Blowflies and lice information manual

A practical approach to producing low residue wool

Bob Armstrong Geoffrey Knights Wendy McLeish

Important terms

Withholding period (WHP)

A stated period following pesticide application during which the product (i.e. wool, meat or milk) should not be used.

Rehandling period

A stated period following pesticide application during which people should not handle the wool or sheep, so as to avoid contact with the pesticide. This varies from pesticide to pesticide.

Wool harvesting interval (WHI)

A stated period following pesticide application during which wool should not be shorn and sold. This may vary for different markets.

Export slaughter interval (ESI)

The recommended period between treatment with a pesticide and slaughter for selling meat in export markets with different statutory residue requirements from those of Australia.

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Bob Armstrong

Geoffrey Knights

Wendy McLeish

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Enquiries should be addressed to:

Department of Primary Industries

GPO Box 46

Brisbane Queensland 4001

www.dpi.qld.gov.au

Foreword

Up to the early 1990s the nation's sheep and wool producers relied heavily on pesticides for the management of blowflies and lice. For many, their only concerns were the effectiveness and cost of the application. However the world has changed. Today producers can no longer apply pesticides without paying due care and attention to the effect that their use will have on the environment, human health, animal welfare and the marketing of their wool.

To keep pace with community trends and legislative changes, government is directing resources to help resolve the issues that they raise. It aims to enable industry to be nationally and internationally competitive through achieving responsible pesticide use and residue control.

This focus led to the development of a partnership between government and industry with the aim of 'reducing the prevalence of ectoparasites of sheep and minimising chemical residues on wool'. The Wool Industry Chemical Residue Committee (WICRC) was established in 1995 and includes producer, government and industry representatives. The Department of Primary Industries, Queensland (DPI) administers the WICRC in conjunction with its state-wide research, development and extension activities in the area of integrated pest management.

Queensland producers have responded positively to the challenge of reconciling their use of pesticides for parasite control with the need to maintain access to sensitive markets. They are very aware of the global community's expectations that agriculture minimise pesticide use, and equally concerned with the occupational health and safety implications of pesticide use.

At a series of discussion days hosted by DPI in 1998, which was attended by approximately 10 per cent of Queensland producers, a number of factors impeding producers from reducing their reliance on pesticides was identified. Many of these related to on-farm management, but producers also identified conflicting and poorly targeted information as contributing to the problem.

To remedy this situation and deal with other problems identified at the discussion days and in market research, DPI initiated development of a publication that would provide all the core information most needed and regularly sought by clients. An innovative approach was taken to the generation and presentation of this information, and the result is a manual that has established a new standard in the provision of high quality, user-friendly, up-to-date and relevant information to the wool industry.

Barry McDonald

Director

Agency for Food and Fibre Sciences

Department of Primary Industries, Queensland

Preface

To compete confidently in a world market and increase their profitability on a sustainable basis, wool producers face many challenges. One of these is to reduce pesticide use and pesticide residues on wool. This will be achieved only through the adoption of new technologies and ways of doing things.

In order to rise to this challenge producers need access to reliable, concise, user-friendly information on the integrated management of blowflies and lice. The authors identified DPI's innovative Agrilink concept as the most appropriate type of vehicle to deliver this information.

This manual is based on the Agrilink model and is built around several important principles. Its content focuses on the core information that is most needed and regularly sought by producers. It is formatted to make access and information retrieval easy. The practices of quality management have been applied to guarantee a product of high quality and integrity. Finally, the eight sections stand-alone, yet are complementary, with links to other sections in the manual. They include:

- Industry situation
- Common questions
- Management program
- Key issues
- Problem solver
- Contacts and references
- Glossary
- Index.

This manual is a culmination of DPI's activities throughout the 1990s in the areas of integrated parasite management (IPM) and pesticide residues on wool and draws on research, development and extension work conducted throughout Australia.

Geoffrey Knights

Project Leader

Agency for Food and Fibre Sciences

Department of Primary Industries, Queensland

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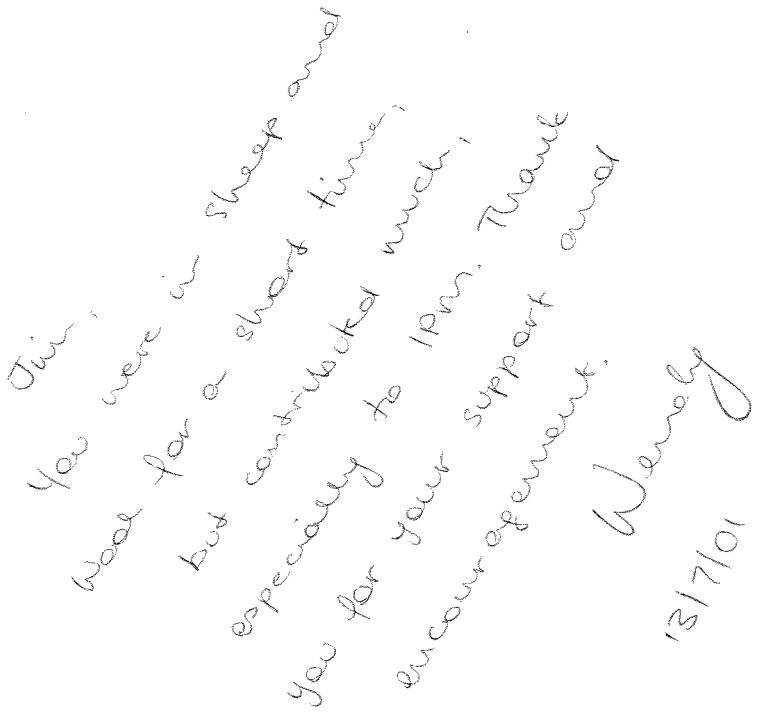
The authors are particularly grateful for information and advice provided by members of DPI's Agrilink project team, including Noel Vock and John James.

Thanks to DPI sheep and wool staff Anne Cathcart, Lloyd Dunlop, Rebecca Farrell, Dave Jordan, Arthur Le Feuvre, Deborah Maxwell, Terry Tierney, Rudolf Urech and Michael Ward. Thanks also to former sheep and wool staff Warren Hunt, Dale Miller and Noel O'Dempsey. Thanks to Peter Green for his photographs of flies and larvae.

The contributions of Paul McIntyre, King Lethbridge and Norm Bray of an industry perspective are particularly appreciated. Thanks are due to Tony Brightling and Garry Levot for their reviews of the manual. Thanks also to Brian Horton of the Department of Primary Industries, Water and Environment, Tasmania for use of the raw wool to wool scour flow chart.



Industry situation 1
A brief overview of issues related to blowflies, lice and pesticide residues in Australia.

Common questions 2
The 30 or so most commonly asked questions about blowflies, lice and pesticide residues.

Management program 3
Our guide to planning your own integrated parasite management program.

Key issues 4
Detailed information on key issues and important decisions affecting your management of blowflies and lice.

Problem solver 5
A selection of common problems and integrated parasite management solutions.

Contacts and references 6
A list of industry organisations, special product and service providers, and further reading.

Glossary 7
An alphabetical list of words and terms and their definitions.

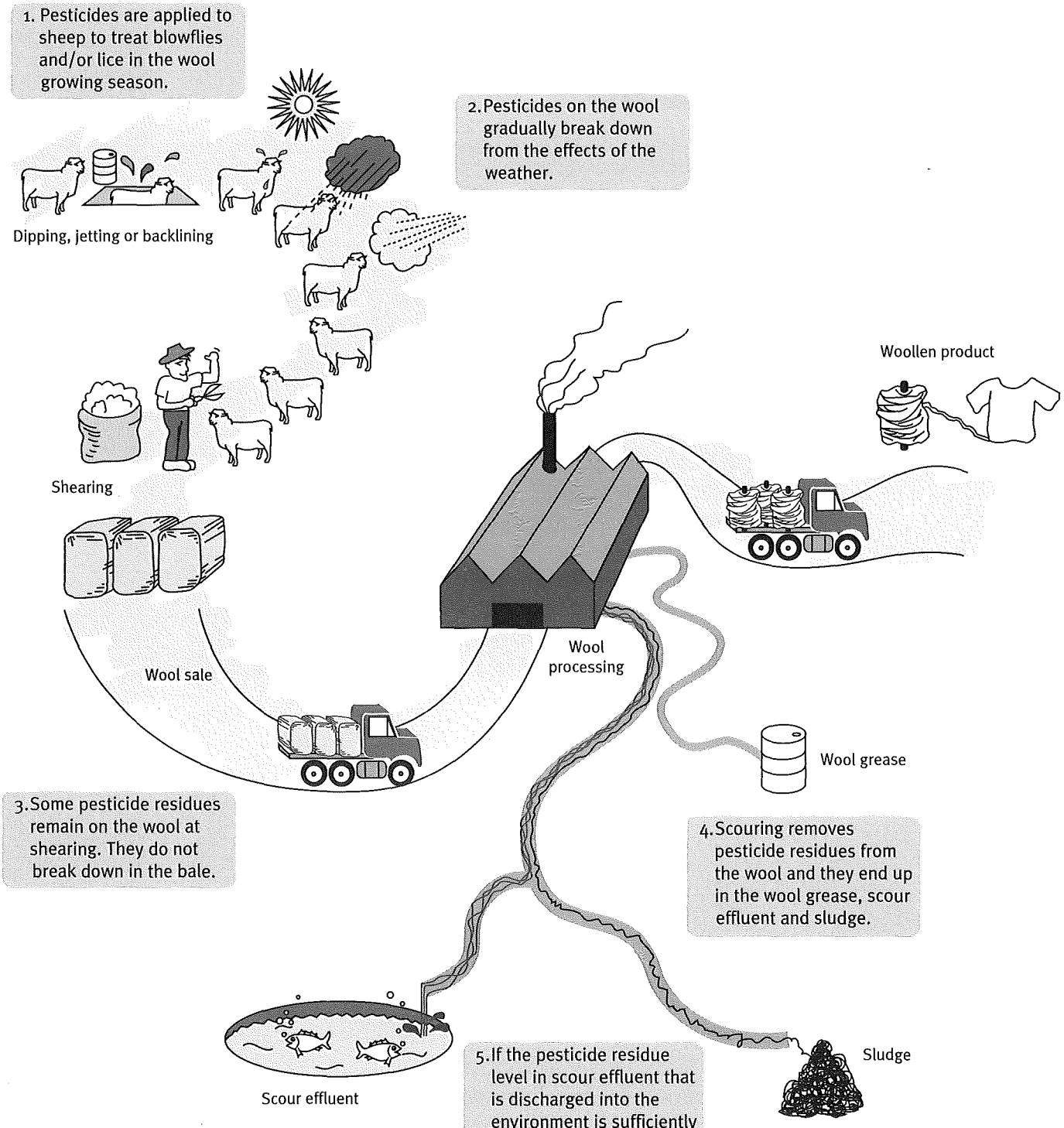
Index 8
An A to Z index to help you find information quickly.

Industry situation

Pesticide residues on wool

Parasite infestation in the Queensland sheep flock from blowflies and lice causes significant economic loss through reduced efficiency of production. Management of blowflies and lice currently relies heavily on the use of pesticides. While pesticides start breaking down on the sheep's back from the time they are applied, when the sheep is shorn some pesticide remains on the wool until it is processed; it is then discharged into the environment as scour effluent or sludge.

Raw wool to wool scour effluent and sludge flow chart



There are global, government and wool industry concerns about the environmental impact of pesticides in wool scour effluent. These concerns mean that producers may no longer be able to rely heavily on pesticides for the control of external parasites. Pesticide residues are also likely to have an impact on the future marketing of Australian raw wool and the price received for it.

Concerns relating to pesticide use include the:

- impact on the environment of pesticides in wool scour effluent;
- impact on the trade in Australian raw wool and our market image;
- occupational health risks to producers, shearers and other wool handlers;
- public health risks of pesticides in wool grease and products based on wool grease, such as lanolin and cosmetics;
- ability of producers to control blowfly and louse infestations economically;
- impact on animal welfare if the capacity of producers to use pesticides is restricted.

It is necessary therefore to ensure that pesticide treatments result in minimal residues on wool while maintaining effective control of blowflies and lice. The Australian wool industry has taken an active role in reducing the levels of pesticide residues on Australian raw wool, including:

- monitoring those residue levels;
- researching the causes of high residue levels;
- informing producers and advisers of how to minimise residues arising from the use of pesticides;
- researching new methods of pesticide application;
- researching management systems that involve limited but strategic use of pesticides to control blowflies and lice;
- reviewing recommended withholding periods (WHPs) and establishing wool harvesting intervals (WHIs) for wool.

It is worth recalling that in the past, when there was pressure on agriculture to minimise residues of banned and persistent organochlorine (OC) and arsenic pesticides, the industry responded and eliminated the use of those pesticides.

More info...

Integrated Parasite Management, section 3, page 2

The eradication of lice by an effective treatment program removes a major source of pesticide residues on wool because there is no need for any further treatment. Blowfly infestation can be more difficult to control, but pesticide use can be minimised with the employment of integrated parasite management (IPM) techniques.

In Queensland, Agforce Sheep and Wool Limited and the Department of Primary Industries (DPI) have been working together on the pesticide residue issue since 1995 through joint participation in the Wool Industry Chemical Residue Committee (WICRC).

Impact of pesticide residues

Following scouring, residues of pesticides applied to control blowflies and lice on sheep end up in wool grease, scour effluent and sludge. Pesticides contained in effluent discharged into rivers or the ocean can pollute the water. If the pesticide residue level is sufficiently high then death of aquatic life (for example fish, insects and crustaceans) can occur.

Environmental authorities, both in Australia and overseas, are establishing environmental quality standards (EQSs) for pesticides discharged to rivers and streams. While these are not finalised at the time of publication, the following table provides a guide to the levels of pesticides that may be accepted in the United Kingdom (UK) and Australia.

Level of pesticides that may be accepted in the UK and Australia

Pesticide	(Draft) UK effluent residue content in water (ng/L)	Max. residues on wool to meet UK EQSs (mg/kg wool)	Australian effluent residue content in water (ng/L)	Max. residues on wool to meet Australian EQSs (mg/kg wool)
Organophosphate	10	0.56	1000	3
Synthetic pyrethroid	0.1	0.06	50	1.5
Cyromazine	5000	28	93 000 000	97 000
Dicyclanil	200	1.12	1 100 000	1146
Diflubenzuron	6	0.84	1000	7.4
Triflumuron	18	4.9	3500	70

Source: Savage, G. 1998, *The residue implications of sheep ectoparasiticides — A report for The Woolmark Company*, National Registration Authority, Canberra.

The above table shows that the maximum level of synthetic pyrethroid (SP) pesticide residue on wool that will be accepted in the UK is very low (0.06 mg/kg). In the 1999–2000 growing season the average residue level of SP on Australian fleece wool was 2.2 mg/kg. This means that even the use of an SP off-shears for lice control will exceed this limit. Therefore the use of SPs will be unacceptable to the UK market. In contrast, the maximum level of cyromazine pesticide residue on wool that will be accepted in the UK is 28 mg/kg and the average residue level on Australian fleece wool in 1999–2000 was just 5.1 mg/kg.

The issue is complex as different countries could establish different acceptable levels, and the pesticides in effluent discharged to land may have a lesser impact in some countries where the treatment and disposal methods result in the pesticides being broken down more readily.

The European Union (EU) has enacted the Integrated Pollution Prevention and Control (IPPC) directive (96/61/EC) that requires all EU member countries to introduce legislation aligned to integrated pollution prevention and control. This directive became operative in October 1999 and is to be fully implemented by 2007. Legislation has been enacted in the UK and Germany and other EU member countries will progressively follow suit.

The IPPC directive requires wool processors to use 'best available practice' to reduce pollution from pesticides. Existing technologies for the treatment and disposal of effluent to rivers or streams are expensive. One alternative method of disposal requires large areas of land, which are unavailable in Europe. Even if effluent treatment plants are upgraded, standards will only be achievable if processors can purchase wool with low pesticide residues or none at all. Thus if Australian producers wish to maintain access to the European market (which consumes up to 40 per cent of Australia's wool production) they will need to substantially reduce pesticide residues on wool at the time of shearing. The most economic solution and 'best practice' for industry means the adoption of management practices that achieve effective control of blowflies and lice with minimal or no pesticide use.

Pesticide residue monitoring

Monitoring studies funded by Australian Wool Innovation Limited on the Australian wool clip began in the 1992–1993 growing season and have continued. The results of this National Residue Survey (NRS) up to date of publication are shown in the following table.

Average pesticide residues on Australian fleece wool (mg/kg) 1992–2000

Chemical	1992–1993	1993–1994	1994–1995	1995–1996	1996–1997	1997–1998	1998–1999	1999–2000
OP	10.2	9.0	4.3	4.4	4.5	5.8	2.4	2.0
SP	5.8	6.6	5.7	5.5	3.8	3.3	1.6	2.2
Cyromazine*			5.2	6.3	8.7	5.8	7.4	5.1
Dicyclanil*								0.1
Diflubenzuron*					1.2	3.6	3.5	2.9
Triflumuron*					3.5	6.1	7.6	9.0

*Member of the insect growth regulator (IGR) chemical group. Note: Dicyclanil is a new pesticide on the market and was not included in NRS testing until 1999–2000.

These results must be interpreted with caution, as the residues are not distributed evenly over the Australian wool clip. However the following trends can be identified:

- SP residue levels steadily declined between 1994 and 2000 because of lice resistance and loss of market share to insect growth regulator (IGR) pesticides; however this trend is tailing off.
- Organophosphate (OP) residue levels declined because of blowfly resistance and occupational health and safety (OH&S) concerns, the reduction reflecting fewer high residue clips (i.e. less long-wool jetting). OPs are still found in 39 per cent of the Australian wool clip due to their widespread use for off-shears lice treatment, blowfly strike treatments and mulesing powders.
- Cyromazine residue levels have fluctuated depending on seasonal conditions and blowfly activity.
- Triflumuron residue levels are steadily increasing. This is of particular concern to Queensland producers due to its higher than average use in this state.

These studies have also shown that a small percentage of individual clips contribute the bulk of the residue load. Those clips contributing the most correspond to a shifting population of producers, due to seasonal variations that result in different blowfly and louse infestation in different regions. Many of the levels recorded on individual clips exceed those expected to be acceptable to the UK and European markets. On the other hand a large percentage of the Australian wool clip complies with the expected European levels. The issue here is the identification of this low residue wool in the market.

Trace-back surveys of producers conducted after the analysis of samples established a correlation between residue levels and on-farm management practices. The results indicated that high residue concentrations were generally associated with:

- applying pesticides to sheep in long wool (i.e. greater than six weeks wool growth);
- applying pesticides more than once in the wool growing season;
- shearing sheep with less than 12 months wool.

The correct use of off-shears and short-wool pesticide products within the first six weeks after shearing resulted in low residue levels, provided sheep were shorn with 12 months wool. However it is anticipated that the maximum level of SP residue on wool to meet EU EQSs will be so low that any wool with an SP applied might not meet the standards required for processing in Europe. On the other hand treatment of individual blowfly struck sheep with wound dressings resulted in low residue concentrations on wool as it was diluted across the clip. This was the case even when the dressing was applied in the last three months before shearing.

Market opportunities

In the future, wool processors in countries with stringent EQSs (such as those of the EU) will source wool from those countries that have an active residue reduction program (such as Australia) resulting in identifiably low concentrations of residues. Therefore it is essential for the Australian wool industry to give buyers an indication of the pesticide residue status of the wool they purchase through mechanisms such as vendor declarations, quality assurance (QA) schemes, or residue testing.

NOTE

The AWEX Code of Practice is available on the Internet at www.awex.com.au or call (02) 9223 8788

The Australian Wool Exchange (AWEX) has reviewed its Code of Practice to include a voluntary vendor declaration for producers, covering the pesticide residues on their wool. The new Code of Practice came into effect from 1 January 2001 and the declaration is part of the Woolclasser's Specification.

Price differentials

It is expected that, with time, price differentials will develop for low residue wool. These differentials are expected to be in the form of discounts for high residue wool rather than premiums for low residue wool. This is because a high proportion of the Australian wool clip already meets the expected standards. The major issue in avoiding price discounts will be the identification of low residue wool in the market.

Identifying residue levels

More info...

Identifying pesticide residue levels, section 4, page 48

Mechanisms to identify pesticide residue levels on wool have been developed. They include a voluntary vendor declaration, QA schemes and residue testing. In the case of the voluntary vendor declaration and QA schemes, which provide a treatment history of the flock, producers must comply with a standardised format that provides wool buyers and processors with information that enables them to identify and buy wool with an acceptable pesticide concentration. Testing wool for pesticide residues is expensive and has been undertaken only by those producers seeking to meet specific market or customer requirements, such as for organic wool. In future testing may be necessary to gain access to sensitive markets such as the EU.

In cases where pesticides have been applied for animal welfare purposes to long wool in the few months prior to shearing, it will also become necessary to be able to identify that wool using the voluntary vendor declaration, QA schemes or residue testing. The wool can then be marketed appropriately and possibly be processed in plants with suitable effluent treatment facilities. Scours located in New South Wales, for example, should meet this criterion.

Organic wool and eco-labels

More info...

Organic wool and eco-labels, section 4, page 51 and section 6, page 13

There is a growing worldwide trend to natural, organic and ecologically sustainable products, including a small but expanding market for organic textiles. Some manufacturers, especially in the EU, are promoting eco-labels and these could provide marketing opportunities for producer groups who can certify their wool as having low or no pesticide concentration. The wool would need to be produced under a credible QA or organic certification scheme to rigorous standards and be independently audited.

Status of blowflies and lice

Blowflies

In Queensland the incidence of blowfly strike is highly dependent on seasonal conditions and varies greatly from region to region and from year to year. However in summer rainfall regions (such as Queensland) the main peaks of blowfly activity occur in spring and autumn. In temperate regions with dry summers the peak activity is normally in spring. As a consequence the incidence of pesticide residues on wool due to treatment for blowfly control is sporadic. For example in the mid to late 1990s, dry seasonal conditions pointed to the use of pesticides for lice treatment rather than blowfly control as the major contributor to pesticide residues on wool.

Because of the potentially devastating effects of blowfly strike on their flock many producers use a yearly strategy of preventive pesticide treatment, even though severe blowfly waves may happen only one or two years in ten. Surveys of Queensland producers by DPI have shown that 70 per cent of those who apply pesticides for blowfly strike use preventive strategies.

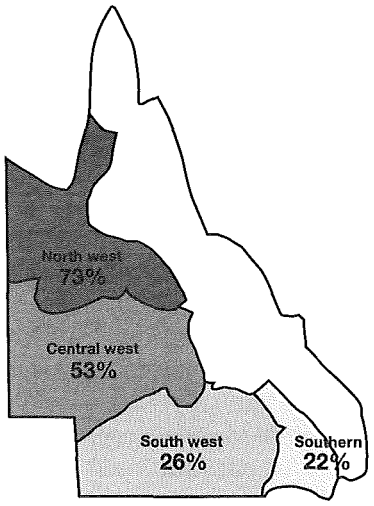
More info...
Integrated Parasite Management, section 3, page 2

The effective implementation of a blowfly management strategy based on IPM principles would ensure that widespread pesticide use in long-wool sheep would be necessary in only one or two years in every ten. As a result, pesticide residues from treatment for blowfly control could be kept to a minimum in most years and any marketing disadvantage confined to those one or two years.

Lice

Ineffective eradication of lice after shearing resulting in re-treatment of sheep in long wool is one of the major sources of pesticide residues. Surveys in Queensland by DPI have demonstrated that the prevalence of lice infestation in sheep flocks has consistently remained around 30 per cent, with the incidence being highest in central-west and north-west Queensland as shown in the following figure. The situation therefore remains endemic throughout the state.

Prevalence of louse infestation in Queensland sheep flocks by region (1998)



More info...
Integrated Parasite Management, section 3, page 2

Efficient off-shears or short wool application of an effective pesticide for lice control has the potential to dramatically alter the situation to such an extent that eradication can be achieved. Producers in New South Wales have demonstrated that lice can be eradicated and up to 40 per cent of producers in that state have lice-free flocks and do not treat. Eradication enables producers not to treat — thus minimising residues on wool and production costs — and to rely on IPM practices to prevent reinfestation.

Effects on wool quantity and quality

Blowflies

The effects of blowfly strike on wool quantity and quality vary widely from year to year and from flock to flock. Wool from blowfly struck sheep is generally downgraded because of stain and tenderness. Once a sheep is struck, wool and body weight growth is reduced by a factor that depends on the severity of the strike. In light strikes (fewer than 1500 larvae) little loss may occur, but in medium to heavy strikes (greater than 1500 larvae) losses of 22–33 per cent in wool production during the strike have been reported. In some cases a break in the wool occurs and results in the sheep shedding the fleece. In addition, growth is suppressed for about a month after treatment. Wool quantity is also reduced by treatment of struck sheep and sheep deaths. Thus significant economic losses can occur.

The annual cost to industry of the Australian sheep blowfly, when last estimated for publication in 1995, was $161 million.

Lice

Lice do not significantly reduce sheep body weight or fibre diameter. There may be a small reduction in wool growth rate because the sheep are biting and scratching and not feeding. However lice mostly cause losses to fleece weight because as the affected sheep bite and rub they remove wool from the fleece.

Lice infestations are generally categorised as being light, medium or heavy. In a light infestation there is on average less than 1 louse per 10 cm parting or opening of wool; in a medium infestation lice numbers are between 1 and 5 per 10 cm parting or opening; and in heavy infestations there are more. The effects of lice vary according to the severity of the infestation. For example losses of 0.3–0.9 kg per fleece and 0.4–1.1 kg per fleece have been reported from different experiments.

Other effects of lice that lower the value of the fleece are cotting, unscourable colour, yield losses of 4–6 per cent, reduced staple strength and style, and reduction of fibre length in the wool top of about 10 per cent due to increased noil.

The annual cost to the Australian wool industry of lice infestation and control, when last estimated for publication in 1995, was $169 million.

Integrated parasite management

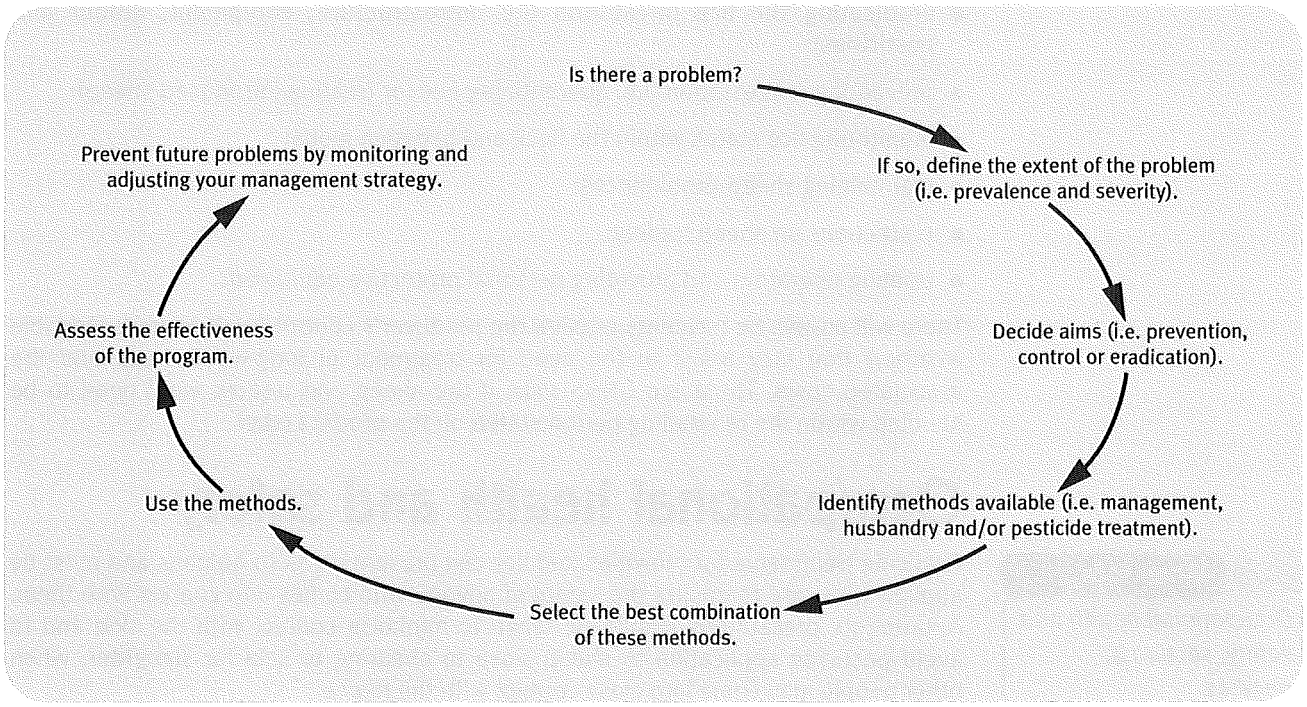
More info...

Integrated Parasite Management, section 3, page 2

In this context IPM is a systematic approach involving preferred alternative methods available to producers to control blowflies and lice. The primary aim is to use pesticides strategically and reduce reliance on them. To be effective, IPM methods must be complementary and cost effective, have minimal negative impacts, and provide a medium to long term solution.

By using an IPM approach to control blowflies and lice, producers can greatly reduce the level of pesticide residues on wool. Pesticide treatments for blowflies and lice are often considered separate issues, but in terms of residues they both contribute to the total pesticide load on wool and so benefit from an integrated management program.

Integrated parasite management flow chart



Source: Evans, D. & Karlsson, J. 1999, 'Integrated approach reduces chemical reliance', *Farming Ahead with the Kondinin Group*, no. 88, pp. 74–75.

