Prevention and control of blowfly strike in sheep

Blowfly strike (flystrike) occurs when the eggs of the sheep blowfly (*Lucilia cuprina*) hatch in moist wool and the maggots feed on the flesh of the live animal. Flystruck sheep have increased rectal temperature, show rapid breathing, and suffer weight loss caused by loss of appetite.[1] The maggots create painful wounds which, if undetected, can debilitate the animal to the extent that it eventually dies of blood poisoning.

Introduction

Increasing scrutiny of painful farm animal husbandry practices such as mulesing, has led to public and retailer demand for 'non-mulesed' wool.[2] The wool industry has responded by developing alternatives to mulesing through an extensive research and development program.

A number of alternative methods of preventing and controlling flystrike in the breech area are available while others are in various stages of development. The RSPCA advocates the use and development of non-surgical and pain-free methods of reducing the risk of blowfly strike in sheep and is actively encouraging producers[3] who conduct mulesing to adjust existing practices and adopt new and humane approaches and technologies as they arise.

The RSPCA supports an integrated approach to the prevention and control of blowfly strike and this research report examines measures to prevent flystrike in the absence of mulesing.

Flystrike

The most prevalent cause of flystrike in Australia is the sheep blowfly, *Lucilia cuprina*. It initiates more than 90%[4] of all strikes on susceptible sheep. The sheep blowfly thrives in warm and humid environments. The female blowfly is particularly attracted to sheep with wool stained and wet from urine and faeces. However, it is not the wet wool but the subsequent skin irritation it causes that attracts the fly and creates the ideal environment for her to lay her eggs.[5] Sheep that are affected by fleece rot or dermatophilosis (lumpy wool or dermo) are also susceptible to flystrike.[6]

Flystrike is common among the Australian sheep flock. Heavily-wrinkled sheep with a soiled breech area are most susceptible and over 90%[7] of strikes generally occur in the tail and breech area.[8] However, flystrike may also occur on the body of the sheep (a major problem in warm, humid conditions), the poll, the pizzle and on wounds.

Mulesing

In 1929, John Mules developed a surgical technique for reducing the amount of wrinkle in the breech area of sheep in order to lower the risk of blowfly strike (flystrike).[9] This operation became known as 'mulesing' and, because it is highly effective in preventing flystrike, continues to this day.

The purpose of the mules operation is to reduce the susceptibility of sheep to flystrike by making the breech area less attractive to flies. With less wrinkle and more bare skin, faeces and urine cannot accumulate thereby significantly reducing the risk of flystrike. The mules operation also results in a number of secondary benefits, for example, reduced wool stain and dags, ease of shearing and crutching, lower chemical residues in the wool, and a reduction in labour costs associated with inspection and treatment of animals.[10]

Mulesing involves the removal of crescent-shaped pieces of skin, from the base of the tail up towards either side of the perineal area, using sharp shears. In addition, a strip of skin is removed from each side of the tail. The resulting wound, when healed, increases the bare area while at the same time reducing the amount of wrinkle.

Mulesing is performed without anaesthesia and generally also without pain relief. The operation is quick; however the acute pain is long lasting – up to 48 hours.[11] Mulesed lambs will socialise less[12],

lose weight in the first two weeks post mulesing[13], exhibit behavioural indicators of pain including prolonged standing and less time lying and feeding[14], and stand in a hunched position[15].

It was only in 2006[16] that a topical anaesthetic for application post mulesing became available to producers, providing pain relief for up to 8 hours.[17]

The development of long-acting drugs administered before or at the time of the mulesing operation is underway[18] [19]. These drugs aim to reduce or eliminate the pain of the procedure.

