	10	9	-0.7	-0.3	25	14	-1	-1	13	2
Sire F	15	1996	6	5	-0.4	-0.3	22	8	-1.3	-2	15	7.4
Sire G	1	59	4	3	-0.4	-0.5	27	15	-1	-1.1	12	5.5
Sire H	2	115	11	10	2.5	1.4	26	11	0.1	-1.5	10	4.8
Sire I	1	224	7	6	1	0.3	28	12	-1	-1.1	12	1.3
Sire J	1	125	4	5	-0.5	-0.1	28	16	-1.2	-0.3	13	-0.4
Sire K	1	73	10	10	0.2	0.2	25	13	0	-1.6	17	6.2
Sire L	1	37	8	9	-0.6	-0.1	22	8	-0.2	-2.4	22	3.6
Sire M	3	165	12	12	1.1	0.7	25	12	0.1	-1.9	13	3.2
Sire N	11	1073	12	10	3.9	2.7	22	4	-0.4	-0.5	27	-2
Sire O	1	41	14	12	2.9	2.3	23	4	-0.5	-0.2	16	-6.6
Sire P	1	118	10	11	0.1	-0.2	27	13	0.8	-1.9	15	6.7

Figure 4.4: Sire ASBV trait leaders for Breech Wrinkle, Fleece Weight and Merino Production Plus Index as at April 2017. Listed in Decreasing Wrinkle Order. *Source:* www.sheepgenetics.org.au

YWEC %	NLW %	EBWR Score	EBCOV Score	LDAG Score	POLL H P	FP+ Index	MP+ Index	DP+ Index
20	8%	**-0.9**	-0.1	0.0	PH	**152**	**182**	**189**
-38	13%	**-1.0**	**-1.5**	0.0	PP	**155**	**176**	**199**
25	4%	**-1.1**	-0.2	-0.1	PH	**156**	**174**	**165**
46	8%	**-1.1**	-0.2	0.0		**150**	**169**	**165**
26	2%	**-1.1**	-0.3	**-0.3**		**149**	**168**	**163**
-16	0%	**-1.4**	0.0	0.1	PP	**162**	**167**	**156**
26	0%	**-0.8**	0.0	0.0		**155**	**167**	**158**
-66	5%	**-0.7**	**-0.9**	**-0.3**	PP	**147**	**167**	**186**
-17	0%	**-1.1**	-0.1	0.1	PP	**149**	**163**	**167**
0	0%	**-0.8**	-0.3	0.0	PH	**146**	**160**	152
1	1%	**-0.8**	-0.1	-0.1		144	**160**	**162**
-8	7%	**-1.1**	-0.2	0.6	PP	144	**159**	**159**
-9	1%	**-0.8**	-0.4	-0.1	PP	140	**159**	**168**
-50	9%	**-1.5**	**-0.6**	-0.2		132	**155**	**190**
-7	10%	**-0.8**	**-0.9**	-0.1	PP	127	**155**	**186**
22	2%	**-1.0**	-0.1	0.1	PP	131	**154**	**158**

TRAIT LEADER
Top 10% of the merino breed

ABREV	UNIT	DESCRIPTION
YWT	Kg	Yearling Body Weight
AWT	Kg	Adult Body Weight
YEMD	mm	Yearling Eye Muscle Depth
YFAT	mm	Yearling C site Fat Depth
YCFW	%	Yearling Clean Fleece Weight
AGFW	kg	Adult Greasy Fleece Weight
YFD	Micron	Yearling Fibre Diameter
YDCV	%	Yearling Fibre Diameter Coefficient of Variance
YSL	mm	Yearling Staple Length
YSS	N/Kt	Yearling Staple Strength
YWEC	%	Yearling Worm Egg Count
NLW	%	Number of Lambs Born
EBWR	Score	Early Breech Wrinkle
EBCOV	Score	Early Breech Cover
LDAG	Score	Late Dag
POLL	H P	DNA test H = Horn P =Poll
FP+,	Index	Fibre Production Plus Index
MP+	Index	Merino Production Plus Index
DP+	index	Dual Purpose Production Plus Index

The base year for Wrinkle, Cover and Dag is 2000. The base year for all other traits is 1990.