Benefits and costs of an IPM approach

There are benefits in implementing an IPM approach; however as with any management practice there are also costs. Care needs to be taken to ensure that the costs do not exceed the benefits. The benefits of an IPM approach are the same for both blowflies and lice and include:

- protecting sensitive markets through minimising pesticide residues on wool;
- the opportunity for producers to establish a market niche;
- reduced production costs (such as pesticides and labour), therefore increased availability of funds for capital improvements or personal expenditure;
- delaying the development of resistance to pesticides;
- reducing operators' exposure to pesticides;
- reducing environmental exposure to pesticides.

More info...

Calculating the cost, section 4, page 39

The costs of an IPM approach may not be the same for blowflies and lice due to the characteristics of the parasites and the strategies required for managing them. The costs associated with managing blowflies in an IPM approach include:

- selecting and breeding blowfly resistant sheep;
- monitoring blowfly populations (using technology such as the LuciTrap® system);
- predicting active blowfly periods;
- preventing blowfly strike (i.e. mustering, mulesing, crutching, early shearing and jetting);
- training operators and providing personal protective equipment.

The costs associated with managing lice in an IPM approach include:

- eradicating the lice infestation (i.e. infrastructure, equipment, labour and pesticides);
- preventing reinfestation (i.e. quarantining and/or treating introduced sheep);
- monitoring lice status within the flock and between mobs;
- maintaining sheep-proof fences;
- restrictions on sheep trading;
- training operators and providing personal protective equipment.

There will always be incidents outside the producer's control (such as unseasonable weather) that may result in the need for treatment of long-wool sheep and the associated costs. There are OH&S risks if the sheep and treated wool need to be handled within the rehandling period stated on the product label.

Occupational health and safety

More info...
Occupational health and safety, section 4, page 42

Pesticide treatments for blowflies and lice can present a risk to humans and must be applied with care to ensure the safety of anyone who comes into contact with them. Appropriate precautions should be taken to minimise contact with the skin and to avoid pesticide application to sheep close to shearing or sale for slaughter, when other people may come into close contact with the fleece.

Producers have a duty of care to provide a safe workplace for their employees. For example in a landmark decision in Wagga Wagga, New South Wales in 1995 a shearer was awarded $250 000 and in 1997, three additional shearers from the same team were awarded almost $700 000 in damages after exposure to diazinon, from the OP chemical group, at shearing.

More info...
Training providers, section 6, page 5

Training courses for farm chemical users provide basic information on the safe handling and effective use of agricultural and veterinary (agvet) chemicals on farms. Courses include instruction in the use of protective equipment and clothing, record keeping, the use of pesticides, and the storage and disposal of containers. They are recommended for all producers.

During 1996–1997 DPI surveyed 301 Queensland producers to document their practices in the handling and storage of pesticides for the control of blowfly and louse infestation. The survey revealed that 25 per cent of owners/managers and 21 per cent of their employees had attended training courses. Although 40 per cent of owners/managers kept records, only 29 per cent recorded who used the pesticides. Protective equipment, even when available, was infrequently used. There was a high level of compliance with disposal of excess pesticide and containers in accordance with manufacturers' recommendations. Most survey respondents stored pesticides at a site protected from the weather, but only 54 per cent secured the pesticides from unauthorised access. Producers appeared to place a low priority on spillage control.

Many producers indicated that under hot working conditions the use of some protective clothing was uncomfortable and restricted their ability to work. Manufacturers include minimal protective clothing requirements on the product label and these should be adhered to.

All WHPs relating to OH&S must be adhered to and in some situations may override other WHPs, such as for meat, wool and milk, and WHIs.

Animal health and welfare

NOTE

The Model Code of Practice is available on the Internet at www.affa.gov.au

Producers have an animal welfare obligation to use sound animal husbandry principles and practices in the prevention and control of blowfly strike and lice infestation. Both parasites cause irritation, rubbing, and fleece derangement. Blowfly strike can also stop wool production and cause sheep deaths. The procedures used to control these parasites should be performed correctly to avoid causing injuries or stress to the sheep.

The *Model code of practice for the welfare of animals — The sheep 1991*, is a guide for sheep handlers and managers. Appropriate sections of this code are as follows:

- Sick, injured or diseased (for example parasitised) sheep should be given prompt and appropriate treatment or be humanely slaughtered.
- Appropriate preventive measures should be taken against diseases that are common and likely to occur in a flock, and they should be implemented in strict accordance with manufacturers' recommendations.
- The correct procedures to prevent and control parasitism (such as lamb marking and mulesing) should be used in accordance with animal welfare requirements when handling animals.

More info...

Management of blowflies, section 2, page 7

Blowfly strike in long wool sheep can be minimised by good husbandry and management procedures and, if necessary, by timely preventive treatment. However when large numbers of sheep are likely to be affected by blowfly strike in the months close to shearing producers can either treat with a pesticide or shear early. If a pesticide is used considerations must be given to the WHP, the WHI, the export slaughter interval (ESI) and the rehandling period. When small numbers of sheep (less than 2 per cent of the mob) are being struck they should be treated individually. Treatment of individual struck sheep normally does not pose a residue problem.

More info...

Management of lice, section 2, page 10

Lice can be eradicated by the correct use of pesticides in the first six weeks after shearing provided subsequent management prevents reinfestation. Where there is a severe lice infestation in long wool just before shearing, pesticide use may not be the most appropriate treatment and bringing shearing forward is the best option. In this situation producers would have to balance OH&S, environmental, animal welfare, productivity and profitability concerns against creating, recording and reporting a residue problem, such as in a voluntary vendor declaration or QA scheme.

Common questions

Common questions

This section responds to your most commonly asked questions about pesticides, blowflies and lice. The questions have been drawn from surveys of producers, industry advisers and DPI extension staff throughout Queensland. The answers have been kept as concise as possible; where more detail is required you are referred to other sections of the manual. Notations on the left-hand margin will help you make these links. You may also find the glossary section helpful.

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Pesticides and pesticide residues

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How do I get my wool tested for pesticide residues? 6

Will I be able to keep using the pesticides I currently use?

Provided the pesticide is registered for the treatment method and target parasite and the requirements on the label are adhered to, you can keep using it. However in some cases when the pesticide is used according to label instructions, the residue status of the wool when shorn is high and access to sensitive markets may be restricted. Check the withholding period (WHP) and wool harvesting interval (WHI) or consult your adviser for up to date information.

Pesticides used for blowfly and lice control are periodically reviewed (as for example in *The residue implications of sheep ectoparasiticides — A report to The Woolmark Company* 1998) for compliance with environmental and occupational health and safety (OH&S) regulations. As a result, over time some pesticides may be withdrawn and the remaining pesticides may have their use modified. In addition new products can become registered and available for use.

Will the pesticides I use leave residues?

More info...
Pesticide use and residue levels, section 4, page 47

All pesticides used according to label instructions will leave residues. The rate of breakdown of pesticides on wool depends on:

- the type of pesticide (i.e. its active ingredient);
- which part of the wool staple the pesticide is applied to (there is faster breakdown at the tip than at the base of the staple);
- environmental conditions (the rate of breakdown is faster in hot, dry climates).

All pesticides need sunlight and air to break down. Once the wool is shorn from the sheep and pressed into a bale the rate of breakdown is negligible. Note that the chemical group spinosyn breaks down extremely rapidly and does not leave residue levels that impact on the environment or OH&S.

What causes high pesticide residues on wool?

HINT

The use of effective pesticides according to label instructions, WHPs and WHIs, combined with integrated parasite management (IPM) practices, normally result in acceptable residue levels.

A combination of commonly used management practices leads to high pesticide residues on wool. These include:

- repeat treatments with pesticides from the same chemical group;
- pesticide treatment in long wool sheep, especially close to shearing;
- higher than recommended pesticide strength;
- some application methods (hand jetting, for example, leaves higher residues than an automatic jetting race (AJR) but provides a longer period of protection);
- shearing before the expiry of the WHP or the WHI (such as shearing rams at six months wool, shearing weaners at eight months of age, or shearing early as a result of a flywave or high lice infestation);
- double skirting to remove seeds or burrs, leading to a concentration of residues in the main line (this relates particularly to backline treatments);
- mixing two or more pesticides.

How close to shearing can I use pesticides?

IMPORTANT

Depending on the active ingredient, pesticides vary in their WHP, WHI and rehandling period.

You need to know the WHP, WHI, rehandling period and application method to determine how close to shearing you can use a particular pesticide. Most of this information is found on the product label. WHIs are published by Australian Wool Innovation Limited on its Internet site at www.cleangreenwool.com

If necessary, evaluate alternative pesticides or alternatives to pesticide use, especially if you wish to sell your wool to a sensitive market such as the European Union or certify it as organic.

What are the differences between chemical groups?

Chemical groups vary in the way they kill and the rate at which they kill the parasite, as some chemical groups kill quickly, some slowly. You will need to adjust your management practices to cater for these differences.

Insect growth regulator (IGR)

Within the IGR chemical group there are two sub-groups with different modes of action; diflubenzuron and triflumuron on the one hand and cyromazine and dicyclanil on the other. The IGR group provides the longest residual action/protection (up to 20 weeks for both blowflies and lice). IGRs do not kill blowflies or adult lice immediately, but rather prevent larvae (nymphs) from moulting and further development.

More info...

Choosing a chemical group, section 4, page 25

Consequently all lice on the sheep are not dead until nine weeks or more after treatment, when their life cycle is complete. Blowfly larvae (maggots) may take several days to die; however they stop feeding on the sheep immediately following treatment.

Organophosphate (OP)

The OP chemical group normally kills blowflies and lice quickly; however when it is applied as a backline treatment it takes time to disperse and kill the target parasite. When applied as a jetting treatment for blowfly control, it can provide protection against blowfly strike for up to six weeks. However widespread resistance to this chemical group has been detected and excessive residue can also result; therefore jetting with an OP pesticide is not recommended. OPs applied as a plunge or shower dip treatment kill lice quickly, but provide only a short protection period of up to six weeks.

Spinosyn

The chemical spinosyn was introduced to the market in 2000 for control of blowflies and lice in long wool and is applied as a jetting treatment or flystrike dressing. It kills the target parasite quickly and provides four to six weeks protection. Spinosyn breaks down rapidly, is a safe, low residue product and can be used two months prior to shearing as it has nil wool and meat WHPs and a nil export slaughter interval (ESI).

Synthetic pyrethroid (SP)

The SP chemical group is mainly used for lice control and kills susceptible lice quickly on contact. When applied as a dip treatment susceptible lice die immediately, however when applied as a backline treatment it can take up to six weeks for them to die. Widespread resistance to this group of chemicals has been detected, so if resistance is suspected use an effective registered pesticide from an alternative chemical group.

If I mix these pesticides will they still work?

Pesticides should only ever be mixed according to the manufacturer's instructions on the product label. If there are directions for mixing with another pesticide they can be mixed and retain their effectiveness. But some pesticides are incompatible and mixing these may result in a loss of effectiveness.

Which pesticides should I use to control blowflies and lice?

Any effective pesticide that is registered for blowfly or louse treatment and is applied according to label instructions can be used to control these parasites. Appropriate products from the IGR chemical group are recommended, in association with IPM practices.

Pesticides from the IGR group can give sheep protection from blowfly strike for up to 20 weeks. In comparison, most OPs protect sheep from blowfly strike for only four to six weeks — or even less if the blowflies are highly resistant to this group. It should be noted that there is emerging evidence that where blowflies are highly resistant to OPs the period of protection provided by diflubenzuron-based products from the IGR chemical group is also reduced.

Due to the widespread resistance of lice to SPs in Queensland it is recommended that they not be used and an IGR be applied off-shears to eradicate lice. The IGRs give protection from lice reinfestation for up to 20 weeks.

Guide to commonly used treatments for blowflies and lice

For an up to date list of commonly used treatments for blowflies and lice, visit the DPI Internet site at www.dpi.qld.gov.au or contact the DPI Call Centre for the cost of a local call from anywhere within Queensland on 13 25 23 from 8 am to 6 pm, Monday to Friday. Interstate callers please phone (07) 3404 6999.

The list includes the product name, its chemical group and active ingredients, target parasite/s, WHPs for meat and wool and the manufacturer's name. The products are grouped according to their application method.

Which pesticides should I use on wounds from mulesing and lamb marking?

HINT

Mulesing and marking should be carried out during cold weather or at hot, dry times of the year when blowfly and bush fly activity is low.

Any product registered for that purpose could be used. Research conducted by NSW Agriculture (1999) reveals a big variation in the effectiveness of various products registered for use on wounds. No product will give 100 per cent protection of wounds during flywave conditions. Consult your adviser for further information.

Which pesticides should I use for hand dressing blowfly struck sheep?

More info...
Treating individually struck sheep, section 4, page 31

The use of a pesticide from the IGR group (particularly cyromazine products) for hand dressing blowfly struck sheep is recommended. Cyromazine blowfly strike dressings, even though they are slower than OPs in killing the larvae, prevent most larvae from developing into mature flies. The use of OPs is not recommended as many blowflies are resistant to them and the large or third stage larvae will fall off the sheep and develop into resistant blowflies. The chemical spinosyn can be applied as a blowfly strike dressing. As it breaks down rapidly, has no adverse OH&S or environmental effects, and has a nil WHP it can be used within the last two months prior to shearing.

What is the cost of using pesticides?

More info...
Calculating the cost, section 4, page 39

Products from the IGR chemical group are recommended even though they are more expensive than products from other groups. This is because they have been proven to be more effective and in most cases to eliminate the need for re-treatment associated with using a cheaper product that has been on the market for longer. Re-treatment leads to increased costs associated with mustering, labour and pesticide use and also to high residue levels.

The obvious costs associated with purchase of the pesticide and its application are often the only factors calculated when considering this question. However lost production, animal welfare, environmental damage, operators' and wool handlers' health and safety and residue levels should also be taken into account.

Will I be able to sell my wool if I apply pesticides late in the wool growing season?

More info...
Identifying pesticide residue levels, section 4, page 40

All wool is saleable, regardless of pesticide use. However as markets such as the EU seek wool with low pesticide residues it is expected that in the future price discounts will be realised for wool with high residue levels. Mechanisms to identify residue levels on wool have been developed. They include a voluntary vendor declaration, quality assurance (QA) schemes and laboratory testing.

How do I get my wool tested for pesticide residues?

More info...

Laboratory testing, section 4, page 49 and section 6, page 14

There are two ways to have your wool tested for pesticide residues — either through your wool broker or directly with the testing laboratory. Testing through your wool broker is recommended as the test is able to be done using a core sample of sale lots taken for testing by the Australian Wool Testing Authority Ltd (AWTA) in the wool store. This method is much more accurate than collecting your own core samples from bales in-shed, which is necessary if you are dealing directly with the testing laboratory.

A wool sample taken from a single sheep, or even a small group of sheep, is not a reasonable representative sample of the pesticide residue status of a flock or mob.

Management of blowflies

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Are some sheep more susceptible to blowfly strike than others?

More info...
Sheep susceptibility, section 4, page 3

Yes, some sheep are more susceptible than others. Sheep with fleece rot, lumpy wool, yellow wool, devil's grip or excess wrinkles are highly susceptible to blowfly strike. Purchasing rams from a stud that selects and breeds against those characteristics will help you to breed sheep resistant to blowfly strike.

Poor husbandry procedures contribute to increased susceptibility and include unmulesed or incorrectly mulesed sheep, incorrectly docked tails, uncrutched sheep, wool stained with urine or faeces (dags), lambing stain on ewes, and wounds from fighting among rams.

Can I minimise blowfly strike?

Yes, by implementing an IPM program. This approach is based on making the host (the sheep) less attractive to egg laying female blowflies through a combination of preventive measures including breeding and selection, correct mulesing and tail docking at lamb marking, blowfly trapping, and strategic timing of shearing and crutching. In wet seasons a flywave can develop and jetting with an effective registered pesticide may be necessary.

What should I do if my sheep get blowfly strike?

More info...
Chemical control of blowflies, section 4, page 30

The number of sheep being struck, the season and weather conditions, the time of lambing and the length of wool will all affect your response. Your options are to individually treat struck sheep; to treat only the most susceptible mobs in the flock; to treat the whole flock or to shear early. If you choose to treat you will also need to decide whether to jet only affected or high-risk areas on the body or the whole body.

If you decide on individual treatment you will have to catch, clip and treat each affected sheep. This treatment option is preferable to treating entire mobs, as the residue level in the clip is low due to the dilution effect when the affected wool is mixed with the rest of the clip at shearing.

HINT

Assess the risk of further blowfly activity and the possibility of a flywave developing by reviewing seasonal conditions and monitoring the number of flies in blowfly traps.

If you decide to treat susceptible mobs or the whole flock consider jetting affected areas only (such as the breech of ewes, pizzle of wethers and poll of rams). At the next shearing the areas of the fleece containing the highest residue levels will be skirted off with the residues concentrated in these lines and not the fleece line. However if strike is occurring in ewes prior to lambing, the above options may not be practical, and you may need to treat the mob with a full body rather than a targeted jet.

Sheep can be struck in any length of wool; however the incidence of blowfly strike is lower in short wool. If sheep in long wool are being struck and you decide to treat you will need to consider WHPs, WHIs, ESIs and rehandling periods to determine when it would be best to shear.

What weather conditions lead to a flywave?

More info...

Blowflies life cycle, section 4, page 2

Blowfly activity normally occurs during spring and autumn when weather conditions (moisture and temperature) are favourable. In some seasons an extended period of moist mild weather leads to the continued build up of the blowfly population resulting in a flywave, however the flock must also be highly susceptible to blowfly strike.

What should I do if there is a flywave?

Your main consideration in a flywave is the welfare of the sheep. Targeted jetting and treatment of individual struck sheep is not an option due to the spread and severity of strike. You should select a product from an effective chemical group (preferably the IGR group) and hand jet all sheep. Alternatively, if more urgent action is needed, use a spray-on application or a pesticide that is suitable for an AJR that has been modified or manufactured to meet NSW Agriculture specifications. Remember that applying an OP with an AJR during a flywave gives only a couple of weeks protection and is not recommended as you may have to re-treat, increasing production costs and residues. OH&S risks also need to be considered if an AJR is used. The WHPs, WHIs, ESIs and rehandling periods will also determine the pesticide you use.

If the sheep are in long wool, determine whether early shearing is a viable option. For this you will need to consider the availability of a shearing team, whether a clean muster can be achieved in wet conditions, and the lower price likely to be realised from the sale of prematurely shorn wool.

Should I treat my flock preventively against blowfly strike?

Firstly, assess the odds as to what sort of fly year it will be. If it is drier than normal and the Southern Oscillation Index (SOI) is negative it is highly probable that it will be a low blowfly strike year. If it has been wet and the SOI is positive, above average rainfall can be expected along with increased blowfly numbers.

Have you been buying your rams from a stud that selects against blowfly strike? Are your sheep mulesed? If your sheep are not susceptible to blowfly strike you may decide not to treat. If you assess the risk to be high you will need to determine how close you are to shearing and whether there are effective pesticides available for use in that length of wool. You may decide to treat only the most susceptible sheep (weaners, hoggets and rams) or to jet susceptible areas only (breech, pizzle, poll).

In any event, ensure that all management and husbandry options have been used to their maximum and avoid the use of pesticides until necessary. If you are using blowfly traps they must be operational before the start of the blowfly season to maximise the benefits of suppressing the blowfly population. In Queensland they should be operating by early August.

How do I minimise blowfly strike in my lambs and weaners?

IMPORTANT

Lambs that are aged over six months when they are mulesed require an anaesthetic.

Lambs should be mulesed and tail docked at lamb marking. This will reduce the occurrence of blowfly strike in weaned lambs up to their first shearing, even if blowflies are active. If lambs are not mulesed at marking due to drought, do it after they are first shorn. Monitor weaned lambs regularly for blowfly strike, and treat affected individuals rather than the whole mob if possible. Identify and cull ewe weaners that have been struck as part of your breeding and selection program.

Management of lice

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How can I tell if my sheep have lice?

More info...

Diagnosing lice, section 4, page 13

Inspection using the recommended fleece parting technique is at present the only method for confirming whether lice are present. For a successful monitoring program you should check each mob for infestation at least four times a year (such as at crutching, lamb marking, drenching and before shearing). As light infestations can vary between paddocks — depending on previous treatment, management practices and exposure to reinfestation — it is necessary to check all mobs on the property.

A heavy infestation has a characteristic smell and is therefore unlikely to go unnoticed by experienced operators (such as shearers, wool rollers and the classer) who come into close contact with the fleece at shearing. However to confirm a light infestation the fleece parting technique must be used.

CSIRO and Elizabeth Macarthur Agricultural Institute (EMAI), with funding support from Australian Wool Innovation Limited, are developing a simple and sensitive test to be used during shearing that will detect the presence of lice. It was not commercially available at the time of publication.

Other less accurate indicators of lice infestation include:

- obvious fleece derangement;
- obvious biting, pulling and rubbing of the fleece;
- wool tufts found on fences and trees;
- the presence of lice on sheep on an adjoining property;
- the presence of sheep from an adjoining property in your paddocks.

How can I be sure that my sheep don't have lice?

It may take a number of years of monitoring to develop confidence that your sheep are free of lice. Use the following criteria to help you decide:

- You have used the fleece parting technique for the past two to three years and have not seen any lice.
- You have used an effective lice treatment for the past two to three years and successfully eradicated lice.
- Your flock has been totally isolated from lice infested sheep for the past two to three years.
- You have not seen your sheep biting, rubbing or pulling at their fleeces for the past two to three years. (Be careful not to confuse rubbing with heavy grass seed contamination.)
- There has been no cotted wool for the past two to three years.
- You did not treat a mob as a trial, and they remain lice free.
- You have no record of stray sheep in your paddocks.
- You are working with adjoining property owners/managers on managing lice.
- Shearing shed operators (such as shearers, wool rollers and the classer) have not seen lice on your sheep for the past two to three years.
- You have not treated for lice for the past two to three years and have found no signs of lice.

Is it possible to eradicate lice?

Yes. DPI surveys conducted in 1997–1998 and 1998–1999 found that 70 per cent of Queensland sheep flocks were free of lice, which indicates either that the flocks never had lice, or that lice had been eradicated. NSW Agriculture surveys conducted during the 1990s have shown that the proportion of producers in that state who have lice-free flocks and do not treat for lice has increased to around 40 per cent.

Effective treatment and the implementation of an IPM program make eradication possible. Many producers have found that treating off-shears using an IGR pesticide has helped them to eradicate lice. Before the introduction of IGRs some producers were achieving eradication by dipping effectively.

More info...

Eradicating lice, section 4, page 34

As some lice are resistant to some chemical groups it is essential to use an effective pesticide, to follow the instructions on the product label, and to employ the correct application technique and equipment.

If you have experienced difficulty with eradicating lice using your current preferred method of treatment you should investigate an alternative approach; this may involve changing your method of treatment and/or chemical group.

Producers on adjoining properties who have worked together have successfully eradicated lice from their properties. They are then able to coordinate their efforts to maintain their lice-free status.

How can I keep my sheep free of lice?

HINT

Make an arrangement with the owners/ managers of adjoining properties regarding collection of stray sheep. Sheep should not be returned over the fence.

If your sheep are free of lice you will be able to keep them lice free by implementing and maintaining strict management practices. There are two main sources of reinfestation: stray sheep and introduced sheep.

External buffer zones can act as barriers against stray sheep. These include double fenced roads and highways, neighbouring cattle and/or cropping properties, natural borders such as cliffs and rivers, and adjoining lice-free properties, all of which should be capitalised on. If an adjoining property is lice infested you could create an internal buffer zone by treating only mobs in the paddocks along that boundary, or running only cattle in boundary paddocks. Sheep proof fences (boundary and internal) are essential.

Procedures for the management of introduced sheep include:

- shearing and treating newly purchased rams;
- quarantining introduced sheep until they have been diagnosed lice free;
- shearing and treating (according to their risk status) any of your own sheep that have been collected after straying on to an adjoining property.

More info...

Control with minimal chemical use, section 4, page 21

Can sheep be infested with lice from cattle or goats?

In normal field conditions body lice (*Bovicola ovis*) are found only on sheep and cannot breed on cattle or goats. In turn, cattle and goat lice cannot breed on sheep. Body lice from sheep have however been transferred to goats that were run with sheep in a shed. The lice can complete a life cycle on goats but they won't reproduce on goats. There is no evidence that sheep lice can spread to goats or cattle and be maintained as a source of infestation for sheep.

What are the likely outcomes of not treating for lice after shearing?

If your sheep are lice free and your IPM program is effective your flock should remain lice free. On the other hand if there is a breakdown in your management program (such as from stray or introduced sheep, or a residual lice population) the flock could become infested.

More info...

Build up in lice numbers, section 4, page 7

If the infestation is from a residual lice population resulting from ineffective treatment, a medium to heavy infestation can be expected on most sheep in the mob by next shearing, with associated losses. If the infestation is from stray or introduced sheep, a light to medium infestation can be expected on some but not all sheep in the mob by next shearing. The later the infestation starts in the wool growing season, the lighter it will be.

Most importantly, in the event of a breakdown in your management program you need to identify when and where it occurred and implement changes to ensure that it doesn't happen again.

What should I do if I think my long-wool sheep have lice?

IMPORTANT

Treating in long wool will only control, not eradicate lice, so regardless of what you decide to do you will need to treat with an effective pesticide after shearing to eradicate the infestation.

The first thing you should do is make an accurate diagnosis. Any obvious biting, pulling and rubbing of the fleece could be caused by itchmite or grass seed, not lice. If, on inspection, no lice are present you should not treat. If inspection confirms your suspicions and lice are present, your first considerations are the length of wool and degree of infestation.

If shearing is only three months away or less and the infestation is light, it will probably not be economic to treat. Accept the losses involved, shear at the normal time and start an IPM program with an effective treatment after shearing. If you diagnose a light infestation between three and nine months after shearing treat with an effective registered pesticide.

If you diagnose a medium to heavy infestation between three and nine months after shearing treat with an effective registered pesticide. However if you are only three months or less from shearing you should weigh up the practicalities and economics of shearing early; treating only those sheep showing signs of fleece derangement to arrest further production losses; or treating all sheep to control the spread of lice. Sheep from a lice infested mob that are not showing signs of fleece derangement will suffer minimal production losses and treatment may be uneconomical. By choosing not to treat all the sheep in the mob you will also reduce residue levels in the clip.

What should I do if I think my lambs have lice?

The first thing you should do is make an accurate diagnosis. If, on inspection, no lice are present you should not treat. If lice are present you should consider the age of the lambs. If the lambs are less than five months of age and still on their mothers treat with a pesticide registered for use on unshorn lambs. If the lambs are more than five months of age your options are to shear and treat or to treat with a registered pesticide in long wool. Any pesticide applied to lambs poses a residue risk if lambs are shorn before 12 months of age.

Regardless of what you decide to do you will need to treat with an effective pesticide off-shears to eradicate the lice infestation.

What is the lice treatment for ewes and lambs after shearing?

If no lice are diagnosed and the risk of reinfestation is low, no treatment is required. If lice are diagnosed shear both ewes and lambs and treat them off-shears with an effective registered pesticide. You will need to separate ewes and lambs for ease of treatment and consider WHPs, WHIs and — for sheep intended for slaughter — ESIs. If lambs are to be sold to export markets you should avoid treating off-shears with pesticides that have an ESI that may extend past the expected sale date.

If your lambs and ewes have lice but only the lambs are being shorn, shear the lambs and then treat and wean them. For this approach to be successful it is essential to keep ewes and shorn lambs separate. You will need to treat ewes in long wool that have lice but are not being shorn. Ewes will need to be treated after shearing with an effective pesticide to eradicate the infestation.

What is the lice treatment for ewes that will lamb soon after shearing?

If no lice are diagnosed, no treatment is required. If lice are diagnosed treat the ewes off-shears with an effective registered pesticide. If you treat with an IGR it can take up to six weeks to kill all lice; therefore if the lambs are born less than six weeks after shearing all lambs will need to be treated for lice at lamb marking. If the lambs are born more than six weeks after shearing they should not be infested from the ewes and no further treatment should be needed.

Can I use dipping to eradicate lice?

More info...
Applying pesticides, section 4, page 35

Correct application with an effective pesticide, when combined with IPM practices, will eradicate lice. However if you have been dipping for a number of years and haven't eradicated lice, they may have developed resistance to the chemical group being used (such as the SP group) or there could be a problem with your dipping technique. If you are still not able to achieve lice eradication after switching to another chemical group and verifying that your dipping technique is correct it is recommended that you use an effective backline product off-shears.

Should I consider getting rid of my dip?

There is no simple answer to this question. If your dip is of the plunge or circular shower type and its structure is sound, it is suitable for use following a thorough cleaning of the dip and sump and flushing of the pipes. Rectangular shower dips however are not recommended, as studies by NSW Agriculture have shown that they do not sufficiently wet sheep.

More info...
Dipping equipment, section 6, page 15

With a circular shower dip, check the pump pressure and flow rate and ensure that all nozzles work correctly. Many older dips do not operate at correct pressures and flow rates so you will need to check and upgrade such equipment to so that it meets specifications. Refer to the specifications indicated by the manufacturer.

You will also need to consider OH&S issues with shower dips. They produce over-spray that can wet operators and others in close proximity and give rise to aerosol drops that can be inhaled. Raising the height of the dip wall and covering all gates will reduce the amount of over-spray.

Should I dip or backline after shearing?

If you have the option between plunge or shower dipping and backline treatment you need to consider the costs associated with each method and their relative convenience.

Dipping requires additional infrastructure, labour and time and there are also environmental (dip wash disposal) and animal welfare considerations. Dipping drought affected sheep and dipping in cold and wet conditions cause stress to the animals. Also, pesticides used in dips are not registered for off-shears use (i.e. within 24 hours after shearing).

There are fewer OH&S considerations associated with applying a backline treatment, and all products are registered for off-shears use. Drought affected animals will be less stressed and it is more convenient to treat stragglers and small mobs by backlining. Since backline products can take up to six weeks to kill all lice, ewes should be shorn and treated six weeks before lambing and all stragglers and introduced sheep — such as rams — should be quarantined after treatment.