An integrated approach to flystrike prevention and control

The key to effectively managing flystrike in the absence of mulesing is to make the sheep less attractive to the blowflies through an integrated approach to blowfly control. Such an approach, already practiced by many producers, includes

- animal husbandry and farm management practices that take into account the timing of shearing and crutching;
- effective tail docking (should that be required);
- strategic application of chemical treatments (should they be required to control flies);
- effective control of scouring (especially the control of worms); and
- regular inspection of the flock.[20]

These options for preventing and controlling flystrike in the absence of mulesing may be accompanied by a breeding and selection program that aims to reduce wrinkle and increase the bare area in the perineal region and remove susceptible sheep from the flock. Together these strategies, which are discussed in further detail below, will have a cumulative effect on the flock's overall resistance to flystrike.

Monitoring blowfly activity and reducing blowfly populations

Blowfly activity is monitored at those times of the year when conditions are likely to be warm and humid as this is when the blowfly is most active.

Blowfly populations can be monitored and reduced in some situations using fly traps. A trap specifically developed to lure the sheep blowfly is readily available and has been shown to reduce the incidence of flystrike by 46%[21]. Flies entering the trap die from lack of water and food as they cannot escape. The lure lasts for up to 3 months and the trap is most effective in areas where sheep tend to congregate, for example, near water.[22] Guidelines for using a lure will be specific to the region in which it is being used. The lure is most effective when exposed to the sun, but sheltered from the wind and attached to posts rather than trees. Effectiveness is enhanced when adjacent farmers all use traps at the same time.[23]

Paddocks that are wet, heavily shaded and sheltered provide ideal conditions for blowflies. Weaners, heavily wrinkled sheep and previously struck sheep are at high risk of becoming flystruck if moved to such high-risk paddocks.[24]

When used as part of an integrated approach to controlling flystrike – for example when used in combination with strategic shearing and crutching – flytraps have the potential to reduce or eliminate the need for chemical fly treatments.

Preventative chemical fly treatments

Chemical treatments are part of an integrated approach to control flystrike – they are not a stand-alone option. Blowflies come into contact with the chemical treatment as they land on the wool and, depending on the active ingredient, the chemical works by interfering with the larval stage of the blowfly's lifecycle, by affecting the blowfly's nervous system, or by reducing motor activity and causing paralysis of the blowfly.[25]

If chemical fly treatment is necessary, it has been found to be more effective if applied to the breech 6 weeks rather than immediately after shearing or crutching.[26] It is recommended to avoid the use of chemicals within 3 months of shearing unless treatment and/or prevention is necessary, in which case compliance with wool and meat withholding periods is required.

An additional beneficial effect of chemical fly treatments is that, by reducing the capacity of flies to lay eggs, fewer maggots develop into pupae, meaning fewer pupae overwinter in the soil and therefore fewer flies emerge in the following spring.

The expectation is that the breeding of less wrinkly sheep and the need to avoid residues in wool and lanolin, may see the use of chemical treatments significantly reduced if not eliminated. Until then, chemical fly treatments may be used sparingly and strategically, that is, with consideration of the timing of shearing and crutching, and specifically selected to target the blowfly.

Crutching and shearing

Crutching is the removal of wool from between the back legs and around the tail of sheep. It may also include removing wool from the head (particularly rams) and from the bellies of male sheep. Shearing is the complete removal of wool. The timing of crutching and shearing is key in reducing the risk of flystrike.

Because the sheep blowfly thrives in warm, moist conditions, the periods of greatest risk of flystrike occur when rainfall is followed by warm weather or vice versa.

If shearing is conducted in spring, maximum impact is obtained if it is done just prior to the period of expected maximum blowfly activity. Subsequent crutching is carried out at the end of summer or beginning of autumn, depending on conditions.

Twice-yearly crutching is another strategy for reducing flystrike risk. For example, an autumn and pre-lambing crutch for those shearing in summer, and a late-spring and autumn crutch for those shearing prior to lambing in spring.[27] Alternatively, a smaller 'bung-hole' crutch instead of a second crutch could be as effective as a second crutch if carried out within three months prior to shearing.[28]

Tail docking

Wool-bearing skin on and near the tail can be subject to flystrike, particularly as the wool grows longer and becomes stained with urine and faeces.[29] The length of the tail also affects susceptibility to flystrike.