Accuracy %. As the amount of information on each trait increases the accuracy % increase

INHERITANCE OF BREECH STRIKE

Large differences between sheep in the incidence of breech strike have been reported at key trial sites. Results from a trial at Mt Barker in WA show the variation in the incidence of breech strike in the progeny of 69 sires across four years where no flock based preventative treatments were used (Figure 4.5).

In year three, the most resistant sire only had one of its non-mulesed progeny struck, while the non-mulesed progeny of the second most resistant sire in year three was still better than mulesed animals. In the same year, the most susceptible sire had 100 per cent of his progeny struck.

The large differences that exist between sire progeny groups indicate that some sires are genetically more resistant or susceptible than other sires. This trait has a heritability of 20% under normal management conditions. This implies that it would be possible to breed directly for breech strike resistance. However, it would require that the animals are allowed to become struck, which would be a poor welfare outcome on any scale and not practical under normal farm conditions. A good solution is to use indirect selection by using 'indicator' traits such as dags and skin wrinkle.

Figure 4.5: The incidence of breech strike in progeny from 69 sires tested over four years. *Source:* Unpublished results from a WA breech strike trial.

Make use of indicator traits to reduce your flock's susceptibility to flystrike.

SELECTING EWES

To identify the best ewes for resistance to breech strike, score the flock for the indicator traits that are most important in your environment. These are likely to be a combination of:

- dags
- breech wrinkle
- urine stain
- breech cover
- wool colour

It is essential to also select for structure as well as productivity (wool cut, growth rates and carcass or fertility, or a combination of them all).

Multiple trait Breeding Values should be used to select for resistance to flystrike at the same time as other important production traits because some traits are unfavourably correlated, i.e. lower wrinkle leads to a lower wool cut unless managed well in the selection process.

A number of the indicator traits may have to be measured at different times during the year, which means that it becomes a multiple-stage assessment process. For example, dag score during the fly risk period, breech wrinkle in bare shorn or crutched animals, fleece weight at shearing, and fertility at weaning.

Follow a sequential culling process to remove susceptible animals from the flock as follows.

1. Cull the wrinkliest ewe lambs, and those that have high dags and high urine stain after the first strike risk period while ensuring enough animals remain in the flock for later culling.

2. Cull any animal that has been struck.

3. Cull the remaining high risk animals on the breech strike indicator traits, ie wrinkle, dags, breech cover, etc. that are appropriate for your environment close to the second strike risk period.

4. Also cull the lowest ranking animals on your selection index that suits your breeding objective (based on production measurements such as growth rate, clean fleece weight and fibre diameter) and obvious visual faults, prior to their first joining. Leave some capacity for further culling on these traits and fertility at later ages.

5. Continue to cull any animal that gets struck over its lifetime, as any struck animal is more likely to become struck again and pass on that susceptibility to its offspring.

A breeding and selection system based on the above will not prevent all strikes, but it will decrease your flock's susceptibility to flystrike in the current generation and allow for selection on productivity as well. Many years of selection is required to make a reasonable overall genetic improvement in resistance to breech strike.

IMPACT ON OTHER PRODUCTIVITY TRAITS

The more traits that are used in selecting superior animals, the slower the genetic gain in a particular trait. This is due to having to choose animals that have the best balance of many traits, which may cull some animals that are very superior in one or two individual traits. Choosing to breed for low wrinkle with no selection on fleece weight will decrease fleece weight, just as selecting to reduce micron alone will decrease fleece weight.

Analysis of sires across Australia has shown there are individuals within a mob with low breech wrinkle scores and higher than average fleece weights. Figure 4.6 demonstrates not only the variation among different rams, but also that sheep with high fleece weight and low wrinkle score (animals within the left top quadrant have both high greasy fleece weight (GFW) and low wrinkle score) do exist in the national flock. Therefore, selecting for reduced wrinkle score should not necessarily result in a decrease in fleece weight.

The latest research shows there are additional traits that also impact on flystrike resistance and susceptibility and further research is now being conducted to identify these yet unknown factors that attract flies.

Selecting against wrinkle **does not** mean you will lose GFW.