Management program

Management program

This section outlines the integrated parasite management program for maximising control of blowflies and lice while minimising reliance on pesticides and residues on wool. To keep it as brief as possible and easy to follow, little detail is provided here about each of the recommendations; where more information may be helpful you are referred to other sections of the manual. Notations on the left-hand margin will help you make these links. You may also find the glossary section helpful.

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What is integrated parasite management?

Definition

Integrated parasite management (IPM) is a systematic approach to controlling blowflies and lice with the primary aim of reducing reliance on pesticides by using preferred alternative management methods. An IPM program includes consideration of animal welfare, environmental, economic and occupational health and safety (OH&S) concerns.

Blowfly control and lice control are often considered separate issues, but in terms of residues they both contribute to the total pesticide load on wool and so benefit from an integrated management program.

More info...

Control with minimal chemical use, section 4, page 16

An IPM program calls for planning of the year's management activities and involves a number of components. The component that most people are familiar with is based on applying good management and husbandry practices that integrate:

- timing of shearing;
- timing of crutching;
- mulesing all sheep;
- docking lambs' tails to the correct length;
- keeping mobs separated;
- quarantining introduced sheep;
- achieving complete musters;
- regularly inspecting the flock;
- recording all pesticide treatments.

Breeding and selection programs are a major factor in improved host resistance to blowfly strike. Whenever possible rams — the major contributors to the genetic pool — should be purchased from a stud that has blowfly resistance as one of the selection criteria in its breeding program. Struck sheep and sheep with fleece rot should be culled from the flock. Strong host resistance should be maintained through good nutrition, disease control (vaccination), worm control and by minimising stress.

A number of management activities aimed at minimising pesticide use are specific to blowfly control. They include:

- monitoring climatic conditions to predict blowfly activity;
- monitoring blowfly populations through trapping;
- reducing blowfly populations through trapping;
- catching, clipping and treating individual blowfly struck sheep;
- preventive jetting or backlining of susceptible sheep (such as weaners and hoggets) at the start of the blowfly season;
- targeted jetting of specific areas on the sheep if a flywave is expected (such as pizzle of wethers, breech of ewes, poll of horned rams);
- controlling internal parasites.

Even when producers have used all management and husbandry options to their fullest, they are sometimes confronted with specific blowfly and louse problems that require identification and treatment. The aim is to use some general control principles so that residues on wool are minimised at the next shearing. These include:

- treating with a pesticide as early as possible after shearing;
- minimising the use of pesticides in the six months before shearing;
- avoiding the use of pesticides altogether in the three months before shearing;
- using the most effective and safest method of pesticide application.

Preparation prior to shearing

Planning of the coming wool growing season's management activities should begin at least one to two months before shearing. However we recommend that you also plan long term (such as for the next three to five years), allowing for seasonal adjustments and unforeseen problems. Your IPM program prior to shearing should include three key activities.

Monitoring for blowflies	4
Monitoring for lice	4
Planning and preparation	5

Monitoring for blowflies

More info...
Monitoring blowflies, section 4, page 12

One or two months before shearing there are a number of ways to predict whether or not you are about to face a flywave. These include blowfly trapping (using the LuciTrap® system) and the Southern Oscillation Index (SOI). If traps have been used according to instructions an increase in the number of Australian sheep blowflies caught will often indicate a rise in blowfly numbers. Warm, humid weather is conducive to a flywave and a positive SOI indicates above average rainfall.

You need to determine how susceptible your sheep are to blowfly strike. If they have been mulesed and bred or selected for blowfly strike resistance, they will be less susceptible to strike than unmulesed, unselected sheep. In addition some classes of sheep are more susceptible than other sheep: for example weaners are at greater risk than adult sheep.

More info...
What should I do if there is a flywave? Section 2, page 8

If you have predicted a flywave and your sheep are at high risk of blowfly strike you will need to consider your options, which include targeted or full body jetting of high risk mobs, close observation and treatment of individual struck sheep, and early shearing. Carefully consider the implications of your decision for animal welfare, withholding periods (WHPs), wool harvesting intervals (WHIs), export slaughter intervals (ESIs) and rehandling periods.

Monitoring for lice

More info...
Monitoring lice, section 4, page 13

One to two months before shearing it is essential that you determine whether or not your sheep have lice. To ensure an accurate diagnosis, firstly you need to know what lice look like and secondly you need to positively identify them.

Not all mobs of sheep on your property may be exposed to the same level of risk from lice infestation. For example introduced sheep present a high risk, while mobs that are isolated present a low risk. Mobs that are exposed to natural barriers, such as a paddock of cattle or crops, a river or a double fenced roadway, present a low risk.

As part of an IPM program you should monitor your flock for lice at least four times during the wool growing season, such as at crutching, drenching, lamb marking and before shearing.

REMEMBER

Treatment will provide protection only for the period specified by the manufacturer on the product label.

Positive diagnosis

If you diagnose a light infestation you need to consider the costs associated with shearing early, versus doing nothing and then shearing at the normal time and treating after shearing. If you diagnose a heavy infestation close to shearing you may consider shearing early and applying an effective pesticide after shearing.

REMEMBER

Long-wool treatment will only control, not eradicate lice. Eradication requires effective treatment after shearing.

With a heavy infestation you may decide to treat only those sheep showing signs of fleece derangement to arrest further wool losses, or treat all sheep to control the spread of lice. If you decide to treat in long wool, ensure that you use an effective treatment method and observe WHPs, WHIs, ESIs and rehandling periods.

When you make a positive diagnosis you should let the owners/managers of adjoining properties with sheep know that your mob/flock has lice. You could also take the opportunity to talk to them about the feasibility of developing a voluntary lice eradication group. This could involve just two properties or as many as twenty.

If you are planning to sell an infested mob for slaughter (such as young cull ewes, cast-for-age ewes, wethers, or carry over prime lambs) do not treat, to ensure that you meet WHPs and ESIs. You will need to keep the mob isolated to prevent cross-infestation of the rest of the flock.

More info...

Working in groups, section 4, page 23

Negative diagnosis

If you make an accurate diagnosis that there are no lice in your flock you need to evaluate the risk of reinfestation during the coming wool growing season. If the risk is low, plan not to treat at shearing and employ non-chemical IPM strategies over the next 12 months. If the risk is high, such as from stock introduced on agistment, consider not treating, quarantine the introduced sheep and monitor all mobs.

Planning and preparation

The period one or two months before shearing is the most appropriate time to plan your IPM program for the coming wool growing season. Decisions made now may affect your clip and flock management for three to five years.

The lice status of your flock has the greatest impact. If your flock has lice you will need to treat with an effective pesticide after shearing. If your flock does not have lice you should confirm your diagnosis and consider non-treatment based on the degree of risk of reinfestation.

More info...

Chemical use, section 4, page 24

If you are treating your flock after shearing there are a number of questions to resolve before shearing gets under way:

- which chemical group, and which product from that group, you are going to use;
- which application method you need to use to apply the pesticide effectively (use only equipment recommended by the manufacturer);
- if you are dipping, whether you have access to adequate skilled labour and whether your equipment is operating effectively;
- if you need to employ a dipping contractor, whether that contractor follows best practice management principles.

Other preparations for shearing should include:

- checking that all facilities (such as yards, shearing shed) are in good working order;
- checking that dipping equipment is empty, clean, dry and in good working order;
- consulting your wool broker about marketing strategies and whether or not your core samples will be tested for pesticide residues;
- consulting your merchandise supplier about effective pesticides and requesting a copy of the relevant Material Safety Data Sheet (MSDS);
- ensuring that you have appropriate personal protective equipment for all operators;
- disposing properly of used pesticide;

- consulting your shearing contractor about your requirements (such as team to report if lice are present, the need for clean shearing, and culling blowfly struck sheep, in particular young ewes);
- considering when and how you are going to muster for stragglers and, once caught and shorn, if they are going to be treated for lice;
- planning the movement of mobs and the segregation of high risk mobs if you have a split shearing.

If you have employed an alternative de-fleecing technique (such as Bioclip®) you will need to discuss with the contractor strategies for post-harvest parasite treatment (if required).

More info...

Suppliers, section 6, page 15

Shearing

Shearing is the main event in the wool growing season. How you approach your management of lice, in particular, will have a major impact on the year's activities. One annual shearing is preferred to split shearing as it makes effective parasite management easier. Your IPM program at shearing includes six key areas for effective parasite management and minimal pesticide use.

Timing of shearing	7
Mustering sheep	7
Detecting lice	7
Wool harvesting and classing	8
Treatment methods	8
Health and diseases	9

Timing of shearing

More info...
Management strategies, section 3, page 13

The timing of shearing depends on a number of factors in addition to wool length including the availability of shearers and shed staff, periods of expected blowfly activity, time of lambing, risk of grass seed contamination and, to a lesser degree, lice eradication. To reduce your reliance on pesticides it may be necessary to change your time of shearing.

Mustering sheep

Achieving total control of your stock movements is essential for the eradication of lice. The following management practices will help you achieve complete musters:

- maintain stock-proof fences;
- control timber regrowth;
- wig sheep at crutching to prevent wool blindness;
- select and breed for open faces to prevent wool blindness;
- develop the property to facilitate complete musters through smaller paddock sizes, laneways, and trap yards for self-mustering;
- design and maintain conveniently placed holding yards and strategically placed watering points.

Detecting lice

Before shearing starts you should know the lice status of your flock as a direct result of having monitored all mobs at least four times throughout the wool growing season. Once shearing starts, feedback from the shearers, wool rollers and classer will help confirm your diagnosis. By this time, however, you should have decided whether to treat after shearing or not.

If you have decided not to treat and then diagnose lice part way through shearing you should confirm the diagnosis. If your monitoring program throughout the year has been effective any incidence of lice should be low. As lice populations build very

More info...

Non-treatment shearing, section 5, page 5

slowly you should consider not re-mustering to treat sheep previously shorn. The suggested strategy is:

- quarantine and monitor non-treated sheep;
- treat the lice-infested mob only, using an effective pesticide, and keep it separate from the non-treated sheep;
- fix the source of infestation if it can be positively identified;
- monitor mobs that follow the lice-infested mob through the shed.

Wool harvesting and classing

Use the experience of your shearers, wool rollers and classer to monitor the lice status of your flock, as well as to get feedback on the general health and quality of other flocks in the district. Encourage shearers to participate in advanced shearer training courses to ensure clean shorn sheep.

Evidence of colour at shearing could be an indication of fleece rot and may provide an opportunity to identify sheep for culling. Take care that you are identifying colour associated with fleece rot and not canary stain or scourable colour stains.

Sheep that cannot be cleanly shorn due to lumpy wool (dermo) need to be identified for special treatment to ensure effective lice eradication and avoid spreading the lumpy wool infection to the rest of the flock. Similarly, sheep roughly shorn due to cotted wool should be identified for special treatment.

Blowfly struck sheep need to be identified for culling, and stained (struck) wool should be separated and placed in a sealable plastic bag to ensure that no larvae survive. Do not treat struck sheep on the shearing shed board.

To participate in, and be accredited for, quality assurance (QA) schemes (such as Flockcare, Clipcare, Dalcare and Traprock TQM (Total Quality Management)) you need to demonstrate good management practices. Having a sound IPM strategy will contribute to your QA accreditation. The Australian Wool Exchange (AWEX) voluntary vendor declaration provides a means for you to indicate to buyers the residue level of the wool for sale (i.e. unknown, nil, low or high).

Treatment methods

More info...

Pesticides and their use, section 4, page 25

If a 'no treatment' strategy after shearing is not possible, a decision on the best method of treatment needs to be made. Your current facilities, such as plunge or shower dip, will influence your decision on the treatment method, but other factors (such as convenience, cost, and availability of labour) may determine whether dipping is preferable over backlining.

Whichever method you choose, you should follow this standard checklist:

- calibrate the backline applicator, plunge dip tank or shower dip sump;
- all equipment is maintained and meets the manufacturer's specifications;
- treat to the heaviest sheep in the mob;
- treat all sheep, including stragglers;
- all operators are skilled (i.e. trained);
- use an effective pesticide and follow the instructions on the product label;
- environmental standards are observed (including disposal of excess dip fluid);
- OH&S standards are observed;
- animal welfare considerations are observed.

Health and diseases

More info...
Applying pesticides, section 4, page 35

All sheep should be cleanly shorn to ensure effective control of blowflies and lice. Sheep with cotted fleeces and lumpy wool are difficult to shear, and rough shearing reduces the effectiveness of any treatment used. It is essential to limit the spread of lumpy wool, which occurs rapidly when sheep are wet and in close contact at shearing. If plunge or shower dipping, sheep with lumpy wool should be shorn last if possible and treated after all the other sheep. Similarly, freshly shorn sheep in count-out pens during wet weather are ideal candidates for rapid spread of the disease.

Cuts inflicted by shearing and open wounds (such as poll wounds from fighting among rams) are susceptible to blowfly strike and bush fly irritation. Treatment may need to be considered if blowflies are active. Plunge and shower dips should be cleaned immediately after use and the status maintained to minimise the risk of post-dipping lameness arising from bacterial infection.

Management between shearings

To maintain a flock's lice-free status and prevent blowfly strike between shearings, there are three key activities that need to be carefully managed within an IPM program: prevention, monitoring and control.

Blowflies 10

Prevention 10

Monitoring 10

Control 11

Lice 11

Prevention 11

Monitoring 11

Control 12

Blowflies

Prevention

HINT

A positive attitude is required on both sides of the boundary fence for eradication and prevention of lice infestation.

Selecting and breeding of sheep resistant to blowfly strike are integral components of an IPM program. They should be combined with other IPM husbandry and management activities, namely:

- lamb marking and mulesing;
- crutching (two crutchings per year or crutching at eight months rather than six months wool);
- fly trapping to reduce blowfly numbers;
- timing shearing to occur just before the expected blowfly season.

If the risk of a flywave is high you should apply an effective pesticide, keeping in mind WHPs, WHIs, ESIs, rehandling periods and length of wool. Ewes about to lamb need close attention to prevent blowfly strike and you may need to crutch them (the preferred option) or apply jetting fluid to the breech.

Monitoring

More info...

Monitoring blowflies, section 4, page 12

By considering the season and assessing the possibility of rain you can predict active blowfly periods. If you are approaching the normal blowfly seasons (in Queensland they are spring and autumn) and it has been raining (25 mm or more), you may conclude that there is a high risk of blowfly strike and develop a strategy to counter it. On the other hand if it has been dry and you are entering winter or summer, a less aggressive strategy may be appropriate.

Recording blowfly numbers in blowfly traps (using the LuciTrap® system) can also help you to monitor blowfly populations and the potential for strike. Another useful source of information is the Southern Oscillation Index (SOI). A positive SOI indicates above average rainfall.

REMEMBER

The number of strikes depends mainly on the number of susceptible sheep, not the density of blowflies in the area.

IMPORTANT

To reduce pesticide residues on wool minimise the use of blowfly treatments in the six months before shearing and avoid them altogether in the three months before shearing.

Sheep should be inspected to assess whether they are susceptible to blowfly strike. Long wool and wool affected by urine, faeces (dags) or lambing stain is more attractive to blowflies than short or clean wool. Young sheep and ewes present a greater risk of strike than older sheep and wethers. Wrinkly sheep are more prone to blowfly strike than plain bodied sheep. Rams pose a high risk of poll strike through fighting; however the incidence of poll strike is lower in polled rams.

Control

After making an assessment of the potential for blowfly strike in your flock, and if a severe flywave is expected, mobs at high risk should be treated with an effective pesticide or, if feasible, shorn. However if the risk is low, endeavour to identify individual struck sheep and catch, clip and treat those sheep only, so that the residue load is diluted across the clip. Rams with poll strike should have the pesticide applied to the poll only (poll jet). If very severe blowfly strike occurs consider shearing early or crutching. In all cases animal welfare, WHPs, WHIs, ESIs and rehandling periods must be considered.

Lice

Prevention

The first rule of prevention is to quarantine all introduced sheep. Introduced sheep may include rams, strays (such as from an adjoining property or from travelling stock), purchased mobs and agisted mobs. When purchasing sheep aim for mobs shorn at a similar time to your flock and buy from a lice-free property. If strays are from an adjoining property return them to that property's yards, not over the fence. If your sheep have strayed into an adjoining property, pick them up yourself or have them delivered to your yards — not over the fence.

Prevention is also dependent on management of stock movements:

- shear all long-wool stragglers and treat with an effective backline product;
- cull sheep that regularly stray;
- strictly monitor and control stock movements if you have split shearings;
- keep an accurate count of your sheep;
- achieve complete musters through timber control, fencing, laneways, trap yards, and wigging sheep to prevent wool blindness;
- work with the owners/managers of adjoining properties. For example implement a combined fencing program between properties to reduce costs and negotiate an agreement on the return of stray sheep.

Monitoring

More info...

Monitoring lice, section 4, page 13

Inspect mobs for lice infestation at least four times during the wool growing season, such as at crutching, lamb marking, drenching and before shearing. Inspect 10 to 20 sheep; this should confirm whether the problem is lice and not another factor such as grass seed. Any sheep showing signs of fleece derangement should be inspected first. Do not expect to achieve an accurate diagnosis without positively identifying individual lice.

Control

IMPORTANT

To reduce pesticide residues on wool minimise the use of lice treatments in the six months before shearing and avoid them altogether in the three months before shearing.

If you are operating a recommended IPM program you should not find yourself in a situation where lice are diagnosed late in the wool growing season. However if this should occur the infestation will be impossible to eradicate in long wool sheep and the following options need to be considered:

- Don't treat and accept the consequences. This option includes shearing at the normal time and treating with an effective pesticide after shearing.
- Shear early and treat with an effective pesticide after shearing.
- Treat with an effective pesticide and delay shearing until WHPs, WHIs, ESIs and rehandling periods have elapsed. (This will control but not eradicate lice.)
- Treat only visibly affected sheep rather than the whole mob or flock, as this will keep lice in check until shearing and the pesticide residue load will be spread across the clip. Treat the whole flock with an effective pesticide after shearing.

Regardless of what you decide to do you will need to treat with an effective pesticide after shearing to eradicate the infestation.

Management strategies

More info...

IPM Handy Guide for blowflies and lice, see insert

By referring to the previous three sections you can create your own personalised management strategy to maximise control of blowflies and lice and minimise reliance on pesticides and residues on wool. The aim is to capitalise on the climatic conditions to get maximum benefit from the management strategy. Plan to incorporate all recommended IPM practices and use pesticides only if necessary. Following are two example IPM strategies for Queensland.

Northern Queensland 13

Southern Queensland 14

Northern Queensland

Shearing is predominantly carried out in north-west Queensland during winter or early spring. This is likely to give autumn lambing ewes a nutritional boost prior to joining and short wool could help them resist any early summer blowfly activity. However by the time the ewes lamb in autumn they would be more susceptible to blowfly strike as they would have seven to eight months wool.

A mid summer shearing in north-west Queensland could bring on humpy back during mustering due to high temperatures. Summer storms could cause shearing delays, but their effects are generally short-lived due to the hot drying conditions. Remaining surface water could cause difficulties with achieving complete musters, which is a problem for effective lice eradication.

A late summer shearing in north-west Queensland may prevent problems with grass seed contamination in the wool through the following winter. However sheep with long wool in mid summer will suffer heat stress, which could effect reproduction resulting in lower lamb birth weights and survival rates.

Example management strategy for a wool growing season commencing in winter with an autumn lambing

Period	Action
July–August	Shear all sheep; treat for lice only if necessary; wean lambs; set blowfly traps
September–October	
November–December	Join ewes and rams; replace lures in blowfly traps; inspect for lice
January–February	Crutch all sheep; inspect for lice
March–April	Inspect for lice; ewes lambing (from April 1); replace lures in blowfly traps
May–June	Mark and mules lambs; crutch all sheep if QA requirement; inspect for lice

Southern Queensland

In southern Queensland shearing occurs all year round. A late winter shearing is more suitable for flocks lambing in spring, however complete musters are difficult to achieve for effective lice eradication as sheep can stay away from watering points for days at a time. The problem worsens if it rains and conditions remain wet due to the short, cold days.

Cold, dry conditions maintain very low blowfly populations and shearing in winter means the sheep go through the high risk spring flywave period with short wool. However shearing during very dry winters can stress pregnant ewes, sometimes resulting in pregnancy toxaemia. If treating after shearing, backlining off-shears is more suitable than dipping in short wool. If dipping avoid doing it late in the day so that sheep don't get cold during the night.

A summer shearing in southern Queensland means that the sheep will go through the autumn flywave period with short wool, which makes them less susceptible to blowfly strike. However it will also mean that spring lambing ewes are lambing with as much as seven to eight months wool and will be more susceptible to blowfly strike. An advantage of a summer shearing is that hot, dry conditions will help destroy residual lice populations off-shears.

Example management strategy for a wool growing season commencing in winter with a spring lambing

Period	Action
July–August	Shear all sheep; treat for lice only if necessary; set blowfly traps
September–October	Ewes lambing
November–December	Mark and mules lambs; replace lures in blowfly traps; inspect for lice
January–February	Wean lambs; crutch all sheep
March–April	Inspect for lice; join ewes and rams (from April 1); replace lures in blowfly traps
May–June	Crutch all sheep if QA requirement; inspect for lice

Note: In southern Queensland sheep should be monitored for worm infestations throughout spring, summer and autumn. If a diagnosis is positive and mobs are to be mustered and drenched, they should be inspected for lice at the same time.

Key issues

Key issues

This section contains detailed information on integrated management of blowflies and lice as well as important information on pesticide use and its impact on the environment, human health, animal welfare and market access. It supplements the management program in section 3 and should be used in conjunction with it. The information provided is not designed to be a complete coverage of each issue discussed, but to highlight the key points that need to be known and understood. Where additional information may be useful, you are referred to other sections of the manual. Notations on the left-hand margin will help you make these links. You may also find the glossary section helpful.

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Understanding blowflies, lice and other external parasites

For the integrated management of blowflies and lice to be effective, an understanding of the biology of the Australian sheep blowfly (Lucilia cuprina) and the sheep body louse (Bovicola ovis) is essential. This section examines the life cycle of each parasite and the important factors affecting infestation.

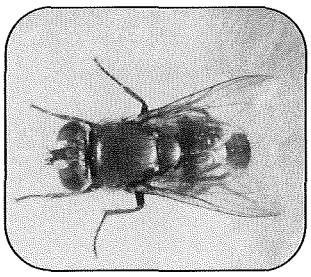
Blowflies	2
Lice	5
Other external parasites	8

Blowflies

More info...
Other external parasites, section 4, page 8

Although several blowfly species are known to strike sheep, more than 90 per cent of blowfly strike in Australia is initiated by the Australian sheep blowfly, which is an introduced species. Unlike the other types of blowflies, the Australian sheep blowfly breeds almost exclusively on living sheep and, in fact, is a poor competitor with other blowflies in carcasses. Understanding the life cycle of the Australian sheep blowfly allows you to plan control strategies targeted at vulnerable stages in that life cycle.

Life cycle



The Australian sheep blowfly (Lucilia cuprina)

Female blowflies lay up to 250 eggs at a time into the damp fleece of susceptible sheep and around moist areas resulting from wounds, urine or faecal stains and infections (such as fleece rot and lumpy wool). So that their eggs will not dry out, blowflies lay them in a group. The female blowfly produces an odour that attracts other females, with the result that thousands of eggs may be laid in clumps on susceptible sheep.

Depending on temperature and moisture, eggs normally hatch in about 12 hours. The larvae crawl down the wool staple to the inflamed skin to feed on weeping serum, or can remain on the wool staple and feed in lumpy wool. They feed for three to five days, during which time they moult twice as they grow. Fully fed larvae drop from the sheep — usually at night in sheep camps — and burrow two to five centimetres into the soil to pupate. What happens next depends on soil temperature. If it is above 15°C, development continues and after a few days blowflies emerge; if soil temperature is below 15°C, development is arrested.

REMINDER

Under the right conditions a flywave can occur after only two to three breeding cycles.

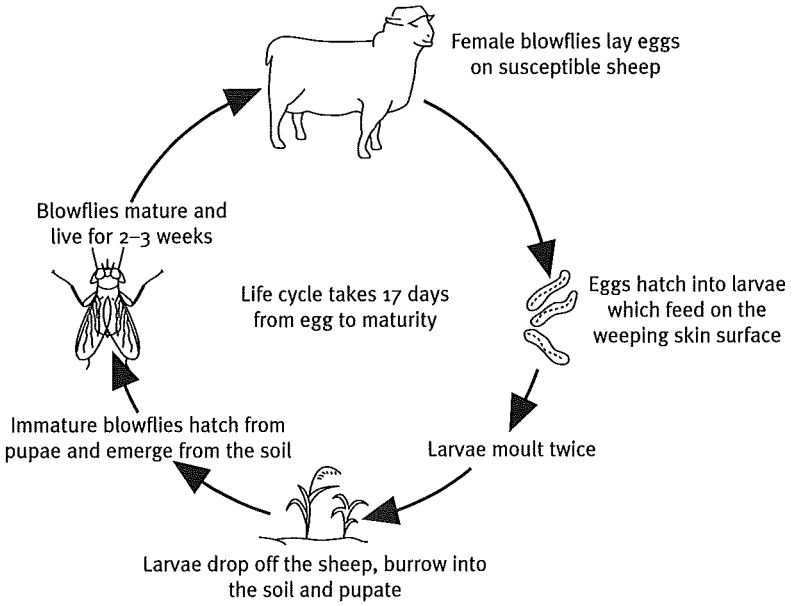
Larvae that drop into soil that is cooler than 15°C, especially during a wet autumn, complete their development the following spring. Depending on location, blowflies emerge over several days when the soil has warmed (i.e. above 15°C). These blowflies are known as the over-wintering population. (In warmer areas of Queensland over-wintering may be of short duration or may not occur at all.) The date of emergence of blowflies at the same location will vary from year to year, with differences of up to four weeks. Emergence times range from early August to mid-October depending on the region.

More than 90 per cent of over-wintering larvae die due to cold weather, waterlogging, predation by ants, and parasitism by minute wasps, but nevertheless a large number of blowflies emerge in spring. The female blowflies must then find a source of protein and a mate. They also require energy and water, which they can get from blossom and dew. Within four days of emergence they are ready to lay eggs. If these blowflies find susceptible sheep, blowfly strike will occur and within days large numbers of larvae

will drop to the soil. These will rapidly complete development and if susceptible sheep remain, or if susceptibility recurs about three weeks later, a flywave will occur.

Prolonged wet weather is particularly conducive to blowfly strike, and sheep that get thoroughly wet several times become extremely susceptible. As well as dampness, air temperatures are important: they must exceed 17°C but remain below 38°C for flies to develop and become active. Wind, which dries sheep and inhibits blowflies from flying, must be less than 30 km/h (i.e. not enough to cause small branches on trees to move) for conditions to remain conducive to blowfly strike.

The life cycle of the Australian sheep blowfly



Sheep susceptibility

Moisture is the key to susceptibility. Fleece that has been wet to the skin just once creates conditions favourable for the development of fleece rot. This is a mild superficial bacterial infection at skin level. A second or prolonged wetting can lead to an enormous growth of the infection and severe skin inflammation. Female blowflies find this highly attractive, as it encourages them to lay eggs and provides moisture for their eggs to hatch and soluble protein on which the young larvae can feed.

Lumpy wool (also known as mycotic dermatitis or dermo) results from chronic infection by the bacterium *Dermatophilus congolensis*. It is particularly attractive to female blowflies and, when moist, the wool fibre can sustain larvae off the skin. As the larvae grow they move down the wool staple and feed at skin level. Fortunately the incidence of lumpy wool is believed to be low in most areas of Queensland; however there are occasional outbreaks.

More info...
Selecting and breeding, section 4, page 17

Not all animals affected with fleece rot or lumpy wool will become struck. Some animals provide a more attractive and suitable site for egg laying than other animals. However animals without fleece rot or lumpy wool rarely become struck. There is a very strong genetic correlation — greater than 0.75 — between susceptibility to fleece rot and susceptibility to body strike. A reduction in the susceptibility of sheep to fleece rot through breeding will result in a genetic decrease in susceptibility to body strike. In the case of lumpy wool such a relationship has not yet been established; therefore it cannot be regarded as a selection criterion in seeking to eliminate the susceptibility of sheep to body strike.

Wool with urine or faecal stains also irritates the skin, making the sheep vulnerable to blowfly strike. Scouring or daggy sheep are prone to breech strike, as are sheep whose tails have been docked too short. A tail of three palpable joints when lifted focuses the flow of urine and faeces away from the sheep, thus reducing soiling of crutch wool.

Mulesing, if performed correctly, also provides a high degree of lifetime protection against blowfly strike in the breech area.

Any wound, even very small injuries, can attract flies. Bush flies and female Australian sheep blowflies looking for protein may irritate the wound; saliva left by the sheep biting at its skin irritation can provide enough moisture for eggs to hatch. Lamb marking and mulesing wounds and footrot damage are especially prone to blowfly strike. (Footrot is rare in Queensland and is generally seen only in sheep introduced from southern states.) Marking and mulesing should be conducted only when flies (both bush flies and blowflies) are least active (i.e. cooler months or hot, dry periods).

Of all the sheep breeds the Merino is most susceptible to blowfly strike, though crossbred and comeback sheep are not immune. Young sheep (weaners and hoggets) are at greatest risk, because they generally have less stamina, are wrinkly due to not being fully grown, and may still be unclassed and unmulesed. Fighting rams may sustain poll strike from a wound and lambing ewes may be struck in lambing stain.

Other factors affecting infestation

HINT

Trapping the Australian sheep blowfly on a number of adjoining properties will reduce the blowfly population and provide information on how prevalent they are.

The rate of increase of the blowfly population contributes to the risk of blowfly strike. Adult females may live only two to three weeks but during this time may produce two or three batches of eggs which each contains up to 250 eggs. If conditions remain favourable into the next life cycle the capacity for population increase and the development of a flywave is enormous.