Skin underneath the base of the sheep's tail is designed to push faeces out and over the wool in the breech area. If a tail is docked too short, this will result in the loss of that skin and the loss of the ability to direct faeces outwards thereby increasing the risk of a soiled breech area which is attractive to flies. Sheep with short or butted tails are more susceptible to breech strike for this reason.[30]

By avoiding short tails (the tail of ewe lambs no shorter than the lower tip of the vulva[31] and the tail of wethers no shorter than the lowest point of the anus), these areas will also be protected from sunburn and cancer.[32]

Control of dags and worms

Dags are formed when faeces soil the wool in the breech area. Reducing dags is therefore important to reducing the attractiveness of this area to flies.

Dags can be caused by scouring (diarrhoea) which, in turn, could be due to worm burdens. Effective treatment of worms using a targeted drench should quickly stop the scouring. Scouring could also be related to worm-immune sheep becoming hypersensitive to worm larvae ingested after a long period of worm absence. In some sheep, an abnormal immune response to these larvae results in inflammation of the gut which causes the scouring.

Breeding and selecting sheep that are resistant to worms may be the long-term solution to reducing worm-related scours while at the same time managing the problem of drench resistance.[33] [34] However, it appears that selecting for low dag score (or low dag weight) is part of this approach.[35] [36] [37]

Scouring is not necessarily related to worm/larvae burden and may have other causes. [38] [39] Diet, for example, can also lead to scours. Improved pastures in higher rainfall areas; rain-soaked grass-dominant pastures, including rye grass pastures, which have rapidly regrown following a dry summer; cereal crops or cereal grain; and sudden changes of diet can all lead to scouring.[40] A strategy of placing high-risk animals in the lower risk paddocks (i.e. dry, lightly shaded and sheltered) may assist in reducing scours and subsequent dags.

Strategic timing of shearing and crutching will also help to reduce dags.

Breeding and selection

The breeding of flystrike-resistant sheep is a long-term process whereby animals with a naturally bare breech area are selected from or introduced into the flock in order to produce progeny with no wrinkle in the breech area and a large, bare perineal area.

In addition to bare breech traits, selection pressure focuses on reducing the flock's overall disposition to flystrike by removing animals that have fleece rot (a heritable infection), are repeatedly flystruck or have low immunity, or are repeatedly affected by worms and scours.[41] Keeping a record of sheep that have been affected by flystrike will identify those that are repeatedly struck – one quarter of strikes are found on previously affected animals[42].

Research trials have shown that, in a certain climatic environment and using certain bloodlines, the bare-breech trait is moderately to highly heritable and does not significantly affect other wool traits such as fibre diameter, staple length and strength, and greasy fleece weight. Selection for a barer breech area will reduce fleece weight, skirtings and belly weight slightly.[43]

Research is on-going and should provide more information on whether the bare-breech trait is expressed in different environments and within other bloodlines. Also, which genes affect the trait and how they are inherited, and, importantly from a producer perspective, how these correlate with production and quality traits.[44]

New and emerging technologies to prevent and control flystrike

The wool industry has sought to develop viable and humane alternatives to mulesing, recognising that the breeding of flystrike-resistant sheep is the long-term solution to flystrike prevention. These 'interim' solutions offer a non-surgical technique for achieving a plainer (less wrinkly) breech area that is less likely to become soiled and therefore is less attractive to flies.

Clips

Clips mimic the effect of the conventional mules operation. Application of clips is a non-surgical procedure whereby folds of skin on either side of the perineal area as well as the tail are clamped together with moulded plastic clips. Four clips are required – one on each side of the tail and one on each side of the breech area next to the tail. The loss of blood supply causes these skin flaps to die and fall off, extending the bare area and leaving it wrinkle free.