AMSEA wrinkle score x greasy fleece weight ASBV

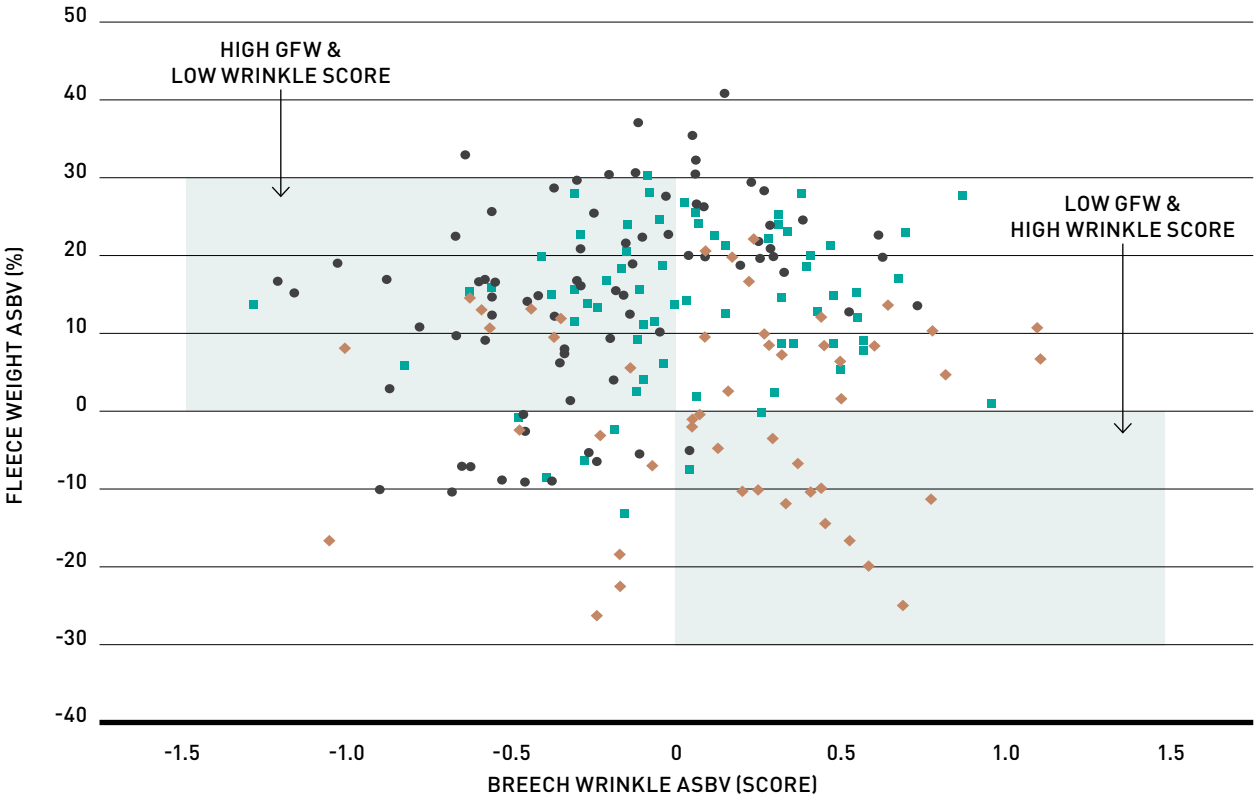


Figure 4.6: The variation in progeny greasy fleece weight compared to the breech wrinkle score from 560 sires involved in sire evaluation trials across Australia. *Source:* www.sheepgenetics.org.au & www.merinosuperiorsires.com.au

05

MOVING TO A NOT-MULES ENTERPRISE

It is very important for woolgrowers moving to a non-mules enterprise to have a detailed plan to manage the transition, especially for the first five years, to avoid the risk of poor lifetime welfare outcomes.

PLAN, PLAN, PLAN

Removing mulesing as a tool to reduce breech strike, requires an increase in other control options, a combination of breeding for low wrinkle, low dag and less breech cover, use of prevention chemicals, double crutching, accelerated shearing, shorter lambing periods and increased use of contract labour.