There are five contributing factors that combine to create an extreme risk of blowfly strike. If any one of these factors is missing, or of low probability, the risk is low or reduced. The factors are shown in the following table.

Blowfly strike risk factors

Factor	Condition	Comment
Rain	10–15 mm per day	Spring/summer rain over several days causes skin damage and leaking serum, which are required for strike to occur.
Australian sheep blowfly population	Appearance in blowfly traps	Traps must be near sheep and camp areas and need to be monitored regularly (at least weekly).
Temperature	Air: above 17°C, below 38°C Soil: above 15°C	Flies are inactive outside the specified air temperature range. Larvae are dormant at soil temperature of less than 15°C.
Wind speed	Wind less than 30 km/h (i.e. insufficient to move small branches on trees)	Wind must exceed 30 km/h around the sheep to prevent blowfly strike. This is quite a high wind speed and unlikely over several days, but possible following rain (when sheep are susceptible).
Fleece and skin susceptibility	Moist fleece	Moisture for eggs to hatch and soluble protein from fleece rot are required for strike to occur.
	Skin damage	Wounds, fleece rot, lumpy wool, urine and faecal stains cause skin damage and leaking serum, which are required for strike to occur.
	Greater than 20 mm of wool	Long wool slows drying, particularly around the breech.

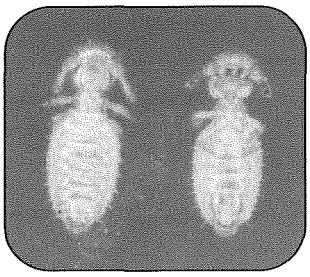
Lice

More info...

Other external parasites, section 4, page 8

The body louse is the most common and prevalent louse found on sheep in Australia. There are two other species of sheep lice in Australia: the foot louse (*Linognathus pedalis*) and the face louse (*Linognathus ovillus*). In normal field conditions body lice are found only on sheep and cannot breed on cattle or goats. In turn, cattle and goat lice cannot breed on sheep. Consequently the primary source of new infestation of body lice is other infested sheep. Knowing the life cycle of body lice allows you to plan control programs targeted at eradication.

Life cycle

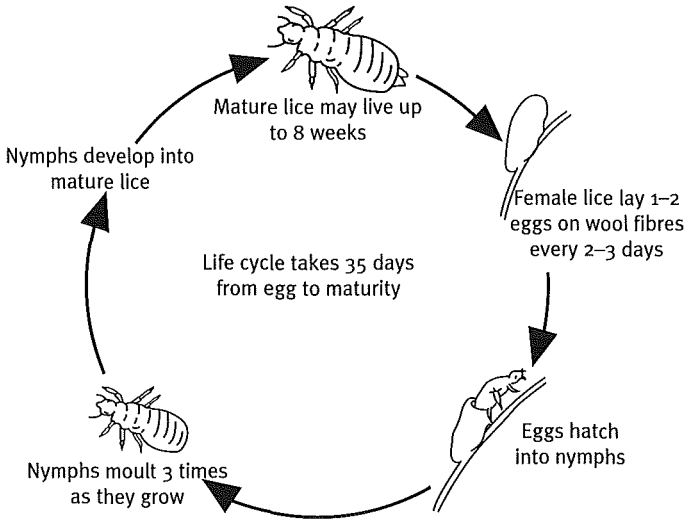


The body louse (Bovicola ovis). Actual size 1–2.5 mm.

Body lice are small, wingless insects that are cream in colour, with reddish-brown stripes on the abdomen. They are generally 1 mm to 1.5 mm in size, though some females are as big as 2.5 mm. Body lice are surface feeders, living on scurf, secretions and bacteria from the superficial layers of the skin. They irritate the skin, causing infested sheep to rub. The extent of rubbing and hence fleece derangement and cotting depends on the severity of the infestation and the sensitivity of the sheep.

Body lice reproduce at a slow rate and survival and development of all stages is related to the micro-environment within the fleece, which depends on wool length, temperature and rainfall. Female lice deposit eggs on wool fibres near their base, generally within about 5 mm of the skin. The stimulus for egg laying is the presence of wool fibre and a temperature of 37.5°C. Female lice lay 1–2 eggs every 2–3 days. Eggs are off-white in colour and difficult to see. They hatch after 9–10 days and the nymphs moult three times as they grow (after 5 days, 7 days and 9 days for each nymph stage). The adult takes 4 days to mature after the final moult. The life cycle occurs on the same sheep and takes a minimum of 5 weeks. Adult females normally live for about 28 days though some are known to have survived for up to 53 days, and adult males normally live for 49 days though some have survived for up to 74 days.

The life cycle of the sheep body louse



Transmission of lice from sheep to sheep occurs during periods of close body contact on sheep camps and during yarding. Sheep lice have been transferred to goats when run with sheep in a shed; they can complete a life cycle on goats but they won't reproduce on them. There is no field evidence that sheep lice can spread to goats and be maintained as a source of infestation for sheep.

Lice are not usually distributed evenly over the sheep but favour the sides, particularly the shoulder, and the flanks, where they are sometimes found in clusters or colonies. After shearing they tend to be found in areas where the wool is longest, particularly

the neck and flank. Contrary to popular folklore, lice do not regularly and frequently move around (circumnavigate) the body of the sheep, but they do move up and down the wool staple and on the body of the sheep in an attempt to control the environment in which they need to survive and reproduce. In a NSW Agriculture experiment, lice placed on the mid-side of a sheep were recovered 30 cm from the infestation site one month later.

Sheep susceptibility

It is commonly observed that some sheep in a flock have more lice than others, but this does not necessarily indicate differences in susceptibility between sheep. Lice spread only slowly among sheep and sheep with more lice in naturally infested mobs may simply have been infested first; poorly treated or missed at dipping; or not closely shorn and therefore carrying more lice after shearing.

However there is evidence that some sheep may limit lice populations through an immune response. A study (James et al. 1998) where all sheep were infested with equal numbers of lice showed very large differences in susceptibility:

- There were large differences between breeds. (Merinos appear to be more susceptible than many other breeds.)
- There were large (and repeatable) differences among sheep within a breed. (If resistance to lice can be correlated with other economic traits, selection for more resistant types may become an option in the future.)
- Lambs rapidly became infested from the ewes and densities of lice on the lambs reached three times those on the ewes. (This indicates that lambs are more susceptible to lice than older sheep and emphasises the need to effectively manage ewes before lambing.)

This study found that the heaviest infestations of lice were on lambs with low growth rates. This is in contrast to previous research that found no association between lice numbers and body weight. However the earlier studies were designed to determine if lice caused a reduction in body weight; in fact the converse may be true. That is, animals with low or falling body weight because of disease, poor nutrition or other stress develop heavier infestations because they are more susceptible to lice. This has clear implications for prevention and treatment strategies.

Other factors affecting infestation

Source of infestation

IMPORTANT

All stray sheep should be considered as potentially lice infested.

The two main sources of infestations in lice-free sheep are introduced sheep — such as purchased sheep (including rams) — and stray sheep. Stray sheep include sheep from other flocks that have entered a mob, or sheep that have strayed, come in contact with other sheep, and returned to their original mob.

As most purchased sheep are in short wool, lice infestations are usually not obvious for several months. They should therefore be kept separate from other sheep (quarantined) until such time as it is quite clear that they are free of lice.

In many cases an infestation may not be new at all. Failure to eradicate lice at a previous treatment because of poor pesticide application, or not treating all sheep (i.e. stragglers), is a major cause of infestation. Studies in New South Wales (*NSW sheep lice control manual* 1997) have shown that where flocks were infested with lice in two consecutive years up to 70 per cent of infestations were due to inadequate lice management. When only a few lice survive it may be many months before treatment failure becomes apparent.

Spread of lice from paddock to paddock across secure fence lines is probably less common than most people would think. In a South Australian trial (Cleland et al. 1989)

it was not until 64 weeks after the introduction of two lice-infested sheep to a lice-free mob that lice spread to sheep in an adjacent paddock. There are scenarios in which spread across fences can occur more quickly than this, for example where sheep camps and/or watering points in adjoining paddocks are close to each other.

Shearers, yards, trees, fences, transports and shearing sheds are sometimes suggested as sources of infestation. This is unlikely, as lice do not live away from the sheep host for long periods (most die within 24 hours); however precautions should be taken in certain conditions. Recent evidence from South Australia (P. James, pers. com.) suggests that lice can live away from sheep for up to four weeks under ideal conditions when protected from sunlight, rainfall and high temperatures, but under field conditions most die within three days of leaving a sheep. It is recommended that a precautionary period of at least ten days be observed before penning lice-free sheep in a shearing shed where lice-infested sheep have previously been held. This is because lice can feed on wool grease and therefore can live for a period on wool kept in bins in the shed.

The same study also showed that lice could survive on shearers' moccasins (stored in a plastic bag away from sunlight) for up to 10 days and therefore could act as a source of infestation. Microwaving moccasins for five minutes will kill all lice.

Reduction in lice numbers

A number of factors can cause a reduction in lice numbers: shearing, increased temperature, rainfall and increased sunlight. Shearing greatly reduces the number of lice on a sheep by physically removing the lice and eggs with the fleece and exposing remaining lice and eggs to extremes of heat or cold. Lice numbers are lowest 30 to 60 days following shearing. Rain, particularly when heavy and prolonged, will saturate the fleece, reducing the numbers of adult lice and larvae and preventing the hatching of eggs. Some pesticides used for treating blowflies in long wool (i.e. organophosphates, diflubenzuron or spinosyn) will also reduce, but not eradicate, lice populations.

Build up in lice numbers

Deaths of large numbers of lice due to shearing have a prolonged effect on lice populations. The few lice remaining after shearing (the residual population) will have produced only a light infestation six months later. After this time, however, numbers can increase rapidly. Survival and reproduction are aided by the protection of the increased length of wool.

The following table shows the spread of lice among sheep following the introduction of two moderately infested sheep into a lice-free mob. (A medium infestation is 1–5 lice per parting, equivalent to a total population of between 5000 and 250 000 lice.) Spread occurred slowly in the early stages and it took more than nine months for 50 per cent of the mob to develop a light infestation. However once this stage was reached build up to a heavy infestation occurred rapidly.

Spread of lice through a flock following the introduction of two moderately infested sheep

Weeks after introduction	1	17	25*	37	44	57	64
Percentage of sheep with lice	4	26	28	46	63	94	98
Percentage of sheep with medium to heavy lice infestation	0	0	0	0	8	25	48

*shorn

Source: Cleland, P. et al. 1989, 'Rate of spread of sheep lice (*Damalina ovis*) and their effects on wool quality', *Australian Veterinary Journal*, no. 66, pp. 298–299.

If the initial infestation were from one sheep with only, say, 10 lice, the build up would be greatly delayed. If the mob were shorn in spring, high temperatures and sunlight would similarly delay build up. If the source of the infestation was a sheep that had lice remaining in a patch of wool that was not wet to the skin at dipping, spread of the lice beyond that patch and to other sheep would be delayed until the residual action of the pesticide wore off.

It is common for a new infestation not to be detected for more than 12 months from the initial infestive contact. This is especially likely in flocks where producers rely on finding rubbed sheep to indicate lice. Once signs of lice become apparent the infestation is already well established and can develop very quickly, both at the level of individual sheep and in the mob. If left untreated at this stage, losses in wool quantity and quality will occur.

Transfer of lice between sheep

Sheep lice move to the surface of the fleece when conditions are shaded and warm and when sheep are in close contact (such as held tightly together in a shearing shed or yards) and transfer can occur. The rate at which transfer occurs will depend on a number of factors.

If the surface of the fleece is warm and shaded it takes only minutes for lice to be found on the tip of the wool staple. If these conditions persist for extended periods more lice will move to the fleece surface and greater numbers will transfer from sheep to sheep.

If a sheep has a heavy infestation greater numbers of lice will find their way to the fleece surface and transfer is more likely to occur when another sheep is in contact. However if a sheep has only a light infestation it may take many contacts for transfer to take place.

Transfer occurs more quickly when sheep have short wool than when the wool is longer. Significant spread can occur in count-out pens after shearing.

Residual pesticide will kill susceptible lice that transfer if pesticide concentration is high enough. However some chemical groups, such as the synthetic pyrethroid (SP) group, have a repellent effect on lice, which may move to areas on the sheep with low SP concentrations and not be killed.

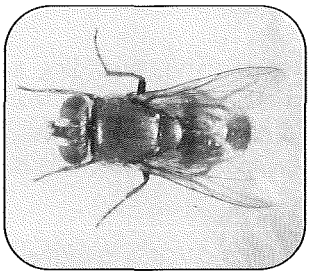
If temperatures are low most lice will remain near the skin and transfer is unlikely. It is also unlikely that much spread will occur when the surface of the fleece is wet or when the tip of the fleece is very hot from sunlight.

Other external parasites

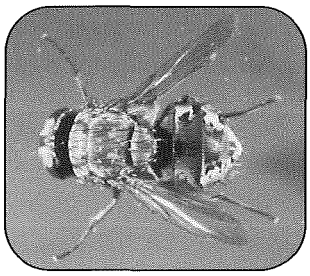
Primary, secondary and tertiary flies

Primary flies

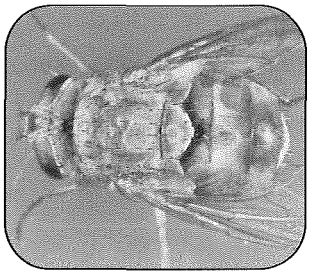
Primary flies are able to initiate a strike on susceptible sheep, and the most important of these is the Australian sheep blowfly, discussed previously in this section. The eastern golden haired blowfly (*Calliphora stygia*) and the lesser brown blowfly (*Calliphora augur*) are other native primary flies of lesser importance in Queensland. The larvae of the Australian sheep blowfly and *Calliphora* species have a smooth appearance.



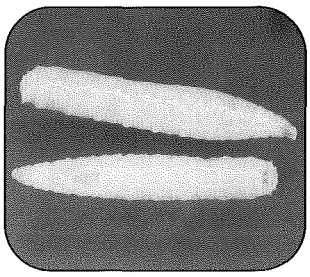
The Australian sheep blowfly (Lucilia cuprina): metallic green body, often with a coppery sheen; narrow abdomen without dark stripes. This is the only species that breeds almost exclusively on living sheep.



Eastern golden haired blowfly (Calliphora stygia): large brown fly; dark brown abdomen with patches of golden dust. This is a cold weather species and is unlikely to be found in Queensland.



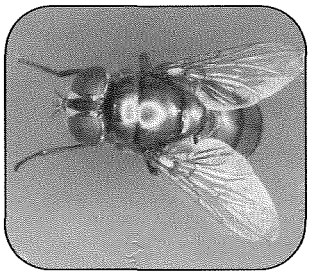
Lesser brown blowfly (Calliphora augur): smaller brown blowfly; blue stripe on a yellow-brown abdomen.



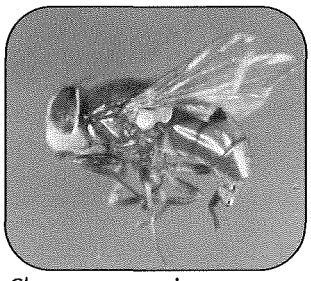
'Smooth' larvae (in this case Lucilia cuprina).

Secondary flies

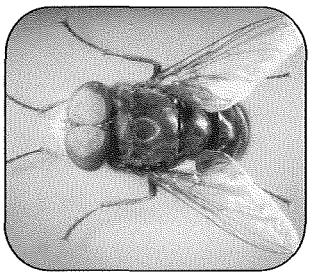
Once primary flies have initiated a strike, secondary flies are able to invade and to increase the size and severity of the wound. The most important of these is the hairy maggot fly (*Chrysomya rufifacies*). *Chrysomya varipes* and the steel-blue blowfly (*Chrysomya saffranea*) are other secondary flies of lesser importance in Queensland. The larvae of some *Chrysomya* species have projections that give them a hairy appearance.



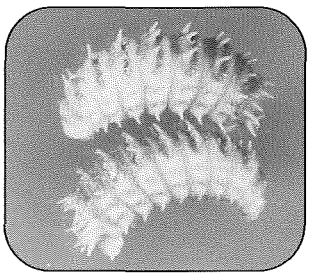
Hairy maggot fly (Chrysomya rufifacies): metallic green colour; broad abdomen with dark stripes; often confused with the Australian sheep blowfly.



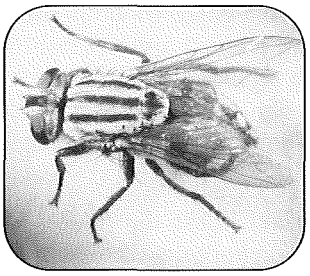
Chrysomya varipes: metallic green colour but smaller than the hairy maggot fly; banded legs.



Steel-blue blowfly (Chrysomya saffranea): metallic blue body, yellow face, smooth maggot.



'Hairy' larvae (in this case Chrysomya rufifacies).



Flesh fly (Sarcophagid): large size and greyish-black non-metallic colour; prominent black and yellow stripes on thorax.

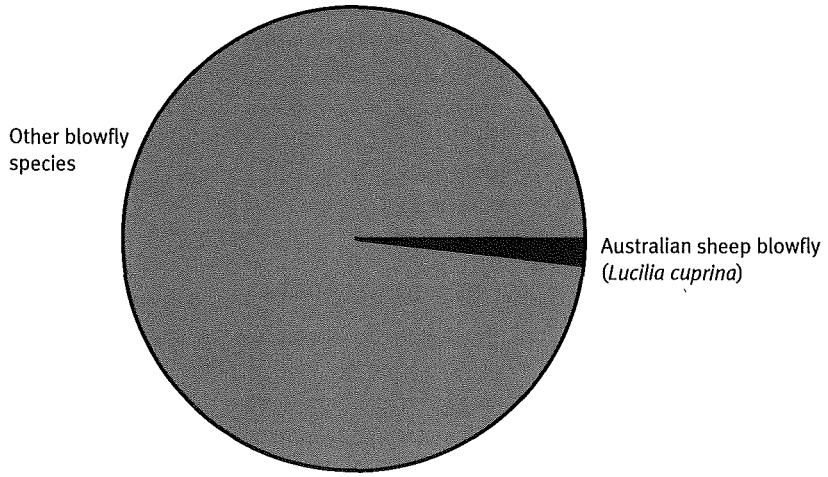
Tertiary flies

Tertiary flies become involved only when the strike is starting to dry out, and they cause little or no damage to the sheep. A typical example is the flesh fly (Sarcophagid), which is unlikely to be found in Queensland.

Flies and carcasses

Carcasses attract a succession of flies (primary through to tertiary), providing a breeding ground for a range of introduced and native blowflies. Left alone very few larvae of the Australian sheep blowfly manage to develop successfully in carcasses, being unable to compete against the hairy maggot fly and *Calliphora* species. This is demonstrated in the following figure.

Numbers of the Australian sheep blowfly that emerge from a carcass relative to other types of blowflies



Important

Broad scale non-selective trapping, chemical baiting or burial of carcasses is not recommended, as many of the flies caught or killed would have acted as regulating agents on the population of the Australian sheep blowfly by eating or repelling the larvae on carcasses and on active strikes.

Foot and face lice

Australian sheep host two other species of lice besides the body louse. These species are sucking lice that feed on blood, appear bluish in colour and have long thin heads. The face louse (*Linognathus ovillus*) occurs mainly on or close to the face and is closely related to the foot louse (*Linognathus pedalis*); however neither is common.

The foot louse infests the legs of sheep and the scrotum of rams. It may also be found on the belly and often retreats between the claws during the hotter months. Affected sheep appear to have a dark shiny film or a dark gritty look on their legs or scrotum. Foot lice tend to favour rams and can be introduced onto a property through the purchase of infested rams.

There is some field evidence that foot and face lice have proliferated on properties that rely on SP backline treatments to control body lice. The product appears not to extend down the legs and scrotum, or onto the face, which are relatively greaseless and further away. Producers who, for the control of body lice, have regularly used plunge or shower dips that allow a thorough wetting of the lower areas of the sheep are unlikely to have foot or face lice on their properties.

These lice are of little economic importance as they do not infest the fleece — although foot lice may extend into the belly wool area — and do not cause the rubbing and scratching that leads to cotting of the fleece, so lowering its value. In severe infestations, especially on the scrotum, foot lice may cause irritation that leads rams to stamp and kick at the scrotum. This in turn may cause injury, infertility and loss of condition.

Those sheep in a flock that show extensive signs of foot and face lice infestation are likely to have been susceptible due to poor health. If untreated, the lice can gradually spread to other animals. They will appear most obvious during winter and spring.

To control foot and face lice apply a registered pesticide and repeat after 14 to 17 days. Pesticides from the OP chemical group are recommended as they kill the lice immediately. The repeat treatment is necessary to kill those lice that have been protected in an egg at the time of the first treatment, but have since emerged.

All parts of the face, legs, belly, scrotum, groin and armpits must be thoroughly wet. This can be achieved using an effective plunge or shower dip, or with hand jetting equipment. As is the case with treating for body lice, all these methods can fail if the equipment is poorly constructed or maintained or used incorrectly.

Finally, check and treat introduced stock, including rams, before they are allowed to mix with other sheep. Sheep movement also needs to be considered, since foot and face lice are able to live away from sheep for up to 18 days.

Itchmite

The itchmite (*Psorergates ovis*) is a microscopic mite that lives under the surface of the skin but can also be found on the surface. It cannot develop off the sheep. Infestations are heaviest during winter and spring and decline in summer. There is also a fall in the population after shearing, especially if shearing occurs during summer. The itchmite tends to be evenly distributed over the body, but is most numerous on the upper part of the body towards the shoulder.

The life cycle of the itchmite is completed in five weeks, on and beneath the surface of the skin. Six stages are involved: the egg, the larva, three immature stages and the adult. The adults are free moving on the skin.

Transmission from long-wool sheep is slow, but mites from shorn sheep are readily transferred, either to other shorn sheep or to sheep in long wool. This occurs mostly after shearing. Infestations develop slowly throughout a flock, and up to two years can be required for numbers to build up to the point when clinical signs appear.

The itchmite can affect all sheep breeds, but is found mainly on fine wool Merinos that are run in the cooler areas of Australia. Seriously affected animals are generally found in older age groups. However heavy infestations associated with extensive damage to the fleece have been seen in hoggets and lambs.

The economic losses caused by the itchmite arise from the skin irritation, which leads to biting and rubbing and consequent damage to the wool. The fleece appears ragged and tufted, particularly in the areas the sheep can reach with its mouth. The clinical signs are not markedly different from those caused by body lice and grass seed contamination. These conditions need to be eliminated from your diagnosis before considering itchmite as a cause of fleece damage.

Itchmite infestation is now very rare due to the widespread use of products from the macrocyclic lactone (ML) chemical group.

Monitoring blowflies and lice

An important part of every integrated management strategy, monitoring has the potential to make the difference between harvesting and marketing a low or high residue clip. While the incidence of blowfly strike is highly dependent on seasonal conditions, monitoring for lice throughout the wool growing season is a key factor in reducing reliance on pesticides.

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Blowflies

Blowfly strike in a flock is most likely when the weather is warm and moist. In Queensland the risk increases during spring and autumn, when temperatures favour blowfly development and activity, and seasonal rains are most likely.

More info...

Using blowfly traps, section 4, page 19

Severe flywaves occur, on average, only one or two years in every ten. This is because it is relatively uncommon for all the factors that favour blowfly strike and blowfly survival to occur together. Our ability to provide long range forecasts of flywaves is limited. There are, however, tools that can be used alone or in combination to help predict a flywave, including blowfly traps and the Southern Oscillation Index (SOI).

Blowfly traps

REMEMBER

The number of strikes depends mainly on the number of susceptible sheep, not the density of blowflies in the area.

You can keep track of trends in the sheep blowfly population and identify high-risk blowfly areas on your property by using blowfly traps. Simply place the traps strategically throughout the property near where sheep camp in August when blowfly populations usually begin to rise. The traps need to be inspected regularly — at least weekly — because over time ants and other insects remove blowflies from the trap and the blowflies desiccate and this affects the count. Finding more blowflies in traps could be an indication of an increase in blowfly strike as both breech and body strike are correlated with the presence of female Australian sheep blowflies.

There are various types of blowfly traps on the market. The LuciTrap® system, which is specific for the trapping of the Australian sheep blowfly, is recommended.

Southern Oscillation Index

NOTE

The SOI is available on the Long Paddock Internet site at www.dnr.qld.gov.au/longpdk/

The SOI may be an effective tool to predict long range blowfly activity. In regions influenced by the SOI, in El Nino years — when the index is substantially negative (minus 5 or more) — below average rainfall is expected. The reverse is true in La Nina years — when the index is positive (greater than 5). Thus it is reasonable to expect less strike in an El Nino year and substantially higher strike in a La Nina year.

Lice

Accurate diagnosis of lice infestation is essential if you are considering not treating sheep so as to minimise pesticide use and residues on wool. Effective eradication of a lice infestation also depends on an accurate diagnosis. Here are three main methods of monitoring for lice, all of them interdependent.

History of the flock

You should consider the history of your flock over the growing period of the current wool clip. Are the lice showing up soon after shearing or close to the next shearing? Lice populations take months to build up to heavy infestations, particularly if only a few lice are present at the initial stage. An infestation of lice early in the growing period is a sign that your lice control program is ineffective.

Consider also the history of any introduced sheep. Were purchased sheep and rams free of lice? The chances of buying lice infested sheep in Queensland is high. A DPI survey in 1998 indicated that in southern Queensland 1 in 4 flocks were infested with lice and in northern Queensland up to 3 in 4 flocks.

Consider the history of stray sheep and stragglers. A commonly held belief is that strays from other flocks cause most lice infestations. However studies suggest that the majority of infestations originate on the home property, particularly when that property is infested in consecutive years. You need to consider if all stray and straggler sheep were caught and treated.

Could there be a history of ineffective pesticide treatments? Widespread resistance in lice to the SP group of chemicals has been detected. A DPI survey (Armstrong and Ward, 1999) also indicates that some producers use application equipment shown to be ineffective.

Other considerations include:

- the effectiveness of your stock control;
- whether your sheep are cleanly shorn;
- how effectively you can keep mobs separate if you have split shearings.

Observation of the flock

Some clinical signs of heavy lice infestation can be identified by observing mobs of sheep in the paddock, without catching them and parting the wool. They include:

- wool derangement (ragged or rubbed fleece);
- biting of wool;
- rubbing of sheep against objects.

However under no circumstances should this method of monitoring for lice be used to make or confirm an actual diagnosis. The signs could be caused by factors other than lice, such as grass seed, fleece rot, blowfly strike, itchmite, stick or burr pulled wool.

Diagnosis

Inspection

When visually testing for lice a negative diagnosis, particularly on short-wool sheep, may not be 100 per cent accurate due to the difficulty of finding lice when they are present in low numbers. To increase the accuracy of your diagnosis it is recommended that you compare information from other sources (such as shearers) and inspect sheep at least four times during the wool growing season (such as at crutching, lamb marking, drenching and before shearing). For an accurate diagnosis the person making the inspection needs to have some skill and/or experience.

Inspection can be conducted in the yard or the paddock. When lice are present in numbers such as to be easily seen the inspection is accurate and requires little time and labour. Accuracy, however, depends upon the inspector's eyesight (90–100 per cent vision is required), ability to identify lice (i.e. to know what they look like) and ability to inspect 20–30 sheep. Use reading glasses if they are normally worn; and a magnifying glass is useful.

On long-wool sheep, lice are most often found in colonies along the back and sides — particularly when lice numbers are high. On shorn sheep they are most often found under the neck, on the lower flanks and upper legs, and in areas where the wool has not been closely shorn. (Uneven distribution of pesticide on the animal due to incorrect application can affect the distribution of lice on the sheep.)

Diagnosis by inspection involves the following steps:

1. Hold the mob in a paddock corner or in sheep yards.
2. Let the mob settle.
3. Circulate the mob in both directions so that both sides of the sheep can be seen.
4. Look for sheep with wool derangement and choose these for your inspection.
5. Catch a sheep and brush any dirt from the wool tip so that it does not fall into the fleece.
6. Part the fleece in good light (but not in direct sunlight, as lice will quickly try to avoid the sunlight and so may not be seen), and inspect for lice. A 10 cm parting is recommended at five sites on each side of the sheep (i.e. 10 sites in all).

The sighting of one louse gives a positive diagnosis, and in that case no further inspections are needed unless you need to determine the severity of the infestation. If inspection of the first few sheep reveals no lice, continue your inspection. If you find no lice after inspecting 20 to 30 sheep the mob is probably free of lice. The following table is a guide to the severity of infestation.

Number of lice on an infested sheep

Severity of the infestation	Average number of lice per parting	Number of lice on the sheep
Light	1	Less than 5000
Medium	1–5	5000–250 000
Heavy	Greater than 5	Greater than 250 000

Source: Brightling, T. 1998, *Meeting the market for clean 'green' wool*, The Wool and Rural Industries Skill Training Centre Inc. & The Woolmark Company, Melbourne.

Most lice-infested flocks fit into the light category (i.e. lice are present but in sufficiently low numbers that it takes partings of the wool on several sheep to find them). Flocks with heavy infestations are rare and generally associated with a chronic infestation that has built up over several years with little, if any, effective control.

Observation by shearers, wool rollers and the classer

Observation by shearing shed personnel can confirm the existence of an infestation. It is not recommended as a single diagnosis but it can be used along with other tests to decide whether or not to treat for lice.

When shorn, lice-infested sheep will bite their skin in the count-out pens and shearers should be able to observe this. However care must be taken that lice infestation is not confused with grass seed contamination. Shearers can also judge by sight and smell.

As part of routine shearing procedure wool rollers and the classer should inspect the wool for the presence of lice as it passes over the classing table. Cotting of wool and wool discolouration are signs of heavy lice infestation.