The results of research trials[45] indicate that clips offer a significant welfare advantage over mulesing in terms of lamb survival, daily weight gain and pain response. In terms of flystrike, clipped lambs are slightly more susceptible than mulesed lambs but better protected than untreated lambs.[46]

Clip research continues to progress, particularly in the area of clip design & biodegradability, application technique, age of application and timing of removal, and further welfare trials.[47]

Clips are available commercially and are being applied by trained operators to ensure correct use.

Needleless intradermal injections[48]

This procedure uses a needleless applicator to inject directly into the skin a special formulation which causes skin cells to die and a thick scab to form at the injection site. The skin tissue surrounding this scab closes in under the scab and, when the scab falls off, it leaves an area of stretched skin similar to the result of mulesing. The procedure is non-surgical.

Various chemical formulations have been and are being trialled. The animal welfare implications of the different formulations need to be investigated. For example, when the effectiveness of one particular formulation was trialled, signs of discomfort and pain were noted in treated lambs.[49] Research continues to progress on the design of the applicator, the precise areas to inject, and on ensuring that the right dose enters the skin and does so without being contaminated or obstructed by the lamb's fleece.

The use of an insecticide to control flies after the procedure is important as the needleless injection causes a high-protein exudate to come out of the holes made in the skin - the exudate is attractive to flies.

Any formulation considered viable will need to be registered and commercial trials commenced. It is intended that the needleless technology be available to producers through trained contractors.

Treatment of sheep with flystrike

Preventative strategies will significantly reduce the risk of flystrike within the flock. However, they may not eliminate the incidence of flystrike altogether.

To reduce animal suffering, flystruck sheep need to be identified quickly – for example, through regular monitoring of the flock – and treated immediately. An animal that has been struck can be identified by the presence of dark areas on the wool, be isolated from the flock, lose appetite (resulting in marked loss of body condition[50]) and/or be rubbing or biting the affected area.

If an individual animal is struck, treatment consists of shearing the affected area as well as at least 5 cm of unstruck wool around it close to the skin. Maggot trails through the wool are followed to ensure that other areas have not been affected. Shearing will remove many of the maggots and will help the area to dry out.[51] Removing any remaining maggots and placing the affected clippings into an airtight bag will kill the maggots.

A registered dressing[52] is then applied and the sheep monitored to determine that it is recovering well. The dressing kills any remaining maggots and allows the wound to heal without it becoming restruck.[53]

Immediate treatment of flystruck sheep is essential. The condition is painful and affected animals may succumb to blood poisoning and die.

The RSPCA view

The RSPCA policy on mulesing states:

- It should not be done if other humane procedures can protect sheep from flystrike.
- It must only be done in an area where it is known it will reduce the incidence of flystrike.
- It must only be performed by a competent person on a well-restrained lamb that is less than 10 weeks of age and using appropriate pain relief.
- Older animals require anaesthesia during mulesing and aftercare to help healing.
- Lambs should not be mulesed if they are sold at an early age for meat.

The RSPCA promotes an integrated approach to the prevention and control of blowfly strike in sheep. Breeding of flystrike-resistant sheep is the alternative to mulesing. It is non-invasive, has no recurrent costs, is chemical-free, has a cumulative effect – and importantly, it is the most humane option.

The RSPCA considers mulesing without pain relief unacceptable. The RSPCA remains cautiously supportive of the use of clips and the needleless intradermal injection technology, pending publication of further comparative welfare trials.

Mulesing with pain relief, the use of clips, and the future use of the intradermal technology, must be considered interim solutions until such time as flystrike can be managed solely through breeding and integrated animal husbandry and farm management practices that aim to prevent and control flystrike. On-farm extension to facilitate the rapid adoption of interim as well as longer-term solutions must be a priority of the wool industry.

The RSPCA urges the wool industry to invest significant R&D effort into a comprehensive flystrike-resistant sheep-breeding program. The R&D program must be underpinned by achievable milestones and provide regular updates to the general public as a means of demonstrating the wool industry's genuine commitment to phasing out mulesing in the shortest possible term.

December 2009

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