An over-reliance on chemicals will increase the risk of the flies becoming more resistance against the chemicals over time. So it is important to place sufficient reliance on the remaining non chemical tools in preparation to moving to a non-mules enterprise.

- **Breeding.** Reduce Breech Wrinkle, Dags, Urine Stain, Cover and Worm Egg Counts. A reduction in each of these traits will reduce the risk of breech strike. Moving to polls will also reduce poll strike and the annual cost of horn trimming

- **Set productivity targets.** This is to ensure that in selecting for low wrinkle, dag and cover, productivity is also improved, ie fleece weight, micron, fertility

- **Short joining and lambing periods.** This reduces the time period when ewes and lambs cannot be handled in the advent of an unseasonal occurrence of strike. It also facilitates early weaning and reduces the tail of light lambs at 10-12 weeks

- **Accelerated shearing.** Crutching and shearing can provide up to six weeks protection from strike. Sheep types with long staple length can be shorn more often and avoid discounts due to low staple length

- **Chemical Prevention.** With the release of dicyclanil (Clik) woolgrowers have had a long acting six month chemical prevention option. This is a key tool that many non-mules breeding enterprises have used to keep strike at moderate rates to date. It has also allowed many merino wether lambs to go un-mulesed prior to sale at 5 to 7 months. The risk with an over-reliance on chemicals is that the blowfly will develop resistance at a faster rate

- **Wool and Livestock Marketing.** While variable, there are often large discounts in the surplus sheep market for unmulesed ewes and wethers purchased for wool production. These discounts can be 25 to 35% per head compared to mulesed animals, which can have a very large financial impact on a non-mules enterprise. It is important to have a well planned and executed livestock marketing plan. To ensure the maximum premium for non-mulesed wool, direct sale options to processors need to be investigated with your wool broker

- **All people in the business need to be on-board.** It is important that all owners and staff, including contractors and shearers are keen to make a non-mules enterprise work. While it is no different to adopting any new technology the consequences for animal welfare are high if it does not go well

- **Link in with other Non-Mules Enterprises.** By working in groups the experiences and journey of other woolgrowers can be shared to avoid any potential risks

- **Re-evaluate the Plan**. At the end of each season, the husbandry management calendar and marketing plans require updating on the back of lessons from the prior season

The key potential costs of moving to a non-mules enterprise that require review are lower sheep prices, increased labour, increased shearing/ crutching and increased chemical use.

AWI'S ROLE IN BREECH FLYSTRIKE PREVENTION

Woolgrowers have sought to find effective alternatives to mulesing, tail docking and castration for many decades. In 2005, AWI recommitted to an intensive research and development program to provide pain relief options and to reduce the reliance on mulesing over time.

Animal welfare and flystrike prevention is AWI's number one research priority with an investment of $34 million since 2005 in programs to reduce the reliance on mulesing and improve the lifetime welfare of sheep. This is a complex area and AWI has invested in programs in five major areas:

Breeding and Selection

- Determine the relative importance of the original five breech traits (dags, breech wrinkle, urine stain, breech cover and wool colour) and their association with breech flystrike
- Estimate the heritability of breech strike and the indicator traits and how they correlate with the important production traits, in order to develop ASBVs for the breech traits
- Identify contributing causes of breech flystrike
- Communicate the advantages of breeding values to encourage adoption of scoring of the breech traits along with the production traits
- Investigate genomic associations with flystrike resistance and susceptibility
- Explore ways to reduce the incidence of dags, particularly in southern Australia

Breech Modification Developments

- Develop non-surgical breech flystrike prevention alternatives for breech flystrike control
- Improved pain relief options commercially available

Improved management practices

- Reduce the reliance on mulesing by increased adoption of specific management practices to reduce the risk of breech strike
- Monitor and reduce the potential of the flies to become resistant to the available chemicals and encourage registration of future chemicals
- Monitor wool residues in sale lots

Grower, Industry and Domestic stakeholder extension training and communications

- Investigate and monitor changes in on-farm management strategies for breech flystrike control
- Provide woolgrowers and stakeholders updates of the RD&E outcomes

International supply chain training and communications

- Ensure international stakeholders are aware of progress in RD&E and ongoing commitment to animal welfare
- Provide advice and support to retailers and brands in addressing animal welfare and related issues

Further detail on AWI's investment in the breech flystrike prevention program is available at www.wool.com/flystrikelatest

FURTHER INFORMATION AND CONTACTS

Australian Wool Innovation (AWI)

www.wool.com/flystrike

- Latest news and information on managing flystrike
- Visual Sheep Score guide

FlyBoss

www.flyboss.com.au

The website includes tools and further information on managing flystrike; Susceptibility, Breeding and Selection, Management, Treatments, Flystrike Decision Support Tool and News.