Lice detection test

Currently no commercial lice detection test is available. However Elizabeth Macarthur Agricultural Institute (EMAI) and CSIRO, with funding support from Australian Wool Innovation Limited, are developing a simple and sensitive test to be used during shearing that will detect the presence of lice. It involves testing the wool grease and debris collected from shearer's combs and cutters.

Control with minimal chemical use

More info...

Management program, section 3

There are a large number of non-chemical management practices for preventing and controlling blowfly strike and — when used in combination with an effective pesticide — eradicating lice and keeping a flock lice free. These practices are important components of an integrated management strategy but not to the total exclusion of a pesticide component. Information on what to do if lice infestation or blowfly strike pose serious problems is given in the following section, Chemical use.

Blowflies 17

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Blowflies

Selecting and breeding for resistance to blowfly strike

Susceptibility to body strike is a heritable trait in sheep that can be selected against. Selecting against breech strike in sheep does not offer the same gains, partly due to the effect of practices such as crutching and mulesing.

One of the reasons it is possible to select against body strike is its close association with fleece rot, one of the major predisposing causes of body strike in sheep in eastern states of Australia. Research has shown that selection against fleece rot, in combination with selection against body strike, will be more effective than selection against body strike only.

Genetic variation has been observed between, and within, Merino strains and bloodlines in their resistance to blowfly strike. It is brought about by variation in the fleece and skin characteristics and in the immune system. These factors influence the effects of moisture and bacteria in the development of fleece rot and body strike.

There are a number of ways you can select for resistance. The best approach is to always purchase rams from a stud actively selecting against fleece rot and body strike. You should also select replacement rams with plain body types. Other approaches include:

- culling any sheep that have had to be treated for blowfly strike (except for poll struck rams);
- at classing, culling hoggets (ewes and wethers) that have excess wrinkle, devil's grip, fleece rot, or yellow or otherwise discoloured wool.

Possible correlations between how softly the wool handles (feels), coefficient of variation in fibre diameter and fleece weight on the one hand and susceptibility to fleece rot and blowfly strike on the other have also been investigated, but are not fully understood at the time of publication.

Correct tail docking and mulesing

NOTE

Mulesing has been shown to decrease the incidence of breech strike by almost 90 per cent.

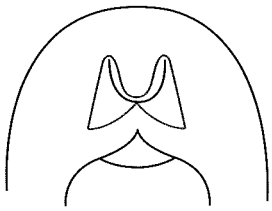
If performed correctly, tail docking and mulesing will achieve skin cover over the butt of the tail, correct tail length and maximum bare area on the breech. This provides a high degree of lifetime protection against blowfly strike in the breech area.

You should ensure that stress to the sheep is minimised and losses are avoided at lamb marking and mulesing time by planning for:

- good nutrition;
- water and feed availability for the ewes;
- quick mustering and treatment of each mob;
- quick mothering up;
- timing mulesing when bush flies and blowflies are not active.

Best practice procedures in line with animal welfare considerations (as summarised from the *Model code of practice for the welfare of animals — The sheep 1991*) include:

- The tail should be docked at the third palpable joint and be just long enough to cover the tip of the vulva in female sheep and be of similar length in the male.
- If a sharp knife is used, a better result is obtained by ensuring that a longer flap of bare skin underneath the tail is left to heal up over the tip.
- Acceptable methods of tail docking are to use a sharp knife, rubber rings or a searing knife heated over a gas flame.



For mulesing, the operation that leaves a V-shaped piece of woolled skin on top of the tail is recommended.

- For mulesing, the operation in which a V-shaped piece of woolled skin is left on top of the tail is preferable to the more radical operation that leaves the tail bare of skin.
- Tail docking and mulesing should be performed on lambs as early as management practices will allow — between 2 and 12 weeks of age — and where possible in conjunction with each other.
- Animals aged over six months require an anaesthetic.
- Appropriate facilities and restraint should be available.
- Competent trained operators should be used, to minimise pain and stress on the animals.
- Instruments should be adequately maintained and sterilised prior to use.
- Proper hygiene is essential to prevent infections.
- When tetanus is known to be a risk, a vaccination program should be carried out.
- Where circumstances indicate, application of insecticidal wound dressings is recommended. Some wound dressings are highly flammable and extra care is needed if they are used in conjunction with a searing knife. Products in powder form can pose an inhalation hazard to the operator. Consult your adviser for further information.

Following these procedures, lambs should be kept under observation and those with infected or blowfly struck wounds should be caught quietly and appropriately treated without unsettling the mob.

The timing of shearing and crutching

More info...
Management strategies, section 3, page 13

Blowfly strike is less likely to occur in short wool, as the fleece dries out more quickly after it becomes wet. If possible, time your shearing so as to have short-wool sheep in the period when blowfly strike is usually most prevalent (i.e. spring or autumn).

Changes to shearing times will need to fit in with other sheep management and property activities and the availability of shearing teams. They can be made gradually (for example by shearing at 10 months wool growth) or in a single adjustment, depending on your overall management program, economic circumstances and pesticide use. In the case of the latter you need to consider withholding periods (WHPs), wool harvesting intervals (WHIs), export slaughter intervals (ESIs) and rehandling periods.

Schedule the crutching of mobs for just prior to other likely periods of high blowfly activity to remove wool contaminated by urine and faeces. (Short wool is less likely to become contaminated in this way.) Ring wethers when you crutch so that there is less wool around the pizzle during the peak blowfly activity period. All sheep should be wigged at the same time to prevent wool blindness, and help achieve complete musters.

If a second crutch and ring is part of your quality assurance (QA) process to remove stain it may eliminate the need to jet preventively for blowfly strike. This is especially the case in adult sheep if a good breeding and selection program is also in place. The cost of the extra crutching is likely to be similar to that of jetting.

Preventing scouring

Wool stained by urine or faeces (scouring) makes the sheep susceptible to blowfly strike. Consider crutching or jetting the breech before the onset of good rains and lush pastures, after which sheep are most likely to scour. In Queensland the major worm is barber's pole worm, which seldom causes scouring, therefore worm infestation is unlikely to cause a problem.

Using blowfly traps

More info...

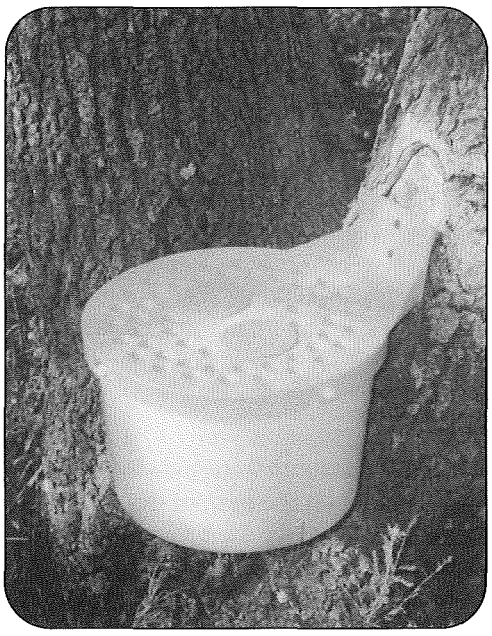
Suppliers, section 6, page 15

The Australian sheep blowfly travels only a relatively short distance (up to 4 km) during its lifetime, which makes it possible to reduce blowfly populations over a trapped area with an efficient trapping system. The LuciTrap® system, which was developed by DPI in conjunction with The University of Queensland and the manufacturer, Bioglobal Pty Ltd, is recommended.

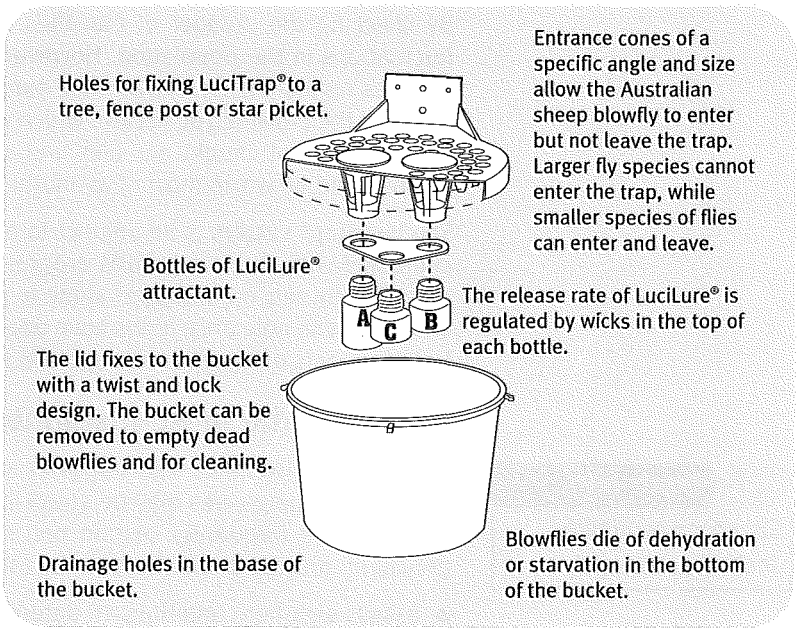
The LuciTrap® system consists of a unique trap that when combined with a patented blend of chemicals attracts and captures the Australian sheep blowfly. It is designed to reduce blowfly numbers and prevent a build up in numbers and subsequent flywaves. LuciTrap® is effective because it intercepts and traps the sheep blowfly at two prime stages in its life cycle:

- when the female is searching for sources of protein essential for egg development;
- when the female is looking for an egg laying site (usually susceptible sheep).

The trap itself consists of a translucent bucket made from tough ultraviolet-stabilised plastic and a removable lid with a flat surface, entrance cones that allow the sheep blowfly to enter but not leave the trap, and holes for fixing the trap to a tree, fence post or star picket. Brackets are built into the lid to hold the bottles of chemical attractant (known as LuciLure®). The attractant consists of chemicals designed to mimic the odours of the primary food sources of the sheep blowfly — fleece rot, animal carcasses, urine and faeces. Wicks in the top of each bottle regulate the release rate of the attractant and once the bottles are uncapped the attractant evaporates into the air for up to three months. The lid is fixed to the bucket with a twist and lock design.



The LuciTrap® system



A cutaway view of the LuciTrap® system. The shelf life of the attractant has been improved so that merchandisers and producers can store the bottles for two years or more before use. It required redevelopment of the attractant from a two-bottle to a three-bottle system that is compatible with existing traps.

HINT

Drawing a map of where your traps are located will make them easier to find each time you return to replace the bottles of attractant.

How to use LuciTrap®

To operate effectively LuciTraps® should be used at the rate of one trap per 100 sheep regardless of area. They should be located strategically on the property in areas where sheep blowflies are most likely to be found — along water courses and near dams, tree lines, yards, sheep camps, shearing sheds and rubbish dumps. The trap should be fixed to a tree, fence or star picket using fencing clouts or tie wire at the height at which the blowflies work, which is about sheep height off the ground (50 cm to 1 m). The trap must also be kept horizontal.

The trap bucket needs to remain translucent to retain its effectiveness over time because flies don't like to enter dark areas. At the beginning of each trapping period (August) you should clean each bucket using soap and water. Also, each time you replace the bottles of attractant you should remove flies, dirt and other deposits.

Bottles of attractant must be replaced every three months throughout the blowfly season. After that they quickly lose their effectiveness, even though there may still be a strong odour.

When to use LuciTrap®

LuciTraps® must be in use at least one month before you expect the blowflies in your district to become active. Do not wait until there are signs of blowfly strike in your flock. Sheep blowfly populations begin to rise, depending on the district, in late winter or early spring. Therefore trapping must start in mid-winter, when sheep blowfly populations are at their lowest and the LuciTrap® system at its most effective. Trapping when populations are still low helps remove the generation of blowflies from which subsequent populations develop.

By checking the number of blowflies in traps in key areas you can keep track of fluctuations in the population. However using the traps to monitor blowfly numbers requires regular visits, as over time ants and other insects remove blowflies from the trap and the blowflies desiccate, which will affect the count. If after six to eight weeks the trap has not caught any flies and ants are not the problem it may be in a poor location and be worth moving to another spot.

The LuciTrap® system is an adjunct to other blowfly control procedures and must be combined with them in an IPM program to minimise pesticide use and residues on wool. Do not rely on LuciTrap® alone to protect highly susceptible sheep from blowfly strike. For example once mobs have been wet to the skin conditions are favourable for large numbers of sheep to be struck. In such a case few flies would be caught in traps.

Protecting the most susceptible sheep

More info...

Sheep susceptibility, section 4, page 3

Young sheep (weaners and hoggets) are the most susceptible to blowfly strike. In addition, lambing ewes may be struck in lambing stain on the back of the udder and fighting rams frequently sustain poll strike. If blowfly strike is, or is likely to be, prevalent, protect these sheep in the following ways:

- assess weather conditions to determine the likelihood that conditions will favour blowfly activity and cause sheep to become attractive to blowflies;
- if the risk of blowfly strike is high, jet the most susceptible areas of the sheep (i.e. breech, back of udder of lambing ewes and shoulders) to protect against strike;
- concentrate LuciTraps® in paddocks carrying the susceptible sheep.

Shearing early

In flywave conditions early shearing could be a viable option. Consideration needs to be given to the availability of shearing teams, the possibility of complete musters in wet conditions, and the price discounts you can expect from the sale of prematurely shorn wool. These need to be weighed against potential problems with WHPs, WHIs, ESIs and rehandling periods if pesticides are used late in the wool growing season.

Pizzle dropping of wethers

Pizzle dropping is sometimes performed on wethers to reduce wetting of the belly wool by urine and resultant blowfly strike. If pizzle strike occurs in wethers and goes undetected, it can provide conditions for the blowfly to survive through periods of low blowfly activity, such as dry summers and winters.

The need for pizzle dropping should be considered according to the risk of blowfly strike. Advice on the correct procedure should be sought from your adviser or veterinarian. Pizzle dropping has been shown to reduce the incidence of pizzle strike by 90 per cent.

Lice

Checking for the presence of lice

More info...
Monitoring lice, section 4, page 13

Monitoring is essential to determine whether or not your sheep are infested with lice. It is very important if you envisage not treating your sheep in order to minimise pesticide use and residues on wool. Effective treatment of an infestation with the aim of eradication also depends on an accurate diagnosis. You should gain the skills and experience required to visually diagnose the presence of lice with confidence.

Regularly observing the flock is essential to a successful monitoring program: you should check each mob for infestation at least four times each year, such as at crutching, lamb marking, drenching and before shearing.

You should also know the history of your flock and of any mobs coming onto your property. If sheep are purchased or introduced on agistment you should request a declaration from the owner or stock agent of the mob's lice status and last treatment. You should also inspect for lice when the mob arrives and keep it isolated until it has been diagnosed free of lice.

Quarantining introduced sheep

All purchased sheep should be considered as potentially infested and isolated from all other mobs — especially mobs known to be lice free — until they have been diagnosed with certainty as free of lice. To do this, fences need to be maintained in sheep proof condition. Laneways can also be useful in providing a quarantine, or buffer zone, as they create a double fence between paddocks.

By keeping introduced sheep in isolation you will confine any lice present to the introduced mob and prevent them from spreading to the rest of flock. Another advantage is that a light infestation, which could be difficult to detect, will have time to build up to a level that can be detected. The infestation can then be diagnosed and measures taken to eradicate it by treating with an effective pesticide at shearing.

You may be in a situation where you are transporting sheep between properties that you own or between an adjoining property and your property. In this case you should follow the same procedure as the one recommended above for purchased sheep.

If you are introducing your sheep to someone else's property (agisting) you should:

- provide the owner/manager with details of each mob's last treatment;
- ensure that fences around your mobs are sheep proof;
- request the treatment history and lice status of the property.

When sheep are being transported or are travelling along the road or on stock routes, Queensland regulations require that permits be endorsed 'To be free of lice and branded'. This regulation is not enforced, nor are lice inspections at saleyards invoked, however interstate movements may be subject to some scrutiny and infested sheep could be returned to the property of origin at the vendor's expense.

Correctly managing stray sheep

If stray sheep from an adjoining property are found in one of your mobs it is preferable to catch them in the paddock and not in sheep yards, as close contact between sheep can accelerate the spread of lice. Don't return the strays over the boundary fence. Inspect them for lice and invite the owner/manager of the adjoining property to collect them; alternatively, return them yourself to the adjoining property's yards. Even if no lice were found in the strays, maintain the isolation of the mob they were in and monitor it for lice.

If strays are returned to you from an adjoining property, inspect them for lice. Even if you find none, don't put the strays back in their mob. Mark them with a distinctive brand and put them in a quarantine paddock to prevent the spread of lice should the sheep be infested.

Achieving complete musters

To successfully eradicate lice it is essential to achieve complete musters. This is because sheep lice are host specific (i.e. they can live and breed only on sheep), so if all sheep are mustered for shearing and treated after shearing with an effective pesticide then eradication will be achieved across the whole flock.

Practices that help achieve complete musters include:

- maintaining stock proof fences;
- controlling timber regrowth (which is usually practised to improve or rehabilitate country);
- using trap yards or sheep self-mustering facilities at watering points to increase the efficiency and effectiveness of mustering;
- using laneways and holding yards;
- preventing wool blindness (i.e. wigging sheep and/or selecting and breeding to remove wool from around the sheep's face) so that sheep can see clearly and won't become separated from the mob;
- supervising contract musterers and unskilled or semi-skilled operators.

More info...
Publications, section 6, page 16

If split shearings are unavoidable, good fences are essential to segregate mobs and prevent reinfestation of short-wool sheep by long-wool sheep with an undiagnosed infestation. Laneways are particularly useful in the case of split shearings to prevent mobs coming into contact with one another when they're being moved.

Applying an effective pesticide to eradicate lice

Sheep should be treated with a pesticide only if lice have been diagnosed using the visual inspection technique. (If you do not have the skills and experience to diagnose lice with confidence you should seek the services of a skilled operator.) Some lice are resistant to some chemical groups, so successful eradication requires that you use a

More info...
Chemical use, section 4, page 24

pesticide that you know is effective, follow the instructions on the label, and employ the correct application technique and equipment.

All lice infested mobs should be treated after shearing. If you have split shearings you should isolate sheep that have been treated with a pesticide from the IGR chemical group, as it will take six to nine weeks for all the lice to die.

Working in groups to eradicate lice

The voluntary formation of a lice eradication group is an option for two or more owners/managers with adjoining properties who are interested in eradicating lice from their flocks and coordinating efforts to maintain their lice-free status. Such an initiative can have management, marketing and social spin-offs, including:

- greatly reduced risk of reinfestation from flocks on adjoining properties;
- improved year round management due to implementation of an IPM program;
- competitive advantages from being able to sell lice-free sheep;
- opportunities for marketing wool with nil or low pesticide residues;
- recognition for having a lice-free flock;
- peace of mind from having eradicated lice and minimised the risk of reinfestation;
- improved communication with owners/managers on adjoining properties;
- an incentive to other owners/managers to follow the group's lead.

Following are some guidelines for forming a group:

- Choose a distinctive name for the group, which reflects its local identity. This enables members to identify with a discrete functional group activity and a locality.
- The ideal size consists of no more than 15 members. Smaller groups are possibly more effective than bigger ones. It is possible to have a large group using the same name but working on a number of aspects. As few as two producers working together constitute a group and numbers will depend largely on geographical location.
- Elect several members of the group as group coordinators to formalise the structure and share the workload. They may be responsible for organising meetings or field day activities, chairing meetings, delegating duties to members of the group, or liaising with outside advisers and other groups.
- Consider nominating an adviser or consultant to be the technical contact person for the group. It is important that this person be considered a team member. The adviser's role could be to provide accurate information on technical matters and sound epidemiological principles. The adviser need not attend every meeting.
- Hold meetings (theory or practical sessions) in a location that is convenient and comfortable for members, such as a meeting room at a club or community hall, a group member's home, a shearing shed or, for a field day, a set of sheep yards.
- Consider participating in training in group dynamics, which can help a team work better together. This type of training is readily available through professional providers such as consultants, TAFE colleges and Meat and Livestock Australia. Federal and state governments recognise the importance of this type of training and offer attractive subsidies to producers through FarmBis.

More info...
Training providers, section 6, page 5

Chemical use

Integrated parasite management programs for blowflies and lice have been designed to maximise parasite control and minimise reliance on pesticides and residues on wool. However for the times when, for animal welfare and production reasons, pesticides have to be used here are the main things you need to know.

Pesticides and their use 25

Choosing a chemical group 25

Parasite resistance to pesticides 26

Following label instructions 27

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Keeping records of pesticide use 29

Chemical control of blowflies 30

Treating to prevent blowfly strike 30

Treating individually struck sheep 31

Treating at lamb marking and mulesing 31

Caring for struck sheep post treatment 31

Applying pesticides 31

Chemical control of lice 34

Eradicating lice 34

Applying pesticides 35

Pesticides and their use

Choosing a chemical group

Once you have decided to treat to control blowflies and/or lice ensure that you do it effectively and avoid negative after-effects. You should:

- positively identify the target parasite (blowfly or louse) and select a pesticide known to be effective against it;
- determine the best method of application of that pesticide, given the length of wool on your sheep;
- ensure that you have the appropriate equipment and that it operates in line with the manufacturer's specifications;
- consider occupational health and safety (OH&S) and the environmental effects of using the pesticide;
- check the WHP, WHI, ESI and rehandling period;
- consider economic aspects of using the pesticide, including the cost per head, persistency, labour costs and time required;
- assess the condition of the sheep to be treated and ensure that the application method will not unduly stress them;
- apply the pesticide according to the instructions on the label;
- dispose of excess pesticide according to the instructions on the label.

Most of the pesticides currently available for use on sheep are synthetic compounds belonging to the IGR, OP and SP chemical groups as shown in the following table.

Chemical groups and their active ingredients

Chemical group	Abbreviation	Active ingredients
Insect growth regulator	IGR	Diflubenzuron, triflumuron Cyromazine, dicyclanil
Organophosphate	OP	Chlorfenvinphos, diazinon, propetamphos
Spinosyn		Spinosad
Synthetic pyrethroid	SP	Alphacypermethrin, cyhalothrin, cypermethrin, deltamethrin
Other		Amitraz, magnesium fluorosilicate, piperonyl butoxide, rotenone, sulphur

Insect growth regulator

The IGR chemical group controls parasites by interfering with the larval stages of the life cycle. IGR products are used to control blowflies and body lice and can be applied as a dipping, jetting, spray-on or backline treatment.

The IGR group has two sub-groups with different modes of action: diflubenzuron and triflumuron on the one hand and cyromazine and dicyclanil on the other. Diflubenzuron and triflumuron affect deposition of chitin, which forms the exoskeleton of the insect. Humans do not have any tissues made of chitin and no chronic effects on human health are known. However many aquatic invertebrates have exoskeletons containing chitin. The active ingredients cyromazine and dicyclanil affect the cuticle of the insect but their mode of action has not been definitively established.

Organophosphate

The OP chemical group kills parasites through its effect on the insect's nervous system. OP products are used to control both the Australian sheep blowfly and body lice and can be applied as a dipping, jetting or backline treatment or blowfly strike dressing.

Spinosyn

The spinosyn chemical group controls parasites by interfering with the nervous system. It provides four to six weeks protection against blowfly strike and can be used to control lice in long wool. Spinosyn can be applied as a jetting treatment or blowfly strike dressing. As spinosyn breaks down rapidly, has no adverse OH&S or environmental effects, and has a nil WHP it can be used within the last two months prior to shearing.

Synthetic pyrethroid

The SP chemical group is related in chemical structure to the plant extract pyrethrin. Like the OP group, SP products kill parasites by interfering with their nervous system. They are used to control body lice and can be applied as a dipping or backline treatment.

Other chemicals

Magnesium fluorosilicate is used to control body lice and can be used in organic production systems. Amitraz, piperonyl butoxide, rotenone and sulphur are additives used to enhance the activity of active ingredients in other chemical groups.

Guide to commonly used treatments for blowflies and lice

For an up to date list of commonly used treatments for blowflies and lice, visit the DPI Internet site at www.dpi.qld.gov.au or contact the DPI Call Centre for the cost of a local call from anywhere within Queensland on 13 25 23 from 8 am to 6 pm, Monday to Friday. Interstate callers please phone (07) 3404 6999.

The list includes the product name, its chemical group and active ingredients, target parasite/s, WHPs for meat and wool and the manufacturer's name. The products are grouped according to their application method.

Parasite resistance to pesticides

REMEMBER

Resistance status refers to the parasite's treatment history, not necessarily the flock's treatment history.

Many sheep parasites, including blowflies and lice, have developed some level of resistance to one or more of the commonly used chemical groups. Resistance is a consequence of repeated application — particularly incorrect application — of pesticides from the same chemical group. It generally develops when the target parasite is exposed to less than lethal doses of pesticide, especially if exposure occurs over a long period. This sub-lethal exposure allows the more resistant members of the parasite population to survive and continue reproducing. Thus, over time, the resistant population becomes the dominant population.

Producers should be able to tell if resistance has occurred when a pesticide, applied according to the instructions on the label, does not kill the target parasite. Be careful not to confuse resistance with treatment failure resulting from incorrect pesticide application.

Significant resistance has been detected in blowflies and lice to the OP and SP chemical groups respectively. To date there have been no confirmed (i.e. published) reports of resistance in lice to pesticides from the IGR chemical group; however unconfirmed anecdotal field reports have been received. These reports have been investigated by the product manufacturer and the reason for the apparent breakdown

in the effectiveness of the pesticide was associated with application and dispersion of the product only. There is evidence that where blowflies are highly resistant to OPs the period of protection provided by the IGR diflubenzuron against blowfly strike is reduced. The maximum expected period of protection provided by OPs against blowfly strike is about four weeks, but under severe flywave conditions it can be much shorter.

NOTE

At the time of publication there was no commercially available test to establish parasite resistance.

Resistance of lice to SPs is widespread and it is highly recommended that you not use an SP pesticide unless susceptibility is assured and you do not intend to market your clip to a sensitive market such as the European Union (EU). In contrast lice resistance to OPs appears to be confined to a few isolated properties. These properties are characterised by continuous use of OPs at sub-lethal concentrations, often caused by management and/or dip operation problems.

Where resistance is suspected you should change to a pesticide from an effective chemical group and apply it as recommended by the manufacturer on the label. Pesticides will perform as claimed only if they are applied correctly. Devices not designed for the application of modern pesticides and not recommended by the manufacturer (such as fire fighting pumps and spray races) should not be used under any circumstances.

Following label instructions

All containers of agricultural and veterinary (agvet) chemicals are labelled so that the contents can be readily identified and used correctly. Labels are a legal document restricting the use to its specific applications, and must be kept fixed to the container at all times. It is important to read carefully and to understand the label instructions when using any pesticide. It is also necessary to retain the label on the container for the information on safe disposal of both the container and the pesticide.

The National Registration Authority for Agricultural and Veterinary Chemicals (NRA) is the responsible body for the administration of regulations governing pesticide labels. Pesticides are reviewed periodically and label instructions can change as a result, so it is important to read the instructions carefully even if you have used the product in the past. See the following page for an example of a product label.

Withholding period

IMPORTANT

In some cases high pesticide residues on wool may occur even when the label instructions are observed.

A WHP is the period of time that must pass for a chemical (such as in meat or milk or on wool) to degrade to a level, based on scientific evidence, that is safe to the consumer. Some chemicals break down or degrade more quickly than others. Thus the WHP specified on the label can vary from nil to several months, depending on the chemical, its formulation, how it is applied and the circumstance of its use. All pesticides for blowfly and louse control have a meat WHP on the label, but only a few have a wool WHP.

The WHPs for wool are under review and subject to change. They represent the time that should elapse between application and shearing to ensure that levels of pesticide remaining on the shorn wool are acceptable to the Australian market. Where these are not stated on the label a default WHP of two months is recommended.

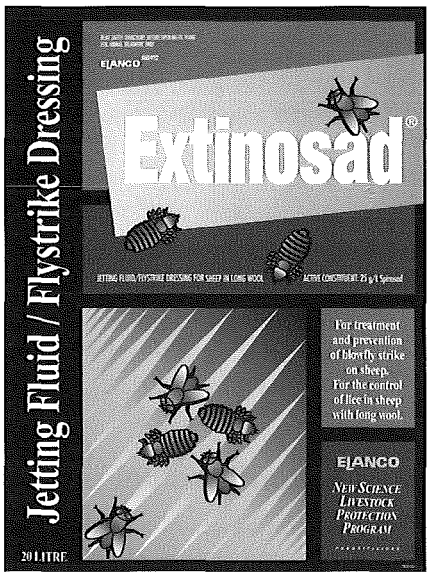
Wool harvesting interval

A WHI is a recommended WHP for wool being sold into markets with different requirements from those of Australia. WHIs are published by Australian Wool Innovation Limited on its Internet site at www.cleangreenwool.com and may also be printed on the product label.

Rehandling period

A rehandling period is the period after the application of pesticide during which people should not handle the sheep for OH&S reasons. The rehandling period and any conditions associated with it are stated on the product label.

Example of a product label prepared to comply with the code of practice for labelling veterinary chemical products. Reproduced by kind permission of Elanco.



READ DIRECTIONS FOR USE BEFORE USING THIS PRODUCT.
SHAKE CONTAINER GENTLY SEVERAL TIMES BEFORE USE.

ELANCO A89412 **Extinosad®**
JETTING FLUID/FLYSTRIKE DRESSING FOR SHEEP IN LONG WOOL

For treatment and prevention of blowfly *(Lucilia cuprina)* strike on sheep, including strains resistant to organophosphates. For the control of lice *(Bovicola ovis)* in sheep with long wool including strains resistant to synthetic pyrethroids.

DIRECTIONS FOR USE:

RESTRAINTS:
DO NOT USE on female sheep which are producing or may in the future produce milk or milk products for human consumption.
(Blowfly strike) When used on sheep with less than 6 weeks wool a reduced period of protection against blowfly strike may result.
(Long wool lice) After shearing, sheep should be re-treated with an effective off-shears or short wool product.