Sheep Genetics

www.sheepgenetics.org.au

Provides national genetic information, e.g ASBV's for breech wrinkle score, and evaluation services for the meat and wool sectors of the sheep industry.

WormBoss

www.wormboss.com.au

Provides the most comprehensive and effective information on managing worms.

National Wool Declaration

www.awex.com.au

The National Wool Declaration (NWD) gives buyers of Australian wool information on the mulesing status of the wool they are purchasing.

Visit http://www.awex.com.au/publication/national-wool-declaration-nwd/ for more information and to download the form.

AWI RESEARCH, DEVELOPMENT, EXTENSION & COMMUNICATIONS STRATEGY: BREECH FLYSTRIKE PREVENTION PROGRAM

Australian Wool Innovation Limited

Updated September 2017

Australian Wool Innovation (AWI) is the research, development and marketing organisation for the Australian Wool Industry. Animal welfare and flystrike prevention – a highly complex issue – is AWI's number one research priority. Since 2005 considerable progress in the R&D program has been made, with AWI investing $59 million in health and welfare R&D activities, including $35 million specifically in breech strike prevention. AWI remains committed to the research, development and extension (RD&E) program to reduce the reliance on mulesing and improve the lifetime welfare of sheep.

AREAS OF INVESTIGATION	OBJECTIVE	CURRENT STATUS/PROGRESS MADE	RESEARCH DEVELOPMENT AND EXTENSION PARTNERS
BREEDING & SELECTION	**Determine the relative importance of the key five breech traits (dags, breech wrinkle, urine stain, breech cover and wool colour) and their association with breech strike**	Phase 1 (2005-2010) identified the importance of these key breech traits.	
		Phase 2 (2010-2015) focused on improved trait accuracy and created resistant and susceptible lines under a normal crutching regime. Phase 2 also identified additional traits associated with breech strike (ie, face cover and neck wrinkle).	Commonwealth Scientific & Industrial Research Organisation (CSIRO)
	Identify breech trait heritability and correlations with other important traits, and use them in the creation of ASBVs and sheep selection indexes	Breech trait heritabilities and genetic correlations with other important production traits have been determined. The accuracy of breeding values continues to increase, allowing correlations between breech and production traits to be refined more precisely.	Department of Primary Industries and Regional Development Western Australia Hanrob Dog Academy
	Further research to identify remaining unknown causes of breech strike	Quarantine sniffer dogs showed they could successfully identify wool samples from flystrike resistant and susceptible sheep from both research sites.	University of Western Australia
		Gas chromatograph and electro-antennogram results have been used to isolate the odour differences between the resistant and susceptible lines but the results have been inconsistent. Further R&D is being planned.	
	Produce and communicate breeding values to woolgrowers to encourage adoption of breech trait scoring	ASBVs have been released and ram breeders are increasingly incorporating breech traits into their breeding objectives. Selection using visual, raw data and Breeding Values is a key focus in woolgrower communications. Target breech trait ASBVs required for a non-mulesed enterprise that does not have an over reliance on chemicals to control breech strike have been identified.	Meat and Livestock Australia (MLA) Sheep Genetics (SG), Australian Merino Sire Evaluation Association (AMSEA) & Sheep Cooperative Research Centre (SCRC) & Merino Lifetime Productivity Project (MLP)
	Identify genomic associations with flystrike resistance and susceptibility	Genomic correlations between breech strike and the key breech traits has been conducted. The correlations are low and currently not able to be commercialised into a breeding tool for growers but further testing and analysis is under review.	CSIRO, DPIRDWA & Sheep CRC
	Explore ways to reduce the incidence of dags, particularly in southern Australia	Continue to communicate the importance of breeding for improved worm resistance and lower dags. Differences in immune responses between high and low dag sheep and high and low worm resistant sheep are being investigated.	State Departments of Agriculture, various Universities
BREECH MODIFICATION DEVELOPMENTS	**Develop non-surgical breech strike prevention alternatives**	R&D for Clips completed and commercialised. Clips available to growers since 2009, with limited uptake.	Veterinary Health Research, Joan Lloyd Consulting, Strategic Bovine Services, Leader Products et al
		R&D into the intradermal option of Sodium Lauryl Sulphate (Skintraction®) commenced 2008. Skintraction® significantly reduces breech wrinkle and breech wool cover.	Cobbett Technologies
		APVMA registered Skintraction® in May 2015 with tight label use protocols that restrict commercialisation. Further R&D is being discussed with new research organisations.	RedCap Solutions, Australian Pesticides & Veterinarian Medicines Authority (APVMA) & Cobbett Technologies
		Preliminary welfare assessments have been conducted on all non-surgical alternatives with encouraging results.	CSIRO and Animal Welfare Science Centre
		Liquid nitrogen application to reduce breech wrinkle and breech cover has shown promising results in field trials.	Steinfort AgVet
		Use of lasers to achieve a permanent crutch, wig and ring have failed to pass the 'proof of concept' stage.	Zeta LLC & CSIRO
		National Mulesing Accreditation Program (NMAP) training is being reviewed and included in the Vocation and Education Training Quality Framework.	Animal Health Australia (AHA) WoolProducers Australia (WPA), Livestock Contractors Association (LCA) and NSW Department of Primary Industries (NSW DPI)
	Improved pain relief options commercially available	Tri-Solfen a topical anaesthetic became available to growers in 2006. Greater accessibility via over the counter sales commenced 2014.	Developed by Animal Ethics, commercialised by Bayer Animal Health
		Surveys indicate 73% of Merino lambs mulesed were treated with pain relief in 2016/17.	AWI & MLA Forecasting Committee
		Buccalgesic® trials for lamb marking have shown encouraging results. Buccalgesic® and Metacam 20® were released in late 2016. Both are meloxicam based analgesic products that reduce pain and inflammation.	CSIRO, Troy Laboratories Boehringer Ingelheim
		Work continues on the delivery of a local anaesthetic (Lignocaine) to coincide with the application of elastic rings at lamb marking (Numnuts™).	4cDesigns, Moredun Research (UK), MLA
		Work continues to reduce the withholding periods for local anaesthetics and increase the number of APVMA approved uses, ie lameness and shearing cuts.	Veterinary Health Research, Animal Ethics Pty Ltd, Red Cap Solutions
		A detailed welfare study on the Liquid Nitrogen Process and Buccalgesic® for mulesing is being conducted.	CSIRO, Troy Laboratories, Steinfort AgVet