Table 1: FOR CONTROL OF LICE IN SHEEP WITH LONG WOOL:

ANIMAL/PEST	TREATMENT METHOD	MONTHS AFTER SHEARING	DOSE (mL of product)	CRITICAL COMMENTS
Sheep/lice	Jetting fluid	6 weeks-12 months wool	100 mL/100 L water (25 ppm)	Using jetting equipment, apply 0.5 L of fluid for each month of wool growth (up to 5 litres per sheep) from the poll to the tail base and around the neck and along each side. Ensure saturation to skin level. Pressure requirements 500-700 kilopascals (75-100psi).

Table 2: FOR TREATMENT AND PREVENTION OF BLOWFLY STRIKE:

ANIMAL PEST	TREATMENT	RATE	CRITICAL COMMENTS
Sheep/blowfly	Jetting fluid	100 mL/100 L water (25 ppm)	Using jetting equipment, apply 0.5 L of fluid for each month of wool growth (up to 5 litres per sheep) from the poll to the tail base and around the breech and pizzle as appropriate. Pressure requirements 500-700 kilopascals (75-100psi).
Sheep/blowfly	Flystrike dressing	5 mL/5 L water (25 ppm)	Prepare a fresh dilution of flystrike dressing each day. Remove the wool from around the wound using clippers or shears. Apply 1 to 2 litres onto the wound.

NOT TO BE USED FOR ANY PURPOSE, OR IN ANY MANNER, CONTRARY TO THIS LABEL UNLESS AUTHORISED UNDER APPROPRIATE LEGISLATION.

When applied as directed, this product will protect sheep against flystrike for 4-6 weeks. A reduced period of protection may occur in coarse wool (meat breed) sheep.

Extinosad is a short acting, non-residual product. Lousy sheep treated with less than 9 months wool growth may need to be re-treated before shearing.

It is good agricultural practice not to treat animals when they are wet or if rain is likely. However, even moderate to heavy rainfall following treatment does not adversely affect the efficacy of the product.

Mixing: SHAKE CONTAINER GENTLY SEVERAL TIMES BEFORE USE.

This product should be mixed at the rate shown in the Directions for Use tables. Mix well, preferably by using a mechanical (e.g. pump) system, before use. Prepare fresh jetting fluid/flystrike dressing daily. At the end of each day, discard unused product according to the disposal instructions on this label.

Actions: Spinosad, the active ingredient in EXTINOSAD, is the first member of the spinosyn class of insecticides and has a unique action on the insect nervous system.

WITHHOLDING PERIODS: **MEAT: NIL**
MILK: DO NOT USE on female sheep which are producing or may in the future produce milk or milk products for human consumption.
WOOL: NIL

Export Slaughter Interval (ESI): NIL

SAFETY DIRECTIONS: May irritate the eyes. Avoid contact with eyes. When preparing and using the prepared jetting fluid/flystrike dressing, wear cotton overalls buttoned to the neck and wrist and a washable hat and elbow length PVC gloves. Wash hands after use. After each day's use wash gloves and contaminated clothing.

DISPOSAL: Triple or (preferably) pressure rinse remaining container contents into the jetting tank. Do not dispose of undiluted chemicals on site. Break, crush or puncture and bury empty containers in a local authority landfill. If not available bury the containers below 500mm in a disposal pit specifically marked and set up for this purpose clear of waterways, vegetation and roots. Empty containers and product should not be burnt.

PROTECTION OF THE ENVIRONMENT:
Do not contaminate sewers, drains, dams, creeks or any other waterways with concentrate, jetting fluids, used containers or diluted product.

Extinosad® is a registered trademark of Eli Lilly & Company

93-23829-00237-8

NRA Approval Number 52227/1200

STORAGE: Store below 30°C (Room Temperature) in a dry place in tightly closed original container. Do not freeze. Do not store in direct sunlight. **KEEP OUT OF REACH OF CHILDREN.**

BATCH NUMBER:

EXPIRY DATE:

ELANCO ANIMAL HEALTH A DIVISION OF ELI LILLY AUSTRALIA PTY. LIMITED
A.C.N. 000 233 992 112 WHARF ROAD, WEST RYDE, N.S.W. 2114 TEL: Toll free 1800 226 324

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Maximum residue limit

When a pesticide is developed and registered for use on any animal, a maximum residue limit (MRL) must be established for its use. The MRL is the maximum residue content acceptable in human food. It is invariably much lower than the level likely to cause observable toxicity.

Export slaughter interval

An ESI is the recommended interval between treatment and slaughter for selling meat to export markets with different statutory residue requirements from those of Australia. These are not printed on the product label but are published by Meat and Livestock Australia (MLA).

NOTE

ESIs are available on the Meat and Livestock Australia Internet site at www.mla.com.au or call (02) 9463 9333.

Storing pesticides

Pesticides are frequently toxic to people as well as parasites and need to be stored according to legal requirements to minimise access and prevent contamination through accidental spillage. In addition QA schemes such as Flockcare have specific guidelines on the use and storage of pesticides.

The specifications for pesticide storage are outlined in *Australian Standard AS 2507–1998*. Briefly, your pesticide storage facility should be isolated, on a cool site above flood height and away from watercourses. It should be constructed of fire resistant materials, have a bunded sealed floor and be well ventilated. The facility should be placarded and kept locked. It should also have:

- a piped water supply, wash basin and hose;
- a dry powder fire extinguisher mounted outside near the entrance door;
- an emergency spillage kit;
- an appropriate first aid kit.

Guidelines for management of the facility include:

- keeping stored quantities of pesticides to a minimum by obtaining pesticides from suppliers on a 'just in time' basis;
- storing pesticides in their original containers;
- rotating pesticides on a 'first in, first out' basis;
- keeping out foodstuffs or seed;
- keeping herbicides separate from pesticides;
- triple rinsing empty containers and allowing room for their storage prior to disposal;
- disposing of empty containers and excess pesticide as recommended on the product label;
- checking the compatibility of pesticides before storing them together (for example don't store Class 6 (toxic) and Class 3 (flammable) products together).

HINT

It doesn't matter which recording system you use (such as a diary, computer, or treatment recording sheet) as long as the necessary information is accurately and systematically stored and easily retrieved.

Keeping records of pesticide use

Accurate information should be kept of all aspects relating to the purchase, management and use of pesticides. A written record on a prepared form that can be readily completed and stored is the best method of preserving information. In addition, these records are a valuable reference in case of an incident.

More info...

Pesticide treatment record Handy Guide for blowflies and lice, see insert

As a guide, a written record should be kept of:

- the target parasite;
- the date of treatment;
- mob/s treated;
- the product name of the pesticide, its chemical group and active ingredient/s;
- the batch number of the pesticide container;
- WHPs (wool and meat), WHI, ESI and rehandling period;
- application method and operation;
- amount of pesticide used;
- dilution rate and topping up rate of pesticide used;
- weather conditions at the time of application;
- name/s of operator/s applying the pesticide;
- wearing and maintenance of personal protective clothing;
- health surveillance undertaken, if any;
- training programs for incident and emergency response;
- training programs for correct pesticide use and application.

Chemical control of blowflies

Pesticide application is only one component of a blowfly strike prevention and control strategy. As part of an IPM program pesticides should be used efficiently and effectively in combination with non-chemical methods to maximise control and minimise pesticide use and residues on wool.

Treating to prevent blowfly strike

NOTE

Pesticide residue surveys have shown that treatments applied less than six months before shearing are likely to leave unacceptable levels of pesticide residues on wool.

Applying pesticides to susceptible mobs only (weaners and hoggets) is preferable to treating the entire flock if you are choosing to preventively control blowfly strike. This will help keep pesticide residue levels down across your whole wool clip and prevent blowfly populations building up if you treat in the main blowfly periods (autumn and spring). Sheep at low risk of blowfly strike should not be treated preventively unless you are facing a flywave.

Alternatively a targeted jet may be applied to areas of the sheep's body susceptible to blowfly strike. These areas are usually the withers, along the back, the breech of ewes, the pizzle of wethers and rams, and the poll of rams.

How soon you will be shearing, and whether there are effective pesticides available for use in that length of wool, will determine whether or not you can treat preventively and still comply with WHPs, WHIs, ESIs and rehandling periods.

If treating sheep with up to 10 months wool use a pesticide that gives long-term protection from blowfly strike to eliminate the need to treat a second time. Products that offer long-term protection are based on the active ingredients cyromazine or dicyclanil, both from the IGR chemical group. Even though cyromazine products kill larvae more slowly than diazinon products from the OP chemical group, they do prevent almost all larvae from developing into mature flies. Studies from Western Australia show that only 1–2 per cent of larvae on the sheep survive to pupate into adult flies when a cyromazine product is applied, compared with 66 per cent for diazinon. Sheep with greater than 10 months wool can only be treated with a product from the spinosyn chemical group.

Diazinon products should not be added to cyromazine products under any circumstances. Mixing products makes no difference in either effectiveness of the kill or recovery of the sheep. All it does is add to the pesticide residue load of your clip and contribute to the development of resistance to the OP chemical group.

Treating individually struck sheep

IMPORTANT

Shearers and shed hands should not be exposed to unnecessary risks presented by the concentrations of pesticide in an area such as a shearing shed.

Treating individually struck sheep is preferable to treating entire mobs because it minimises pesticide residues across the whole clip. Catch any affected sheep and shear the wool from the struck area close to the skin and for at least 50 mm into unstruck wool. This removes many larvae, opens the struck area so that all larvae trails are visible, helps dry the area, ensures that less wool is treated with pesticide and that the dressing, when applied, will be effective.

A registered dressing should be applied to the struck area after it has been shorn to kill the few remaining larvae and prevent any further strike until the wound has healed. Resistance of blowflies to the OP chemical group has reduced the effectiveness of many registered blowfly strike dressings, so pesticides from the IGR or spinosyn chemical group are recommended.

If struck sheep are noticed during shearing or crutching they should be raddled on the poll or backline and separated from the mob for later shearing and treatment. If struck sheep are noticed during jetting, draft them off the mob for individual treatment and then jet them. To prevent larvae in struck wool clippings from developing into the next generation of adult flies the clippings should be sealed in a plastic bag but left untreated. Treating the clippings with a pesticide is not a reliable way of killing larvae.

Treating at lamb marking and mulesing

IMPORTANT

Do not jet lambs just prior to marking and mulesing, as handling treated animals can pose serious OH&S risks — particularly to catchers.

Marking and mulesing activities should be carried out in cooler months or at hot, dry times of the year when blowfly and bush fly activity is low. If lambs are marked and mulesed at or just before blowflies are active a registered dressing can be applied on and around the wounds to help prevent blowfly strike, although this may not offer much protection and intensive husbandry may still be needed.

Caring for struck sheep post-treatment

The care of sheep that have been struck on the body is reasonably simple if treatment has been carried out properly. As part of your selection program consider placing the affected sheep in a separate paddock until they recover sufficiently to be sold for slaughter. Treatment with a registered dressing should prevent any further strike. If the sheep are to be kept for an extended period a preventive jetting may be applied to areas of the body susceptible to blowfly strike (such as the breech of ewes and the pizzle of wethers and rams).

Applying pesticides

Successful pesticide application requires the correct concentration of pesticide to be applied with sufficient volume and correct placement to give the maximum length of protection. Particular care needs to be taken when treating long-wool sheep as the pesticide must penetrate the fleece to the skin to be effective. The product and treatment method are usually determined by:

- equipment available;
- time and labour available;
- length of protection required;
- type and numbers of sheep to be protected;
- wool length;
- time until sheep will be shorn, sold for slaughter or rehandled.

The OP, IGR and spinosyn groups are registered for blowfly strike control. Although resistance has developed to the OP group, it still provides protection against strike for up to four weeks if applied correctly. However the use of OPs is not recommended, as re-treatment could be necessary, leading to high pesticide residues on wool. To date, no blowfly resistance to the IGRs cyromazine and dicyclanil has been detected. However there is emerging evidence of a reduced protection period provided by the IGR diflubenzuron. The spinosyn group provides four to six weeks protection against blowfly strike and has a nil WHP. As it breaks down rapidly and has no adverse OH&S or environmental effects, it can be used within the last two months before shearing.

Treatment methods used to apply pesticides for blowfly control in short and/or long wool include jetting, shower dipping, and backline or spray-on applications.

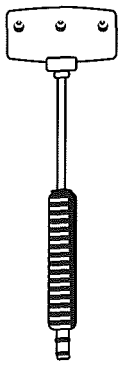
Jetting

For jetting to be cost effective and provide long-term protection against blowfly strike as stated on the label, it is vital that the pesticide be applied thoroughly. The depth of penetration by the pesticide into the wool determines the length of protection it provides. Jetting trials carried out by NSW Agriculture show no relationship between depth of penetration into the fleece and volume of insecticide applied. Some techniques appear to wet the sheep but do not fully penetrate the fleece to skin level, where it is needed. In these cases, repeat treatments later in the season may be necessary, leading to unacceptable pesticide residue levels on wool and increased risks to operators who must handle or jet the sheep. For the producer, the cost of additional applications can far exceed the increased cost of effectively applying a more expensive long-acting pesticide the first time.

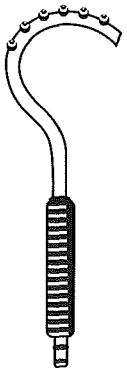
Hand piece

The most effective application method is jetting using a hand piece. Thorough hand jetting achieves maximum penetration of pesticide and maximum length of protection against blowfly strike.

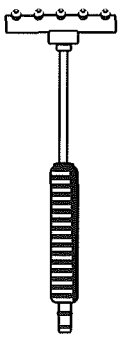
For sheep with greater than four months wool growth the Dutjet hand piece is recommended. This hand piece has three large nozzles with a shroud that opens the staple to facilitate fluid penetration of the wool as the wand is moved down the back of the sheep. For sheep with less than four months wool growth, the traditional sickle shaped or T-piece hand pieces are very effective. Pressure at the hand piece should be around 700 to 850 kPa (100 to 120 psi) for adult sheep.



Dutjet



Sickle



T-piece

Care should be taken to ensure that the jetting fluid gets to skin level by moving the hand piece slowly enough to allow fluid to fill the fleece but not overflow. Sheep should be jetted from the poll, along the back and over the tail in one slow movement. Extra passes of the wand (blows) may be applied to each side of the breech and to the pizzle for wethers and rams.

Automatic jetting race

Automatic jetting races (AJRs) simplify and speed up the treatment of sheep to prevent blowfly strike. They vary according to the method of operation and pattern of pesticide application. Races can either be of the continuous running type or involve intermittent operation triggered by the sheep. The latter is recommended, as it is more cost effective and environment-friendly as less excess fluid is discharged. Races also vary in volume and pressure combinations, such as high volume/high pressure, low volume/high pressure, or high volume/low pressure.

The combinations of pressure and volume are important, as each sheep is exposed to the pesticide in the race for only about 1–2 seconds. With this exposure time the AJR must have the ability to 'dump' the required amount of pesticide on target areas. At least a half a litre of fluid per month of wool growth should be delivered, so a pump capable of delivering this volume in 1–2 seconds is required. (Fire fighting pumps are too low in volume and pressure and are not recommended.) An AJR with the ability to achieve this will give blowfly protection approaching that of thorough hand jetting. However some AJRs do not have the ability to deliver the recommended dose; protection may be reduced by 25–50 per cent in these circumstances.

More info...
Technical reports and articles, section 6, page 17

AJRs should be used only if they have been modified in accordance with NSW Agriculture recommendations. Modification has improved the efficiency of these devices so that they deliver more jetting fluid at skin level with less spray drift than the standard machines. Many manufacturers of AJRs have adopted the recommended modifications and now produce machines with the modifications built in.

Shower dipping

More info...
Plunge or shower dipping, section 4, page 35

Shower dipping is very effective for treating large numbers of sheep rapidly and can be used for both blowfly strike prevention and treatment. However shower dips are not recommended, or widely used for treating sheep in long wool, as a price discount may be applied if a dip stain is noticeable when selling the wool. High levels of pesticide residues also result from shower dipping long-wool sheep.

If blowfly activity after shearing is high, or a flywave is predicted, you may choose to dip preventively in short wool with an effective pesticide that targets both blowflies and lice, or blowflies only if the flock is free of lice.

Backline or spray-on application

Backline and spray-on treatments for blowfly control offer an alternative to jetting or shower dipping long-wool sheep. Procedures for effective long-wool treatment include:

- use the recommended applicator;
- ensure that the applicator is clean;
- calibrate the applicator using an accurate volume measure;
- ensure that all areas to be protected are treated;
- when applying to prevent strike, ensure that bands overlap along the midline;
- if sheep have been struck, check the label to see if the product is recommended for such treatment;
- apply at the rate recommended by the manufacturer;
- use a good race to restrain sheep;
- take the time to apply the dose correctly and do not overfill the race;
- check that all sheep have been treated before letting them out of the race.

Chemical control of lice

Eradicating lice

If a flock is infested with lice the aim of treating with a pesticide is to eradicate them from the property. To minimise pesticide use and pesticide residues, the aim is to do the job correctly the first time so that the flock does not need to be treated again in that wool growing season. This requires effective treatment of the flock after shearing: use either a backline product off-shears or plunge or shower dip within six weeks. To further minimise pesticide use the flock should be kept free of lice so that they do not have to be treated at every shearing.

Procedures to successfully eradicate lice include:

- treat all sheep (including pets, rams and killers) within six weeks after shearing;
- treat lambs at foot at the same time as the ewes;
- use an effective product according to the instructions on the label;
- apply the product using the most suitable application method for that product;
- ensure the equipment is operating to the manufacturer's specifications;
- shear all sheep at one annual shearing or, if split shearings are unavoidable, ensure that mobs are kept separate;
- implement practices to achieve complete musters.

More info...

Managing split shearings, section 5, page 4

Where lice are not eradicated from a flock repeat control methods need to be applied. This can lead to unacceptably high levels of pesticide residues on the wool at shearing, which could restrict access to sensitive markets such as the EU. Surveys have shown that long-wool treatments applied during the six months prior to shearing are a major cause of unacceptable residue levels on wool. It is recommended that treatments be reduced in the six months before shearing and avoided in the three months before shearing. If treatment is required in the two months before shearing and shearing early is not an option, spinosyn is recommended.

What is the difference between eradication, control and treatment?

When reading the instructions on the label of a pesticide that targets lice the following definitions should be applied:

- Eradication (off-shears or in short wool) means the elimination of all live lice and viable eggs from treated sheep and there are no lice on the sheep 52 weeks after treatment.
- Control (in short wool) means reduction of the lice population to non-detectable levels 20 weeks after treatment.
- Control or treatment (in long wool) means reduction of the lice population by greater than 95 per cent 90 days after treatment.

Applying pesticides

Backline or spray-on application

Off-shears backline or spray-on products are available from the IGR, OP and SP chemical groups. As there is widespread resistance in lice to the SP group and its residue levels are unacceptable to sensitive markets, its use is not recommended in Queensland.

For effective backline treatment off-shears you should talk to your shearers or shearing contractor to ensure that all sheep are cleanly shorn. Separate sheep with lumpy wool, evidence of blowfly strike or other skin conditions, as they are difficult to treat effectively and will need special attention.

Depending on the product, some backline or spray-on treatments are registered for use within 24 hours off-shears, while others are registered for use up to seven days after shearing. However it is recommended that the product be applied off-shears, when better dispersion will occur and lice are most vulnerable. Always apply the product according to the manufacturer's instructions on the label.

IMPORTANT

Different products have their own registered applicator and the correct one must be used at all times.

Ensure that the applicator being used is recommended for the product being applied. Equipment should be operating properly and cleaned and maintained according to the manufacturer's recommendations. The applicator should be calibrated using a measuring cylinder, and checked before and after treating each mob. To administer the appropriate dose set the applicator to the dose recommended on the label for the heaviest sheep in the mob.

For efficient and effective application a well-designed and maintained race to restrain sheep is required. The race should not be overfilled and adequate time should be taken to apply the dose correctly. Apply the backline treatment in a straight line along the backbone as recommended by the manufacturer on the label. Applying from the tail to head is recommended for many products as the sheep do not jump around as much and it is easier to apply the pesticide correctly. Finally, check that all sheep have been treated before letting them out of the race.

Plunge or shower dipping

IMPORTANT

For best results dip sheep within three to four weeks after shearing.

Plunge or shower dipping is the traditional treatment method for lice control but it has been largely replaced by backline treatment. Sheep should be dipped at less than six weeks after shearing and for best results within three to four weeks. Pesticides available for short-wool plunge or shower dipping include magnesium fluorosilicate and those from the OP and IGR chemical groups.

There are two types of dip products — stripping and non-stripping. Stripping products (such as those from the OP group) are oil-in-water emulsions in which fine oil droplets carry the pesticide. The greasy fleece takes up the pesticide so the concentration in the wash draining off the fleece is reduced in strength. The wash in the sump or tank becomes weaker and has to be topped up or replenished. This type of dipping requires a high degree of knowledge and attention to detail to maintain the dip at the right strength. Some products are non-stripping emulsions. The pesticide is not taken up selectively by the wool grease and the concentration in the wash draining off the fleece is unchanged. Cyromazine products from the IGR group are of the non-stripping type.

Preparing to dip

Cleanly shorn sheep are necessary for the fleece to be wet to the skin, so talk to your shearers or shearing contractor about your requirements before shearing begins. Sheep with lumpy wool or other skin conditions should be drafted off and dipped last to control the spread of disease.

The product chosen will depend on, among other things, the cost per head, persistency, market access and whether specific requirements for eco-labelling or organic wool are to be met. In any event, the product should be registered for use in a plunge or shower dip.

HINT

Pre-mixing concentrate in water is essential to ensure even distribution of the pesticide in the plunge or shower dip.

Equipment should be operating properly and cleaned and maintained according to the manufacturer's recommendations. Follow the label instructions and carefully calculate the amount of pesticide required in the tank of the plunge dip or the sump of the shower dip.

Accurate calibration permanently marked on the tank or sump as well as a dipstick is essential for effective dipping. Ensure that the tank or sump is thoroughly empty, dry and clean before starting to calibrate. The first step is to begin filling the tank or sump with water using a 200 litre drum. As each 200 litres of water is added mark the tank or sump with waterproof paint and the dipstick with a saw cut. Continue this process until such time as the tank or sump is full.

Dipping effectively

For plunge dipping to be effective all sheep must be thoroughly wet to the skin. They need to be totally submerged (dunked) twice in the tank by pushing them backwards and down to slow their progress. Dunking poles should have a good wide T-shape and be stored in a shed when not in use. Overhead sprays can replace one dunk, but the spray must cover the width of the dip. The dive in is not recognised as a dunk. Sheep should be checked in the draining pen for wetness before being let out.

For shower dipping to be effective the dip should be filled so that the sheep are touching one another but still have sufficient room to move around freely. Packing sheep tightly prevents thorough wetting, whereas when there are too few sheep they may crowd to one side and wetting may be uneven. The sheep should be in the dip until wet to the skin. Under normal conditions this could take at least six to eight minutes on top sprays and two minutes on bottom sprays. Do not guess the time; use a timer. If sheep are not saturated, increase the length of time under the top spray. This could be up to 12 minutes.

Always check the first group of sheep emerging from the plunge or shower dip for wetness using a linen marking pencil or a cigarette paper. Part the wool of the sheep and place either a pencil line or the edge of the paper on the skin. If the sheep is wet the pencil line will spread or the paper will become damp. The most difficult part of the sheep to wet in a plunge dip is the back of the neck and in a shower dip it is under the neck. These are the areas to check thoroughly for wetness.

Maintaining the dip during dipping

Thoroughly mix old and new dip wash when replenishing (topping up) the sump or tank. Proper stirring is also critical when reinforcing the sump or tank. Stir if the dip has been standing more than one hour. If the dip becomes heavily contaminated dip out (that is let the level fall — reinforcing to bring the concentration to the correct level if necessary — pump out, rinse and refill). Excessive contamination can reduce the effectiveness of the pesticide.

Shower dip pumps should deliver 900 litres per minute (200 gallons per minute) at 300 kPa (43 psi) with the sprays operating. All screens should be sound and fine enough to remove the bulk of debris and rubbish. Spray nozzles should be fully operational and free of any blockages. The outside nozzles should spray 1.3 metres (4

feet) up the wall. The top rotating boom should rotate at 5 rpm to 8 rpm: slower or faster is not effective. Constant replenishment systems are recommended by shower dip manufacturers.

Post-dipping procedures

REMEMBER

Dip wash should be disposed of as recommended by the manufacturer on the label.

Dipping out allows the sump or tank level to fall in anticipation of pumping out. This makes economical use of wash rather than pumping out the entire tank or sump. With a plunge dip, dipping out should not proceed beyond the water level at which sheep can freely swim and then walk out of the tank. With a shower dip the limit to dipping out is 50 per cent of the sump level; the remaining 50 per cent is then pumped out.

Once dipping of all mobs is complete pump out the tank or sump to remove all debris and used wash, follow with a rinse to ensure that the sump or tank and foot valve recess is clean, and wash down with a disinfectant. These steps are necessary to prevent the spread of disease and ensure proper hygiene. Keep the sump or tank empty, dry and clean between dipping.

More info...

Should I consider getting rid of my dip? Section 2, page 14

If your dip is decrepit or has potential residue problems, or if you do not have a dip but are thinking of installing one, you need to think carefully about whether dipping is the preferred method of treatment. The trend is away from dipping to backline treatments because of their ease of application, effectiveness and OH&S advantages.

Hand jetting

Hand jetting long-wool sheep should be necessary only if the level of infestation is causing economic loss and shearing early is not an economical or practical option. Treating will not eradicate the infestation, but it should prevent further fleece damage. If a product other than from the spinosyn group is used it will result in high pesticide residue levels that may restrict access to sensitive markets such as the EU.

Hand jetting must be thorough to gain any degree of lice control and the Dutjet hand piece is recommended. This hand piece has three large nozzles with a shroud that opens the staple to assist the penetration of fluid into the wool as the wand is moved down the back of the sheep. Pressure at the hand piece should be around 700 to 850 kPa (100 to 120 psi) for adult sheep. Ensure that fluid gets to skin level by moving the wand slowly enough for it to fill the fleece but not overflow. Start the first blow at the back of the ears and just off-centre of the backline and run to the butt of the tail. Apply the second blow on the opposite side of the backline. The wash will flow around the sides of the animal, wetting as much skin as possible. Apply at least half a litre of wash per month of wool growth.

IMPORTANT

Use of any type of automatic jetting race for treating lice in long wool sheep is not recommended.

Products are available from the IGR and spinosyn groups for hand jetting long wool sheep. The IGR products can be legally applied only to sheep with up to six months wool growth. WHPs and ESIs must be adhered to and rehandling periods should be within OH&S guidelines. Remember WHIs if you are selling to sensitive markets. All long-wool products are under review at the time of publication so consult your adviser for up to date information.

Once the sheep have been treated, quarantine them until shearing as hand jetting will not eradicate lice and other mobs could become infested.

Spray races

A minority of owners/managers continues to use spray races that apply pesticide to the tip of the wool on freshly shorn sheep. Even though these devices can be used they are not recommended, for the following reasons:

- They operate on a principle of low volume, high concentration pesticide application and produce fine sprays that pose OH&S risks.
- Few products are registered for use in these devices.
- There is no control of the rate of flow of sheep through the race and application rates are variable and could be insufficient to gain effective control, let alone eradication.

Calculating the cost of an IPM program

More info...

Integrated Parasite Management, section 1, page 8

There are a number of options for managing blowflies and lice and you can determine the best one for your situation by calculating a gross margin budget. While it is appropriate to calculate gross margins on a whole-of-enterprise basis, to simplify the process we have set out guidelines for calculating a budget that only compares the differences resulting from changing to an IPM program. Contact your adviser for assistance with calculating a whole-of-enterprise gross margin budget.

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How to calculate a budget

Firstly you need to compare your usual management program with an IPM program. In Table 1, record the relevant details of the activities you currently carry out in the column *Usual program*. (Include any additional activities that are not listed in the table.) Then, in the column *IPM program*, record any proposed changes to your usual program.

Next, you need to calculate the total costs and savings associated with implementing the IPM program by considering all the factors that could be affected. In Table 2, assign a monetary value to each of the relevant factors. (Include any additional factors that are not listed.) Some costs and savings will be relatively easy to calculate, such as cost per sheep. Others won't be as straightforward, so following are some examples.

Finally, once all the factors associated with changes in management have been assigned a value, add them up and compare the costs and savings to determine whether changing to an IPM program is cost effective for your situation.

Examples for calculating costs and savings

An IPM program may require the use of a more effective pesticide that is also more expensive than your usual pesticide. This may result in improved wool quality and a decrease in cotting from 10 per cent to 2 per cent. Calculate this out to the number of sheep affected (insert in the column *No. sheep*) and assign a value to the improved fleece value (quality and quantity) in the column *$/head*. Multiply *No. sheep* by *$/head* and insert the figure in the column *Total saving ($)*.

On the other hand, changing to a more expensive pesticide may also need to be assigned a value in the column *Total cost ($)*. To calculate the cost you will need to multiply the number of sheep by the cost per head of the more expensive pesticide. In this example other factors also need to be given a value, including persistency, labour, equipment, and market access.

Peace of mind can be assigned a value rather like insurance; you don't really want to pay it, but you are prepared to pay a certain amount. Examples are concerns about

animal welfare or OH&S. The relevant values can be factored in as a cost on a per sheep or lump sum basis.

Some activities require extra effort or mental anguish, which can also be assigned a value by asking what dollar benefit needs to be gained to motivate you to do it. For example hand jetting is a more difficult and tiring job than using an automatic jetting race. Also, some producers don't mules because they don't like to do it or don't feel confident doing it. This value can be given a cost on a per sheep or lump sum basis.