AREAS OF INVESTIGATION	OBJECTIVE	CURRENT STATUS/PROGRESS MADE	RESEARCH DEVELOPMENT AND EXTENSION PARTNERS
IMPROVED MANAGEMENT PRACTICES	**Reduce the reliance on mulesing by increased adoption of other management practices**	Research has shown that management can reduce the risk of breech strike through practices such as more frequent shearing and crutching and shorter lambing periods.	Sheep CRC, CSIRO, State DPIs, Universities of Melbourne, Adelaide and Sydney. Novartis, NSW DPI and ParaBoss
		Research indicates good protection to breech strike can be achieved by increased use of long acting chemical treatments but that this also increases the risk of fly resistance to the chemicals, so the increased use needs to be regarded as a short term option.	
	Reduce the potential of flies developing chemical resistance	Trials have been conducted to monitor risk of resistance under lab and field conditions.	Sheep CRC, NSW DPI, University of New England (UNE)
		The blowfly has been gene sequenced, identifying 576 genes that are unique to the blowfly, of which 26 hold specific R&D interest at this stage. This offers future opportunities for new targeted host-specific control chemicals and vaccines.	Baylor College of Human Medicine, University of Melbourne and CSIRO and University of Queensland
		Trials have identified proteins essential for fly and larvae survival. A range of chemicals are being tested to find a chemical that specifically impacts on these fly and larvae proteins.	
GROWER, INDUSTRY & DOMESTIC STAKEHOLDER EXTENSION, TRAINING & COMMUNICATIONS	**Investigate and monitor changes in on farm management strategies for breech strike control**	Best Practice information developed and disseminated on breech strike control to encourage practice change.	AWI Extension Networks, State DPIs, ParaBoss, AWI Beyond The Bale, website and Newsletters
		National Wool Declaration (NWD) available to growers to declare mulesing status since 2008.	Australian Wool Exchange (AWEX)
		Premiums and discounts that growers receive from practice changes adopted to improve welfare and reduce reliance on mulesing ie; non mulesing, use of pain relief, accelerated shearing etc. along with changes to staple length and strength issues from accelerated 6 monthly shearing are being monitored.	University of Sydney, AWEX, Surveys
		Genetic trends in the breech traits, other welfare traits and the key productivity traits are being monitored.	MLA, AGBU, Australian Merino Sire Evaluation Association, and Wether Trials (NSW DPI)
	Provide woolgrowers, and stakeholders updates of the RD&E outcomes	Nationwide grower meetings and workshops are held.	MLA, AWEX, AWI Networks, Sheep CRC, Ram Breeders, State Farming Organisations, State DPI's, Wool Brokers
		FlyBoss, WormBoss & LiceBoss were combined to form ParaBoss in 2013. This improved tool for growers has resulted in increased awareness and practice change. Funding has been continued for ParaBoss for 2016 to 2020. The average number of users per month across all ParaBoss sites has increased from 6,922 in 2014 to 13,275 in 2017. The Managing Breech Strike Manual was updated in 2017.	MLA, Sheep CRC and University of New England UNE
		AWI Woolgrower Industry Consultative Committee (ICC) provides a flow of information and understanding of the research progress and supply chain developments to the key woolgrower representative organisations.	Australian Association of Stud Merino Breeders (ASMBA), Australian Wool Growers Association (AWGA), Pastoralists and Graziers Association of WA (PGA) Broad Wool Growers, Australian Superfine WoolGrowers Association (ASWGA), WoolProducers Australia (WPA) and Federal Department of Agriculture and Water Resources (DAWR)
		AWI Animal Welfare Forum meets regularly to improve the flow of information and understanding of the RD&E progress. Regular updates and meetings are held with woolgrower organisations Australian Government; State Departments of Primary Industry.	Animals Australia (AA), Australian Veterinary Association (AVA), Four Paws, RSPCA, Researchers and DAWR
		Regular meetings with Australian Government; biennial meetings with state DPIs are held.	DAWR, State DPIs, State Farming Organisations, Stud Merino Breeder Assns
		Biennial Breech Flystrike RD&E Update to provide results of the Breech Flystrike RD&E Program have been held in 2008, 2010, 2012, 2014 and 2016.	All RD&E partners and stakeholders
INTERNATIONAL SUPPLY CHAIN, TRAINING & COMMUNICATIONS	**Ensure international stakeholders are aware of progress in RD&E and ongoing commitment to animal welfare**	Regular updates including annual Animal Welfare Seminars with retailers, brands and their associations.	Research organisations, welfare organisations, retail associations and supply chain partners
		Independent six-monthly audit of AWI's Breech Flystrike RD&E Strategy by AVA.	Australian Veterinary Association (AVA)
		Annual audit of AWI's Breech Flystrike Breeding & Genetic Selection RD&E program.	University of Adelaide & University of Queensland
	Provide advice and support to retailers and brands in addressing animal welfare and related CSR issues	Ongoing support to individual retailers, brands and processors as required.	AWI staff and various commercial partners

GD2589

NOTES

For the latest updates on the progress of the AWI Breech Strike RD&E Program visit the Breech Fly Strike page on the AWI website, "Latest Publications"

www.wool.com/flystrikelatest

Australian
Wool Innovation
Limited

WOOL.COM

Australian Wool Innovation Ltd gratefully acknowledges the funds provided by the Australian government to support research, development and marketing of Australian wool. GD2428