Table 1. Comparing your usual program and an IPM program

Activity		Usual program	IPM program
Shearing (month/s)			
	1		
	2		
Crutching (month/s)			
	1		
	2		
Joining (yes/no; month)			
Lambing (yes/no; month)			
Lamb marking (yes/no; month)			
Mulesing (yes/no; month)			
Classing sheep (yes/no)			
Weaning (yes/no; month)			
Fly trapping (yes/no; month/s)			
	Set up		
	Replace lures		
	Monitor blowfly numbers		
Monitoring for lice (yes/no; month/s)			
	1		
	2		
	3		
	4		
Pesticide application (length of wool; persistency; target parasite; chemical group; stock (eg ewes, wethers))			
	1		
	2		
	3		
	4		
Additional activities			

Table 2. Calculating costs and savings of an IPM program

Factor		No. sheep	No. hours	$/head	$/hour	Total cost ($)	Total saving ($)
Wool quality							
	Cotting						
	Colour						
	Strength						
Wool quantity							
	Fleece weight						
Sheep health							
	Deaths						
	Growth rate						
Labour							
	Activity						
	Training						
Pesticide							
	Type						
	Persistency						
Trade/use restrictions							
	WHP						
	WHI						
	ESI						
	Rehandling period						
Equipment							
	Protective clothing						
	Maintenance						
Effort or difficulty							
Peace of mind							
Additional factors							
					TOTAL	$	$

Occupational health and safety

Pesticide treatments for blowfly and louse control can present a risk to people's health and safety. IPM practices should be implemented where possible to eliminate or reduce the need for pesticide use. However where necessary pesticides can be used safely provided that appropriate precautions are taken and the relevant regulations are followed. Here are the main things you need to know.

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Pesticide toxicity	42
Protective clothing and equipment	43
Legislation and regulations	43
Duty of care	44
Material Safety Data Sheet	45

Minimising risk

When applying pesticides to sheep the following precautions should be followed to minimise OH&S risk:

- choose a product with low toxicity in preference to one with high toxicity;
- choose a treatment method with low pesticide exposure (such as backline or spray-on application rather than dipping);
- avoid ingestion by washing hands, arms and face with soap and water after handling pesticides and especially before eating, drinking or smoking;
- avoid breathing fumes from pesticide concentrates by wearing appropriate protective clothing and a mask when handling pesticides or treated sheep;
- avoid breathing droplets from pesticide solutions being applied to sheep by wearing appropriate protective clothing and a mask;
- isolate operators from pesticide solution over-spray by installing physical barriers (such as high, solid walls).

Handling concentrates during mixing normally poses the greatest OH&S risk and all precautions recommended by the manufacturer on the label should be followed.

Pesticide toxicity

NOTE

Solvents, stabilisers and emulsifiers found in pesticide concentrates could be more toxic to humans than the active ingredient.

Pesticides vary greatly in their toxicity to humans and animals, from very low to very high. Of the active ingredients commonly used on sheep, those in the OP chemical group have the highest toxicity to mammals including humans. The active ingredients in the SP group are much less toxic to humans but some people are allergic to them and commonly suffer from an allergic dermatitis. The active ingredients in the IGR and spinosyn groups are the least toxic and considered very safe for humans.

Due to the toxicity of pesticides they need to be stored according to legal requirements to minimise access and prevent contamination through accidental spillage. The specifications for pesticide storage are outlined in AS 2507–1998.

IMPORTANT

If weather conditions are too hot to comfortably wear the personal protective clothing and equipment indicated on the label the product should not be used.

Protective clothing and equipment

Owners/managers and their employees should always wear personal protective clothing and equipment when handling and spraying pesticides to protect against skin absorption of the pesticide and inhalation of fumes and droplets. The manufacturer indicates on the label the minimum protective clothing and equipment recommended for use of the product in question. Often this is a cotton boiler suit (overalls) buttoned at the wrists and throat, a washable hat, a respirator or recommended disposable facemask, impervious gloves and waterproof footwear. Lightweight, comfortable spray suits are cheap and readily available. For jetting sheep, or other tasks that necessitate handling wet, treated sheep, waterproof pants, gloves and boots are essential.

All pesticide users should attend an appropriate training course. In Queensland these are offered under the Chemcert banner.

More info...

Training providers, section 6, page 5

Legislation and regulations

In Australia, all agvet chemicals must pass through a sophisticated system of review to reach the marketplace. The National Registration Authority for Agricultural and Veterinary Chemicals (NRA) carries out the major examination of safety and efficacy aspects at a federal level. If and when the authorities are satisfied, a Notice of Registration is issued.

There is a slight variance in emphasis between different states' laws related to agvet chemicals. Following is a summary of the main requirements in Queensland:

- purchase and use only agvet chemicals that are registered for use in Queensland on the animals or crops that you wish to treat; for example if you wish to treat sheep for lice, use only a product registered in Queensland for that specific purpose;
- follow all label instructions including application instructions, safety directions and recommendations for disposal;
- store all agvet chemicals securely and safely (refer to AS 2507–1998 and/or the *Workplace Health and Safety Act 1995* — Industry Code of Practice for the Storage and Use of Chemicals at Rural Workplaces 2000);
- the *Workplace Health and Safety Act 1995* requires employers to exercise their obligations by ensuring that the people they manage who are engaged in handling and using pesticides are adequately trained and protected from exposure.

NOTE

Australian standards are available on the Standards Australia Internet site at www.standards.com.au or call 1300 654 646.

In Queensland, the following legislation is directly relevant to the various aspects of agvet chemical development, sale, storage and use. It applies to all workplaces, including the rural workplace. In some instances, agriculture may be exempt from the specific provisions of a regulation; for further information contact the relevant government authority, for example the Department of Health, the Department of Employment and Training or DPI.

Sale of agvet chemicals to resellers and the public

- *Health Act 1937* — Health (Drugs and Poisons) Regulation 1996
- *Workplace Health and Safety Act 1995*
- *Agricultural and Veterinary Chemicals (Queensland) Act 1994*

Application of agvet chemicals

- *Agricultural Chemicals Distribution Control Act 1966*
- *Chemical Usage (Agricultural and Veterinary) Control Act 1988*
- *Workplace Health and Safety Act 1995*

Storage of agvet chemicals

- *Workplace Health and Safety Act 1995* — Industry Code of Practice for the Storage and Use of Chemicals at Rural Workplaces 2000
- *Local Government Act 1993* — Flammable and Combustible Liquids Regulation
- *Health Act 1937* — Poisons Regulation, Hazardous Substances (Placarding) Regulation

A national standard for the storage of dangerous goods is to be considered by the states so that similar rules will apply throughout the country. It is expected to reflect the existing relevant Australian standards:

- AS 2507 — The Storage and Handling of Pesticides
- AS 1940 — The Storage and Handling of Flammable and Combustible Liquids
- Draft Australian Standard for Storage of Class 6 (Poisons)

Transport of agvet chemicals

The transport of agvet chemicals is governed by the *Australian Dangerous Goods Code*, usually referred to as the ADG Code. In addition, in Queensland transport by rail is subject to the provisions of the *Transport Infrastructure Act* 1994 and Rail (Regulation 1996).

Agvet chemicals and the environment

- *Environmental Protection Act 1994*
- Queensland Farmers' Federation Draft Environmental Code of Practice for Agriculture
- *Health Act 1937*

Miscellaneous laws that can impact on agvet chemicals

- Pest Control Operators Regulations
- *Stock Act 1915*
- Poisons (Fumigation) Regulations
- *Fire and Rescue Authority Act 1990*
- *Rural Lands Protection Act 1985*
- *Plant Protection Act 1989*

Duty of care

Litigation in New South Wales in the mid 1990s involving the use of pesticides on the shearing board has made it clear that everyone working in the rural industry has a duty of care or legal obligation to provide a safe workplace for employees. This duty of care must be demonstrated in all practices undertaken in the workplace.

To help rural industry fulfil its duty of care, advisory standards have been produced as guidance notes addressing different aspects of a variety of workplace activities. These are published under the umbrella of the *Workplace Health and Safety Act 1995*. Advisory standards relevant to the use of pesticides include:

- rural plant (machinery);
- selection provisions and use of personal protective equipment;
- manual handling;
- storage, transport and use of chemicals in the rural workplace.

These provisions are included in the Chemcert training course. They are not regulations but present a suggested method for the management of risks associated with the hazards that exist in the rural workplace. It has been shown that guidance provided by an advisory standard can minimise risks associated with primary production.

Material Safety Data Sheet

A Material Safety Data Sheet, usually referred to as an MSDS, contains detailed information about the nature and risk management of the agvet pesticide. Manufacturers have a legal obligation to provide one to the purchaser of the pesticide. A copy must be available for all users of pesticides to inspect and be supplied to them on request.

Poisons information centre

The poisons information centre gives advice on procedures in the case of accidental poisoning. Call 13 11 26.

Pesticide residues on wool

More info...

Impact of pesticide residues, section 1, page 3

There is increasing demand from world markets and consumers for products that have been produced in a way that is friendly to the environment. This trend has highlighted the need to reduce pesticide residues on wool and review the ways in which wool is marketed. Here are the main things you need to know about the impact and nature of pesticide residues on wool.

Off-farm environmental impact of pesticides 46

Pesticide use and residue levels 47

On-farm environmental impact of pesticides 47

Pesticide residues in woollen products and by-products 48

Pesticide residues in sheep meat and milk 48

Breakdown of pesticides 48

Identifying residue levels on wool 48

Off-farm environmental impact of pesticides

Wool importing countries, especially those in the EU, have introduced legislation requiring their industries to meet stricter environmental standards. This legislation took effect from October 1999 and will be fully operative in all member countries by 2007.

The United Kingdom has led the development of this legislation and its own legislation specifies that manufacturing industry shall 'cause no significant pollution'. Australian Wool Innovation Limited expects that other wool processing countries, for example those in Asia, will eventually adopt similar environmental standards. There are potential market advantages for Australian raw wool if it has low concentrations of pesticide residues. In addition, stricter environmental standards are being proposed in Australia.

The main EU regulation sets environmental quality objectives for a body of water. Maximum allowable concentrations for pollutants are established to protect that environment, and these concentrations are the Environmental Quality Standards (EQSs). For river ecosystems the EQSs establish a safe concentration that will preserve the most sensitive organism in the food chain for the whole of its life, including reproduction.

Many of the pesticides currently used by producers in Australia to control blowflies and lice are highly toxic in the aquatic environment and are likely to cause EQS breaches in the EU. The pesticides leave residues that are still on the wool at shearing. The amount of residue depends on the pesticide used and the time, method and frequency of application. Pesticides on raw wool are removed during processing and end up in varying proportions — depending on the chemical and effluent treatment process used — in wool grease, scour effluent and sludge. Because effluent and sludge are discharged to the environment, processors have to comply with the relevant environmental legislation. This is difficult when the pesticide load is high.

Existing technologies for effluent treatment are expensive or require large areas of land for disposal. The increased processing costs for high residue wool could be passed back to the producer in the form of either lower wool prices or reduced demand if processors decide to procure low residue wool from elsewhere.

More info...

Level of pesticides that may be acceptable in the UK and Australia, section 1, page 4

To maintain market access the wool industry needs to produce wool that meets the needs of customers (i.e. processors) as well as end consumers. Maximum pesticide concentrations allowable in wool have yet to be finalised, but the NRA has recommended guidelines on levels expected to be acceptable to the European and Australian markets.

Pesticide use and residue levels

Australian Wool Innovation Limited began monitoring the Australian wool clip in the 1992–1993 wool growing season. Results showed that approximately 60 per cent of sale lots contained residue levels above those projected to be acceptable to sensitive markets. Furthermore about 50 per cent of the total residue load came from about 5 per cent of sale lots sampled. These had residues far in excess of the projected acceptable level. Subsequent work showed that this 5 per cent was a shifting population of producers, reflecting seasonal variations in different regions.

Producer surveys indicated that high residue levels were generally associated with:

- the use of long-wool products in the six months before shearing to control blowflies and lice;
- repeat pesticide applications to control blowflies and lice;
- pesticide applications to young sheep or sheep shorn with less than 12 months wool.

Pesticide treatments applied to lambs are of particular concern for several reasons:

- Lambs are usually shorn with less than 12 months wool.
- A significant number of lambs are slaughtered with as little as six months wool and a proportion of that wool is recovered by fellmongers for processing.
- Fleece weight is generally much lower than for adult sheep (Australian average: 1.6 kg per lamb) but the pesticide dose can be as much as 50 to 75 per cent of the adult dose, thus resulting in higher residue levels.

The correct use of pesticides within six weeks after shearing generally results in low residue levels, provided sheep are shorn with 12 months wool. Treatment of individual blowfly struck sheep with wound dressings results in low residue levels even when these treatments are applied in the last three months before shearing because the residue load is distributed throughout the clip.

The level of OP and SP residues on the Australian wool clip is decreasing. Queensland studies have shown a 50 per cent reduction in levels from 1994–1995 to 1997–1998. This can be attributed to the move toward the use of pesticides from the IGR chemical group, awareness of the potential effects of high residue levels on market access, and greater awareness of issues associated with pesticide use.

NOTE

Information on dealing with contaminated land is available on the Environmental Protection Agency Internet site at www.env.qld.gov.au

On-farm environmental impact of pesticides

On-farm environmental issues that need to be addressed include the disposal of dip wash, excess pesticide and empty pesticide containers. Producers must take care to prevent contamination of ground and surface water. The manufacturer's instructions on the label should be followed.

Pesticide residues in woollen products and by-products

Processed wool contains little pesticide residue and is unlikely to pose a risk to human health. However pesticide residue in lanolin-based pharmaceutical and cosmetic products applied to human skin could be a public health issue. Consequently the market for pesticide-contaminated wool grease is usually restricted to non-human use. Wool grease can be extensively processed to remove the residue, however this is a high cost process and has the potential to de-nature the product.

Pesticide residues in sheep meat and milk

Pesticides applied to control blowflies and lice can be detected in the sheep's carcass. The WHP that is stipulated on the container label must be adhered to if treated sheep are being sold for slaughter or used to provide milk for human consumption. If the sheep are destined for the export market you need to determine whether an ESI applies. ESIs are usually longer than WHPs.

NOTE

ESIs are available on the Meat and Livestock Australia Internet site at www.mla.com.au or call (02) 9463 9333.

Breakdown of pesticides

All pesticides registered for use to control blowflies and lice break down gradually after application. The speed of breakdown depends on the pesticide, the amount applied, and duration of exposure to sunlight, oxygen and moisture. For example pesticide applied deep into the fleece breaks down more slowly than pesticide near the staple tip, where there is greater exposure to sunlight, oxygen and moisture.

OPs degrade faster on sheep than SPs, which in turn degrade faster than IGRs. Degradation has a significant impact on residual effectiveness of the pesticide in controlling parasites, and on the pesticide residue level on wool at shearing. There is little breakdown of pesticides on wool once it has been shorn and baled, as the wool needs exposure to sunlight, oxygen and moisture for breakdown to occur.

All pesticides currently registered for use gradually break down in the soil or in water. This is in contrast to some pesticides used in the past (such as arsenic and organochlorines) that accumulate in the environment with repeated use over the years. Where yards and holding facilities are contaminated with these chemicals care must still be taken to minimise dust contamination of wool and resultant unacceptable residue levels.

Identifying residue levels on wool

The aim of identifying residue levels on wool is to give buyers of Australian wool information about the wool they purchase. The methods available also give producers the opportunity to identify at sale the nil or low residue wool they produce.

A study conducted by DPI in 1996–1997 into voluntary vendor declarations found that buyers of Australian wool had a preference for wool with low levels of pesticide residues. However any scheme for identifying such wool needed to be cost effective and accountable in order to maintain processors' confidence and achieve more than 50 per cent market penetration. Such a scheme could incorporate QA schemes, a voluntary vendor declaration and/or laboratory testing for residues.

Quality assurance schemes

A QA scheme is a quality system that provides customers with confidence that the product will satisfy their requirements. A number of QA schemes were introduced to the Australian sheep and wool industry during the 1990s. The proponents of these QA schemes for both wool and sheep meat have made provision for the inclusion of pesticide use.

More info...
Wool brokers and exporters, section 6, page 9

The wool schemes are administered by wool brokers and in Queensland include Dalcare (Wesfarmers Landmark), Clipcare (Primac Elders) and Quality Assured Wool (Acacia Wool, Bowden Wool Brokers, NGS Wool, Tourwool). Wool marketing groups also administer QA schemes for wool sold under their brand (for example Traprock Wool Total Quality Management (TQM)). Flockcare is a quality assurance system for sheep meat producers and includes on-farm practices leading to lambs for slaughter, mutton sheep for slaughter, live sheep sales and the requirements of the sheepskin industry.

Voluntary vendor declaration

NOTE
The AWEX Code of Practice is available on the Internet at www.awex.com.au or call (02) 9223 8788

A voluntary vendor declaration for producers covering the pesticide residues on their wool became part of the Australian Wool Exchange (AWEX) Code of Practice from 1 January 2001. The declaration is part of the Woolclasser's Specification and requires producers to keep a complete log of pesticide use for the whole wool growing season and indicate the residue status of the wool (i.e. unknown, nil, low or high) on the specification form. It is not compulsory for producers to fill in the residue declaration. Clips presented for sale with a pesticide residue declaration will be randomly audited, with a wool sample from audited clips analysed for pesticide residues.

Laboratory testing

More info...
Residue testing laboratories, section 6, page 14

Laboratory testing core samples of wool gives a precise measure of the pesticide residue levels on a wool lot. At the time of publication this represented a significant cost and in most cases producers who chose to test their wool clip were doing so to meet the requirements of a specific market. (It is important to obtain the wool buyer's specifications and establish what testing is required, if any, before deciding whether or not to proceed.) Laboratory testing is also used for random auditing of clips presented for sale with a pesticide residue voluntary vendor declaration.

A wool sample taken from a single sheep, or even a small group of sheep, is not a reasonable representative sample of the pesticide residue status of a flock or mob. The most accurate sample is the core sample of sale lots taken for testing by the Australian Wool Testing Authority Ltd (AWTA) in the wool store. For handling costs contact the AWTA.

You can have your wool tested to identify pesticide residue levels either through your wool broker or directly through the testing laboratory. The required procedures are described below.

Wool broker

To notify your wool broker that a residue test is to be done, write it on the Woolclasser's Specification and also make the request verbally. The broker will then submit a pesticide residue analysis request to AWTA on your behalf. AWTA will forward the keeper sample (i.e. wool retained after core testing) to the laboratory of your choice. AWTA retains the keeper sample for a maximum of six weeks after testing, so failure to make the request of your broker before your wool is delivered to the wool store could mean that the test couldn't be done. The test results are returned to your broker who will forward them to you.

NOTE
It is difficult to collect a representative sample under in-shed conditions: the results should be taken as a guide only, and wool buyers may not recognise them.

Testing laboratory

To have a residue test done directly through a laboratory you will need to collect your own core samples from bales in-shed and forward them to the laboratory. You will also need to supply the laboratory with specifications of the testing to be done. The laboratory will then give you an accurate estimate of the cost. (This process will be more expensive than the test organised through your broker.) The test results are returned to you.

NOTE

The NRS Laboratory PE is available on the Internet at www.nrs.gov.au

A number of laboratories are able to test greasy wool for pesticide residues. Check that the laboratory has participated in the National Residue Survey (NRS) Laboratory Performance Evaluations (PE) and is accredited for the pesticide group being tested; if not, the accuracy of the results is open to question. Laboratories will supply information on prices and turnaround times on request.

Future developments

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Vaccines 52
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Canine odour detection (sniffer dogs) 52

Organic wool and eco-labels

More info...
Organic organisations, section 6, page 13

Organic wool production and eco-labeling are emerging opportunities for producers. Organic wool precludes the use of synthetic pesticides (i.e. IGRs, OPs and SPs). Eco-labels do, however, permit minimal pesticide use, the definition of which varies according to the specifications of the label being targeted. Implementation of QA schemes and/or ISO 14000 certification that meet eco-labelling criteria is being investigated for future market development.

HINT
Specifications for organic products vary from label to label and it is best to target those labels to which the product is suited.

While still relatively small, demand for eco-products is increasing in sophisticated consumer markets such as the EU. Ability to supply this niche market depends on the credibility of the product provided. The market is likely to increase, but until internationally recognised standards are adopted market development will be restricted to individual producer-customer agreements or strategic alliances.

One of the eco-labels, the EC Ecolabel for Textiles, is starting to be promoted throughout Europe. It will be widely recognised in all EU countries and on a range of product types. The label requires the use of low residue wool that must be processed using good environmental practices and examines the overall environmental impact of producing a garment. Because processing of a wool product from scouring through to final garment may take place in many different countries, a supply chain approach to provide a specific product range would be needed. This will allow improved recognition of low residue Australian wools in the market place.

Lice detection test

Elizabeth Macarthur Agricultural Institute (EMAI) and CSIRO, with funding support from Australian Wool Innovation Limited, are developing a lice detection test that can be applied on-farm with rapid turnaround time, high reliability and low cost. The test uses debris collected on shear combs during shearing. The debris is homogenised in a solvent. Specific louse proteins, if present in the solution, are attracted to antibodies in an enzyme linked immuno sorbent assay (ELISA). The addition of reactive colour agents indicates the presence (or absence) of louse proteins in the sample. Based on the test result, the producer could decide whether or not to treat the mob after shearing. At the time of publication the test worked well in the laboratory and the challenge was to develop a version that was robust enough for field use.

Pesticides

Pesticides are not developed solely for use in the sheep and wool industry. The cost of developing and registering veterinary chemicals is very high, and the world sheep market alone is not sufficiently large to justify the expenditure. However pesticides that could be marketed in several animal industries are being developed, and some of these could potentially be registered for the control of blowflies and lice. Most research on pesticides is focused on improved formulations and methods of application of existing pesticides, to increase their effectiveness.

Vaccines

Vaccines are an attractive means of combating animal diseases but there are very few examples of vaccines directed against parasites such as ticks and flies. However considerable effort and money have been invested in Australia since the 1980s in the development of a vaccine to protect against the Australian sheep blowfly and blowfly strike. At the time of publication there was no progress to report on the development of a commercial blowfly vaccine.

Vaccines directed against the main bacterial type associated with fleece rot have also been developed, but the resulting protection was not sufficiently strong, or persistent, to proceed with commercialisation. At the time of publication research into a commercial fleece rot vaccine had ceased.

Vaccines against sheep lice infestation are unlikely ever to be effective because of the limited physical contact between the sheep louse and its host.

Biological controls

In response to the introduction of strict environmental legislation in the EU and the associated threat to the use of some pesticides it is expected that in the future research will begin into biological methods for the control of blowflies and lice. Biological products are based on natural life forms such as yeast, bacteria, and mites.

Canine odour detection (sniffer dogs)

Dogs have an extremely well developed sense of smell. They have been trained to identify a wide range of odours, for example illegal drugs, animals, plants and foodstuffs, explosives and even corpses. DPI has demonstrated that a dog can be trained to detect pesticide residues on wool. A trained dog could be used to conduct surveys of wool at a selling centre, or could be used as part of a QA scheme or vendor declaration incorporating random audits of wool.

Problem solver

problem solver

Problem solver

All producers, regardless of their management program, will at some time encounter problems with managing blowflies and lice. The key to dealing with such problems is to design solutions that meet both the short and long-term goals of reducing reliance on pesticides and maintaining animal health and welfare and economic wool production. This section presents integrated parasite management (IPM) options that may help solve some common problems. More detail on important areas is provided in other sections of the manual. Notations on the left-hand margin of the page will help you make these links. You may also find the glossary section helpful.

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Lice in long-wool sheep with blowfly strike

More info...

Number of lice on an infested sheep, section 4, page 14

When both blowfly strike and a lice infestation occur in long-wool sheep you will need to evaluate the risks presented by each parasite and respond accordingly, as demonstrated in the following scenarios.

Scenario 1

If the mob has a light infestation of lice and sheep are being struck, doing nothing for lice control (i.e. not treating) is a viable option. If the incidence of blowfly strike is also low and looks set to remain low or decrease — depending on the season — adopt a strategy of catching, clipping and treating individual struck sheep. Targeted jetting of susceptible mobs (weaners and hoggets) is also an option.

Scenario 2

If there is a light infestation of lice in a mob and the risk of a flywave is high you could adopt a 'do nothing' strategy for the lice infestation and treat the entire mob with a pesticide targeted at blowflies only. However this could result in high pesticide residue levels on the wool.

Scenario 3

If the mob has a medium to heavy infestation of lice and the risk of a flywave is high you could shear early and treat off-shears with an effective pesticide or treat the entire mob in long wool with a pesticide targeted at both blowflies and lice. The latter option could result in high pesticide residue levels on the wool.

Scenario 4

If the mob has a medium to heavy infestation of lice but the incidence of blowfly strike is low and decreasing, you could shear early and treat the entire mob off-shears with a pesticide targeted at lice only.

High incidence of urine stain and dags

Blowfly strike is more likely to occur in sheep with a high incidence of urine stained wool and dags (faeces). However urine stain does not normally present as a problem if recommended management practices are applied. These include:

- correct tail docking;
- correct mulesing;
- good quality crutching at the right time;
- quality shearing techniques to avoid vulva and pizzle damage.

In Queensland, dags on sheep are caused by diarrhoea due to sudden changes from dry to green feed, and the problem can be managed by well-timed crutching.

Introducing sheep of unknown lice status

Every time you purchase sheep (including new rams) you should contact the stock agent and/or the previous owner to inquire about their current and past lice and treatment status. If you personally inspect the sheep and diagnose no lice and the agent/previous owner says the mob is lice free it is still advisable to err on the side of caution. This is because sheep could have become infested if they were transported on a truck or held in yards or a shed that had held lice infested sheep within the previous few days. You could also have failed to detect a light infestation. Consequently all new mobs and rams should be quarantined until shearing, then treated with an effective pesticide off-shears if lice are diagnosed.

More info...

What should I do if I think my long-wool sheep have lice? Section 2, page 13

If you detect a heavy lice infestation among newly purchased sheep you can either shear early and treat off-shears, or quarantine the mob until normal shearing time and then treat. Treating in long wool with a registered pesticide may result in high residue levels and will not eradicate the infestation.

Introducing sheep of unknown treatment status

You should make every effort to determine the pesticide treatment history of purchased sheep from the stock agent and/or the previous owner. This is particularly important if products from the synthetic pyrethroid (SP) chemical group have been used, as there is widespread resistance of lice in Queensland to SPs. Also the use of SPs — even off-shears — is unacceptable to the UK market as the residues exceed environmental quality standards (EQSs).

More info...

Parasite resistance to pesticides, section 4, page 26

Lice infested sheep on an adjoining property

If you suspect that sheep on an adjoining property have lice and are infesting your flock, first confirm whether that is indeed the case. The best way to do this is through cooperation with the owner or manager of the property. If your suspicions are confirmed you should try to work with them to develop a lice eradication program.

If your sheep are infested with lice every year, the chances are that your own lice control program is not effective. A NSW Agriculture survey in 1997 indicated that between 50 per cent and 70 per cent of flocks that are lice infested at one shearing are infested again at the next shearing and that many of these flocks have been treated on more than one occasion in between. This indicates a failure to eradicate lice in the flock through effective pesticide application off shears, rather than reinfestation from sheep on an adjoining property or from straying sheep.

In both situations it is recommended that you review your management strategy and ensure that you are:

- treating your flock with an effective pesticide, applied correctly, off-shears;
- maintaining stock proof boundary and internal fences to control stock movements;
- using buffers (such as a paddock stocked with cattle) to prevent contact between your flock and that of the adjoining property;

- removing (and isolating) stray sheep from your flock as soon as possible;
- cooperating with the owners/managers of adjoining properties (for example coordinate when you muster, shear and treat);
- managing split shearings to minimise the chance of reinfestation of mobs;
- working towards achieving complete musters;
- doing regular maintenance work on fences (for example on the first Monday of every month);
- quarantining and if necessary shearing and treating any introduced sheep;
- monitoring your flock throughout the year to ensure that your management strategy is working.

Managing split shearings

Split shearings can be successfully managed to eradicate lice and prevent reinfestation in the whole flock. This requires a particular focus on stock control, including:

- quarantining introduced sheep and strays;
- keeping mobs from each shearing separate;
- establishing a buffer between shearing groups (such as laneways, cultivated areas, main roads, or paddocks stocked with cattle);
- achieving complete musters;
- regularly inspecting and maintaining internal and boundary fences.

Other things you should do include:

- monitor and inspect sheep regularly for infestation;
- if lice are detected, treat only affected mobs off-shears with an effective pesticide (such as from the insect growth regulator (IGR) chemical group, which provides longer protection);
- record details of pesticide treatments (including date, mob name, product name and active ingredient, application method and number of sheep treated).

More info...

Pesticide treatment record Handy Guide for blowflies and lice, see insert

When buying sheep wherever possible choose mobs that have a shearing compatible with your own flock so that you can work towards a single annual shearing.

Achieving complete musters

Lice reinfestation often occurs when you do not have total control of your stock movements. Total control of stock movements is possible on all properties, though some producers argue that it is not practical.

To achieve total control of your stock movements you need to maintain stock proof fences, control timber regrowth, prevent wool blindness, and develop the property to facilitate complete musters through smaller paddock sizes, laneways, and self mustering devices.

The use of pesticides with a long protection period, such as those from the IGR chemical group, will automatically protect shorn sheep during the time needed to achieve complete musters, including all stragglers. Ensure that operators who carry out musters and apply pesticide treatments are skilled and experienced.

Diagnosing lice half way through a non-treatment shearing

More info...
Monitoring lice, section 4, page 13

If your monitoring program before and during shearing has been effective, the chances are that mobs already shorn will be free of lice, and an infested mob detected half way through shearing should have only a light infestation. As lice populations build up very slowly you should seriously consider not re-mustering previously shorn sheep for treatment.

Once you have made a positive diagnosis it is advisable to:

- keep the shorn, non-treated sheep quarantined and closely monitor them for lice for the remainder of the wool growing season;
- treat only the lice infested mob off-shears with a pesticide effective against lice, and keep it separate from the remaining flock;
- identify the source of the infestation and fix it (if only one mob is infested the source should be easy to find — for example introduced sheep, including rams);
- monitor the mobs that follow the lice infested mob through shearing and treat if lice are diagnosed.

Monitor all mobs during the following wool growing season to ensure that lice have been eradicated. If lice are detected the entire flock should be treated off-shears at the next shearing with an effective pesticide.

Inter-shed transfer of lice

More info...
Sources of infestation, section 4, page 6

Prior to the late 1990s the transfer of lice between flocks by shearing teams was not considered a problem, as most lice cannot survive for more than 24 hours off the sheep. However a South Australian study (2000) has revealed that under ideal conditions lice can survive two to four weeks off the sheep. It is important to consider this when lice-free sheep are shorn after lice-infested sheep. In addition, lice have been found to survive on shearers' moccasins stored in a plastic bag for up to 10 days. This suggests that there is a risk (though a low risk compared with other sources of infestation) that transfer of lice could occur when shearing teams travel from shed to shed. If you are concerned about this risk it is advisable to microwave shearers' moccasins and any unwashed clothing for five minutes; this will kill any lice present.

High pesticide residue levels

HINT

If pesticide residue test results are high, identify the reasons and take an IPM approach to reducing your use of pesticides.

If you have had a laboratory pesticide residue test done on your wool clip and the results appear to be high, this may not necessarily be a problem or mean that the wool is non-saleable. In the first instance you should consult your wool broker to find out the significance of the results. The requirements for individual markets vary and you need to compare your results with the requirement of each market. For example SP levels acceptable to the European Union market are likely to be in the order of 0.0.6 mg/kg, while acceptable levels of cyromazine (from the IGR chemical group) could be in excess of 28 mg/kg.

Contacts and references

Contacts and references

This section helps to direct you to important providers and sources of information on blowflies and lice, pesticide residues on wool and wool marketing. The 'Contacts' directory contains details of industry organisations and special product and service providers. The 'References' section contains a list of useful reading on the topic.

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Industry organisations

Queensland

Agforce Sheep and Wool Limited
PO Box 186
Roma Street
Brisbane Queensland 4003
Telephone: (07) 3236 3100
Facsimile: (07) 3236 3077
E-mail: agforce@agforceqld.org.au

Agforce regional offices are located at Charleville, Cunnamulla, Longreach, Roma and Toowoomba.

Department of Primary Industries
GPO Box 46
Brisbane Queensland 4001
Telephone: (07) 3239 0685
Facsimile: (07) 3239 0688
E-mail: swi@dpi.qld.gov.au

Sheep and wool officers are located at Blackall, Charleville, Cunnamulla, Dalby, Goondiwindi, Longreach, Richmond, Roma, St George and Warwick. To contact an officer call the DPI Call Centre on 13 25 23.

Queensland Farmers Federation
PO Box 3128
South Brisbane Queensland 4101
Telephone: (07) 3844 7261
Facsimile: (07) 3844 7307
E-mail: qfarmers@qff.org.au

Wool Industry Chemical Residue Committee (WICRC)
GPO Box 46
Brisbane Queensland 4001
Telephone: (07) 3239 0685
Facsimile: (07) 3239 0688
E-mail: swi@dpi.qld.gov.au

National

Agriculture Fisheries and Forestry Australia (AFFA)
PO Box 858
Canberra ACT 2601
Telephone: (02) 6272 3933
Facsimile: (02) 6272 4246

Australian Council of Wool Exporters
PO Box 321
Collins Street West
Melbourne Victoria 8007
Telephone: (03) 9629 4527
Facsimile: (03) 9614 6529
E-mail: awis@woolindustries.org

Australian National Committee of International Wool Textile Organisation (IWTO)
PO Box 321
Collins Street West
Melbourne Victoria 8007
Telephone: (03) 9629 4527
Facsimile: (03) 9614 6529
E-mail: acwemelb@ozemail.com.au

Australian Wool Industries Secretariat
PO Box 321
Collins Street West
Melbourne Victoria 8007
Telephone: (03) 9629 4527
Facsimile: (03) 9614 6529
E-mail: awis@woolindustries.org

Australian Wool Processors Council
PO Box 321
Collins Street West
Melbourne Victoria 8007
Telephone: (03) 9629 4527
Facsimile: (03) 9614 6529

Australian Wool Residue Management Council
Level 5, AWA Building
47 York Street
Sydney NSW 2000
Telephone: (02) 9299 5155
Facsimile: (02) 9299 9880
E-mail: info@wool.com

Australian Wool Services Limited
PO Box 14187
Melbourne City MC Victoria 8001
Free call: 1300 361 735
Telephone: (03) 9611 5711
Facsimile: (03) 9611 5710
E-mail: info@wool.com

Avcare Limited
Locked Bag 916
Canberra ACT 2601
Telephone: (02) 6230 6399
Facsimile: (02) 6230 6355
E-mail: avcare@avcare.org.au

Livestock Contractors Association Inc.
PO Box 332
Warren NSW 2824
Telephone: (02) 6847 3001
Facsimile: (02) 6847 4952

National Council of Wool Selling Brokers of Australia
PO Box 321
Collins Street West
Melbourne Victoria 8007
Telephone: (03) 9629 6287
Facsimile: (03) 9629 2289

Sheep Meats Council of Australia
PO Box E10
Kingston ACT 2604
Telephone: (02) 6273 3088
Facsimile: (02) 6273 4479
E-mail: sca@farmwide.com.au

The Woolmark Company Pty Ltd
PO Box 14187
Melbourne City MC Victoria 8001
Free call: 1300 361 735
Telephone: (03) 9611 5711
Facsimile: (03) 9611 5710
E-mail: info@wool.com

Wool Council Australia
PO Box E10
Kingston ACT 2604
Telephone: (02) 6273 2531
Facsimile: (02) 6273 1120
E-mail: woolcouncil@nff.org.au

International

International Wool Textile Organisation (IWTO)
63 Albert Drive
London SW19 6LB
England United Kingdom
Telephone: 44 181 788 88 76
Facsimile: 44 181 788 51 71

Research and development organisations

Australian Wool Innovation Limited
Level 5, AWA Building
47 York Street
Sydney NSW 2000
Telephone: (02) 9299 5155
Facsimile: (02) 9299 9880
E-mail: info@wool.com

Commonwealth Scientific and Industrial Research Organisation (CSIRO)
Division of Textile and Fibre Technology
PO Box 21
Belmont Victoria 3216
Telephone: (03) 5246 4000
Facsimile: (03) 5246 4057

Rural Industries Research and Development Corporation
PO Box 4776
Kingston ACT 2604
Telephone: (02) 6272 4539
Facsimile: (02) 6272 5877
E-mail: rirdc@rirdc.gov.au

Training providers

Agforce Queensland
PO Box 186
Roma Street
Brisbane Queensland 4003
Telephone: (07) 3236 3100
Facsimile: (07) 3236 3077
E-mail: agforce@agforceqld.org.au

Australian Wool Exchange Limited (AWEX)
PO Box R695
Royal Exchange Sydney NSW 2000
Telephone: (02) 9223 8788
Facsimile: (02) 9223 8784
E-mail: info@awex.com.au

Building Rural Leaders Program
GPO Box 46
Brisbane Queensland 4001
Free call: 1800 356 621
Telephone: (07) 3406 2164
Facsimile: (07) 3239 6292

Chemcert Training Queensland Inc.
PO Box 17
Grange Queensland 4051
Telephone: (07) 3352 5033
Facsimile: (07) 3352 5042
E-mail: chemcert@powerup.com.au

Dalby Agricultural College
Bunya Highway
Dalby Queensland 4405
Telephone: (07) 4662 3566
Facsimile: (07) 4662 4048
E-mail: admin@dac.qld.edu.au

Flockcare (Cattlecare)
PO Box 3175
South Brisbane Queensland 4101
Free call: 1800 637 295
Facsimile: (07) 3247 7222

Longreach Pastoral College
Landsborough Highway
Longreach Queensland 4730
Telephone: (07) 4658 4699
Facsimile: (07) 4658 1956
E-mail: admin@lpc.qld.edu.au

Meat and Livestock Australia
165 Walker Street
North Sydney NSW 2060
Telephone: (02) 9463 9333
Facsimile: (02) 9463 9393

Queensland Rural Adjustment Authority (QRAA)
FarmBis and PIPES Schemes
GPO Box 221
Brisbane Queensland 4001
Free call: 1800 623 946

Queensland Rural Industry Training Committee
27 Peel Street
South Brisbane Queensland 4101
Telephone: (07) 3844 7284
Facsimile: (07) 3844 7260
E-mail: qritc@powerup.com.au

Southern Queensland Institute of TAFE
PO Box 260
Warwick Queensland 4370
Telephone: (07) 4660 4600
Facsimile: (07) 4661 5255

University of Queensland
Gatton Campus
Gatton Queensland 4343
Telephone: (07) 5460 1276
Facsimile: (07) 5460 1499

Agvet chemical companies

Bayer Australia Ltd
Animal Health
875 Pacific Highway
Pymble NSW 2073
Free call: 1800 678 368
Telephone: (02) 9391 6000
Facsimile: (02) 9391 6225

Captec Pty Ltd
103–105 Pipe Road
Laverton North Victoria 3026
Telephone: (03) 9282 1000
Facsimile: (03) 9282 1001

ChemAg Pty Ltd
Suite 12, 11 Preston Street
Como WA 6152
Telephone: (08) 9361 1799
Facsimile: (08) 9474 4676

Coopers Animal Health
71 Epping Road
North Ryde NSW 2113
Free call: 1800 226 511
Telephone: (02) 9335 4500
Facsimile: (02) 9335 4085

Cyanamid Websters Pty Ltd
23 Victoria Avenue
Castle Hill NSW 2154
Telephone: (02) 9899 2111
Facsimile: (02) 9899 2151

Elanco Animal Health
Level 1
16 Giffnock Avenue
Macquarie Park NSW 2113
Free call: 1800 226 324
Telephone: (02) 9878 7777
Facsimile: (02) 9878 7720

Farmoz Pty Ltd
Suite 3, Edgecliffe Court
2 New Mclean Street
Edgecliffe NSW 2027
Telephone: (02) 9363 3611
Facsimile: (02) 9363 5977

Fort Dodge Australia Pty Ltd
23 Victoria Avenue
Castle Hill NSW 2154
Telephone: (02) 9899 2111
Facsimile: (02) 9899 2151

Intervet Australia Pty Ltd
95–105 Harpin Street
Bendigo East Victoria 3350
Free call: 1800 033 461
Telephone: (03) 5442 5011
Facsimile: 1800 817 414

Jurox Pty Ltd
85 Gardiners Road
Rutherford NSW 2320
Free call: 1800 023 312
Telephone: (02) 4931 8200
Facsimile: (02) 4931 8222
E-mail: jenq@jurox.com.au

Merial Australia Pty Ltd
Level 6, 79 George Street
Parramatta NSW 2150
Telephone: (02) 9893 0000
Facsimile: (02) 9893 0099

Novartis Animal Health Australasia Pty Ltd
140–150 Bungaree Road
Pendle Hill NSW 2145
Telephone: (02) 9688 0444
Facsimile: (02) 9896 8260

Nufarm Limited
103–105 Pipe Road
Laverton North Victoria 3026
Telephone: (03) 9282 1000
Facsimile: (03) 9282 1022

Schering-Plough Animal Health
71 Epping Road
North Ryde NSW 2113
Free call: 1800 226 511
Telephone: (02) 9335 4500
Facsimile: (02) 9335 4085

Virbac (Australia) Pty Ltd
15 Pritchard Place
Peakhurst NSW 2210
Free call: 1800 242 100
Telephone: (02) 9533 2000
Facsimile: (02) 9533 1522

Vital Crystal Ltd
3 Invergrovie Place
West Pennant Hills NSW 2125

Western Stock Distributors
17 Rheola Street
West Perth Western Australia 6005
Telephone: (08) 9321 2888
Facsimile: (08) 9322 4163

Wool marketing organisations

Australian Wool Exchange (AWEX)
PO Box R695
Royal Exchange Sydney NSW 2000
Telephone: (02) 9223 8788
Facsimile: (02) 9223 8784
E-mail: info@awex.com.au

Homestead Grazing Company Ltd
93 Umang St
Tottenham NSW 2873
Telephone: (02) 6892 4400
Facsimile: (02) 6892 4400
E-mail: infinitewool@bigpond.com.au

Outback Wool
Bingara Station
Cunnamulla Qld 4490
Telephone: (07) 4655 4073
Facsimile: (07) 4655 4762

Quality Wool Suppliers
62 Alligator Creek Road
Alligator Creek
Townsville Qld 4816
Telephone: (07) 4778 8235
Facsimile: (07) 4778 8286
E-mail: richardss@bigpond.com

Traprock Wool Association Pty Ltd
PO Box 431
Stanthorpe Queensland 4380
Telephone: (07) 4667 4128
Facsimile: (07) 4667 4128
E-mail: info@traprockwool.org.au

Wool brokers and exporters

Acacia Wool
PO Box 386
Acacia Ridge Queensland 4110
Telephone: (07) 3274 5781
Facsimile: (07) 3274 0020
E-mail: stenbray@gil.com.au

Australian Wool Network
Unit 3/668 Toohey Road
Salisbury Queensland 4107
Telephone: (07) 3277 0448
Facsimile: (07) 3277 0724
E-mail: kipson@woolnetwork.com.au

Bowden Wool Brokers
PO Box 386
Acacia Ridge Queensland 4110
Telephone: (07) 3274 1130
Facsimile: (07) 3274 0020
E-mail: stenbray@gil.com.au

Chargeurs Wool
2 Bridge Street
Sydney NSW 2000
Telephone: (02) 8255 1200
Facsimile: (02) 8920 2688

e-wool
PO Box 726
Torrens Park SA 5062
Telephone: (08) 8272 8044
Facsimile: (08) 8272 8077
E-mail: ewool@bellsline.com.au

GH Michell & Sons (Aust) Pty Ltd
PO Box 1049
Roma Queensland 4455
Telephone: (07) 4622 5344
Facsimile: (07) 4622 5345
Head office (Adelaide): (08) 8209 4400

Goddard Wool Marketing
PO Box 393
Inverell NSW 2360
Telephone: (02) 6722 1888
Facsimile: (02) 6722 4966
E-mail: goddard@northnet.com.au
Receival depot (Goondiwindi): (07) 4671 2655

Maranoa Wool Pty Ltd
PO Box 566
Roma Queensland 4455
Telephone: (07) 4622 3330
Facsimile: (07) 4622 5163
E-mail: rjfowles@tpg.com.au

NGS Wool
PO Box 386
Acacia Ridge Queensland 4110
Telephone: (07) 3274 3716
Facsimile: (07) 3274 0020
E-mail: stenbray@gil.com.au

Ostini Wool Pty Ltd
Murchison Street
St George Queensland 4487
Telephone: (07) 4625 3493
After hours: (07) 4625 3473
Facsimile: (07) 4625 3945

Primac Elders
GPO Box 186
Brisbane Queensland 4001
Free call: 1800 817 637
Telephone: (07) 3274 1281
Facsimile: (07) 3277 7487
E-mail: mmcneill@elders.com.au

Tourwool
PO Box 386
Acacia Ridge Queensland 4110
Telephone: (07) 3274 1140
Facsimile: (07) 3274 0020
E-mail: stenbray@gil.com.au

TWG Wool
PO Box 253
Longreach Queensland 4730
Telephone: (07) 4658 0834
Facsimile: (07) 4658 0904
E-mail: fheeneytwg@hotmail.com

Wesfarmers Landmark (Fibre Direct)
PO Box 50
Brisbane Market Queensland 4106
Telephone: (07) 3842 7777
Facsimile: (07) 3277 1218
E-mail: richard.thomson@dalgety.wesfarmers.com.au

Woolworx
Free call: 0500 888 110
Internet: www.woolworx.com.au

Wool storage facilities

Australian Wool Handlers
123 Boundary Road
Rocklea Queensland 4106
Telephone: (07) 3277 6777
Facsimile: (07) 3277 6667

Stenbray Pty Ltd
123 Boundary Road
Rocklea Queensland 4106
Telephone: (07) 3274 6206
Facsimile: (07) 3274 0020
E-mail: stenbray@gil.com.au

Wool processors

Australian Country Spinners Pty Ltd
PO Box 278
Brunswick Victoria 3056
Telephone: (03) 9380 3888
Facsimile: (03) 9387 2674

Australian Fibre Spinners
8 Peck Street
Hamilton Victoria 3300
Telephone: (03) 5571 1046
Facsimile: (03) 5571 1046

Australian Topmaking Services
Level 29, Chifley Tower
2 Chifley Square
Sydney NSW 2000
Telephone: (02) 9375 2335
Facsimile: (02) 9375 2328
E-mail: auscol@ix.net.au

Canobolas Wool Topmaking Pty Ltd
Private Mail Bag 18
Orange NSW 2800
Telephone: (02) 6362 4866
Facsimile: (02) 6362 0628
E-mail: cwgwm@netwit.net.au

Elite Fibre Australia Pty Ltd
Apparel Close
Breakwater Victoria 3219
Telephone: (03) 5222 3600
Facsimile: (03) 5222 3687

E P Robinson Pty Ltd
PO Box 279
Belmont Victoria 3216
Telephone: (03) 5222 3022
Facsimile: (03) 5222 4207
E-mail: office@riversdale-mill.com.au

Fletcher International Exports Pty Ltd
Locked Bag 10
Dubbo NSW 2830
Telephone: (02) 6884 5833
Facsimile: (02) 6884 2965

Geelong Wool Combing Pty Ltd
PO Box 209
Corio Victoria 3214
Telephone: (03) 5274 1791
Facsimile: (03) 5274 1838

GH Michell & Sons (Aust) Pty Ltd
GPO Box 1739
Adelaide SA 5001
Telephone: (08) 8209 4400
Facsimile: (08) 8209 4407
E-mail: michell@michell.com.au

Goulburn Wool Scour Ltd
PO Box 214
Goulburn NSW 2580
Telephone: (02) 4821 7366
Facsimile: (02) 4822 1340
E-mail: gws@cil.com.au

Jandakot Wool Washing Pty Ltd
PO Box 2133
Rockingham WA 6168
Telephone: (08) 9419 9100
Facsimile: (08) 9419 9199
E-mail: jww@janda.com.au

Lachlan Industries Pty Ltd
PO Box 417
Cowra NSW 2794
Telephone: (02) 6342 2444
Facsimile: (02) 6342 3522
E-mail: lachwool@ix.net.au

Macquarie Textiles Group
PO Box 319
Albury NSW 2640
Telephone: (02) 6043 0200
Facsimile: (02) 6041 1321

Port Phillip Wool Processors
PO Box 7
Williamstown Victoria 3016
Telephone: (03) 9399 9555
Facsimile: (03) 9397 2290

Riverina Woolcombing Pty Ltd
PO Box 790
Wagga Wagga NSW 2650
Telephone: (02) 6938 3600
Facsimile: (02) 6921 6856

Victoria Wool Processors Pty Ltd
PO Box 430
Altona North Victoria 3025
Telephone: (03) 9315 2522
Facsimile: (03) 9314 8737
E-mail: vicwool@netlink.com.au

Organic organisations

Australian Organic Wool Growers
Byedown
Elong Elong NSW 2831
Telephone: (02) 6886 6212
Facsimile: (02) 6886 6212
E-mail: glenbye@bigpond.com

Bio-Dynamic Research Institute (BDRI)
Main Road
Powelltown Victoria 3797
Telephone: (03) 5966 7333
Facsimile: (03) 5966 7433

Biological Farmers of Australia
PO Box 3404
Toowoomba Village Fair Queensland 4350
Telephone: (07) 4639 3299
Facsimile: (07) 4639 3755
E-mail: bfa@icr.com.au

Maverick International Export Pty Ltd
PO Box 2997
Dubbo NSW 2830
Telephone: (02) 6885 1200
Facsimile: (02) 6885 1201
E-mail: ccrowley@maverick.tc

National Association for Sustainable Agriculture Australia Ltd (NASAA)
PO Box 768
Stirling South Australia 5152
Telephone: (08) 8370 8455
Facsimile: (08) 8370 8381
E-mail: nasaa@dove.mtx.met.au

Organic Connection Australia
PO Box 573
Kew Victoria 3103
Telephone: 1300 303 601

Organic Federation of Australia Inc.
PO Box Q455
QVB Post Office
Sydney NSW 1230
Telephone: (02) 9299 8016
Facsimile: (02) 9299 0189
E-mail: ofa@netspace.net.au

Organic Plus Australia Pty Ltd
PO Box 1208
Coorparoo Queensland 4151
Telephone: (07) 3392 0608
Facsimile: (07) 3391 4460
E-mail: rodger@organicplus.com.au

Organic Retailers & Growers Association
PO Box 12852
A'Beckett Street Post Office
Melbourne Victoria 3000
Telephone: 1800 356 299
Facsimile: (03) 9737 9499

Residue testing laboratories

CSIRO Textile and Fibre Technology
PO Box 21
Belmont Victoria 3216
Telephone: (03) 5246 4000
Facsimile: (03) 5246 4057

DPI Chemical Residue Laboratory
Locked Bag No. 4
Moorooka Queensland 4105
Telephone: (07) 3362 9415
Facsimile: (07) 3362 9460

Victorian State Chemistry Laboratory
Cnr Sneydes Road and South Road
Werribee Victoria 3030
Telephone: (03) 9742 8755
Facsimile: (03) 9742 8700

Wool testing services

Australian Fibre Testing
Orkadilla
Morven Queensland 4468
Telephone: (07) 4654 8183

Australian Wool Testing Authority (AWTA)
PO Box 667
Archerfield Queensland 4108
Telephone: (07) 3277 0866
Facsimile: (07) 3275 2801
E-mail: awtainfo@awta.com.au

Dr Mike Rival
PO Box 120
Goondiwindi Queensland 4390
Telephone: (07) 4671 2203
Facsimile: (07) 4671 4080

Suppliers of specialised products and services

Agvet chemical registration

National Registration Authority for Agricultural and Veterinary Chemicals (NRA)
PO Box E240
Kingston ACT 2604
Telephone: (02) 6272 5158
Facsimile: (02) 6272 4753
E-mail: nra.contact@nra.gov.au

Bioclip®

Bioclip Pty Ltd
PO Box 453
Neutral Bay NSW 2089
Telephone: (07) 9448 8799
Facsimile: (07) 9953 6544

Dipping equipment

Buzacott Rural Machinery
184 Peel Street
Tamworth NSW 2340
Telephone: (02) 6766 2483

Harrington Agricultural Equipment
135 Hendy Main Rd
Mt Moriac Victoria 3240
Telephone: (03) 5266 1313

Hay Steel and Welding
408 Belmore St
Hay NSW 2711
Telephone: (02) 6993 1753

Noel Kelly Welding and Manufacturing
PO Box 107
Coonamble NSW 2829
Telephone: (02) 6822 1793

Rippa Dippa Pty Ltd
21 Bell Avenue
Dubbo NSW 2830
Telephone: 0428 638 067

LuciTrap®

Bioglobal Pty Ltd
437 Joseph Street
Ballarat Victoria 3350
Telephone: (03) 5331 6672
Facsimile: (03) 5342 8140
E-mail: bioglobal@hypermax.net.au

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www.affa.gov.au

Aussie-Sheep-Net (e-mail discussion list)
http://lists.dpi.qld.gov.au/aussie-sheep-net.html

Australian Wool Exchange (AWEX)
www.awex.com.au

Australian Wool Innovation Limited
www.wool.com
www.cleangreenwool.com

Australian Wool Testing Authority (AWTA)
www.awta.com.au

Avcare Limited
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www.tft.csiro.au

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Eco labelling
www.emcentre.com/textile/ecolabels/

e-wool
www.ewool.com.au

Flockcare
www.ausmeat.com.au/programmes/flockcare/

Infinite Wool (Homestead Grazing)
www.infinitewool.com.au

International Wool Textile Organisation (IWTO)
www.iwto.org

Meat and Livestock Australia
www.mla.com.au

National Association for Sustainable Agriculture Australia (NASAA)
www.earthlink.com.au/nasaa

National Registration Authority for Agricultural and Veterinary Chemicals (NRA)
www.affa.gov.au/nra

Organic Federation of Australia Inc
www.ofa.org.au

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www.organicplus.com.au

Organic production
www.ota.com

Rural Industries Research and Development Corporation
www.rirdc.gov.au

Standards Australia
www.standards.com.au

The Long Paddock
www.dnr.qld.gov.au/longpdk

Traprock Wool Association Ltd
www.traprockwool.org.au

Glossary

Glossary

This is not intended to be an exhaustive list of terms and names. A number of definitions are specific to the context in which the term has been used in this manual. Words in italics in the descriptions are themselves described in this glossary.

Active ingredient	The chemical in a *pesticide* that kills the target *parasite*
Agvet	Agricultural and veterinary chemical
AJR	Automatic jetting race; used to apply *pesticide* through high pressure jets to the skin of *long-wool* sheep
Backline	The back of the sheep from the *poll* to the tail
Backline treatment	A type of *pesticide* applied as a single stripe or as multiple stripes along the *backline* of the sheep; also known as backliner
Bioclip	A method of harvesting wool using biologically active molecules that weakens and/or causes a break in the wool
Blowfly strike	The wound created by blowfly *larvae* feeding off the skin of the sheep
Body strike	*Blowfly strike* that occurs on the trunk or torso of the sheep
Breech	The hind area of the sheep
Breech strike	*Blowfly strike* that occurs on the *breech* of the sheep
Bund	A raised border such as an embankment around a storage area, usually to prevent any spillage from spreading
Burr pulled wool	Fleece wool that has been *deranged* as a result of sheep with burr in their fleece rubbing against a hard object
Calibrate	To check and adjust equipment to ensure that it delivers the correct treatment dose
Canary stain	Unscourable bright yellow colour in wool; see also *scouring*
CFA	Cast for age; an animal removed from the *flock* due to old age
Chemical group	A group of *pesticides* with a related chemical structure and similar mode of action
Colour	Fleece that has been discoloured as a result of water, *dipping*, bacteria, etc.
Comeback sheep	Progeny of a Merino cross sheep mated to a Merino sire
Constant replenishment	Maintenance of a constant level and concentration of dip wash in a small sump by using a large adjoining mixing tank
Cott	Wool that has become partially felted or matted while on the sheep's back
Crutch	To remove wool from the *breech* of the sheep by shearing
Dags	Faeces adhered to wool on the *breech* of the sheep
Deranged wool	Fleece that is ragged or rubbed
Devil's grip	Undesirable physical depression behind the *wither* of the sheep

Dip	A method of applying *pesticide* whereby *short-wool* sheep stand under a shower dip or swim through a plunge dip until they are wet to the skin
Dipping out	Allowing the sump or tank fluid level to fall in order to minimise *dip* volume that must be disposed of prior to pumping out and cleaning
Dock	To remove a lamb's tail
Eco-label	A label applied to a product that that has been produced in a certified way that satisfies consumer demands and achieves positive environmental outcomes
Ectoparasiticide	A *pesticide* to control external *parasites*
Efficacy or efficiency	A *pesticide* capable of, or successful in, producing an intended result
EQS	Environmental quality standard; environmental standard for the level of *pesticide* acceptable to regulatory authorities
ESI	Export slaughter interval; the recommended period between treatment with a *pesticide* and slaughter for selling meat in export markets with different statutory residue requirements from those of Australia
EU	European Union; it currently comprises 15 states which are Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden and the United Kingdom
Exoskeleton	The hard outside shell of an insect that forms its skeleton
Fellmonger	To remove wool from sheep skins by chemical processes
Fleece rot	A mild superficial bacterial infection of sheep at skin level
Flock	The total population of sheep, for example on a property; see also *mob*
Fly trapping	To use a trap and a special chemical attractant to catch blowflies
Flywave	A sudden increase in the incidence of *blowfly strike*
Growing season	The period from one shearing to the next
Heritability	The proportion of characteristics passed from parents to offspring that is genetically determined
Heritable traits	Those characteristics passed from parents to their offspring, in the case of sheep commonly through selection and breeding
Hogget	A sheep of either sex aged from about 9 months to 16–18 months
Humpy back	A disease of sheep characterised by difficulty in walking and an arching of the back
IGR	Insect growth regulator; this *chemical group* acts by interfering with the larval stage of the life cycle of the parasite
IPM	Integrated parasite management; a systematic approach involving preferred methods available to producers to control blowflies and lice and reduce reliance on *pesticides*
IPPC directive	Integrated Pollution Prevention and Control directive (European Union)(96/61/EC)

Itchmite	A microscopic mite (*Psoregates ovis*) that lives under the surface of the sheep's skin but also can be found on the surface
Jet	A method of applying *pesticide* whereby it is delivered through high pressure jets to reach the skin of *long-wool* sheep
Lambing stain	Stain on the udder and and back legs of the ewe from the afterbirth when lambing
Larvae	The immature free-living forms of blowflies before they develop into adult blowflies; also known as maggots
Long wool	More than six weeks wool growth on the sheep
LuciTrap®	A patented device that attracts and captures the Australian sheep blowfly
Lumpy wool	A condition that results from chronic infection by the bacterium *Dermatophilus congolensis*; also known as mycotic dermatitis or dermo
Main line	Main fleece line prepared by the wool classer at shearing
ML	Macrocyclic lactone; this *chemical group* is used to control internal *parasites* (worms) and *itchmite*, but can also have activity against blowflies and lice
Mob	A number of sheep running together in one paddock that can form part of a *flock*
Modified AJR	An *AJR* manufactured or modified to NSW Agriculture specifications
MSDS	Material safety data sheet; contains detailed information about the nature and safety management of an *agvet* pesticide
Mules	A surgical operation on the *breech* of the sheep to enlarge the bare area of skin around the anus and vulva
ng	Nanogram; one thousand millionth of a gram (1/1 000 000 000 gm)
Noil	Short tangled fibres removed from wool during combing
NRS	National residue survey; conducted by the Federal Government to monitor *pesticide residues* on wool
Off-shears	The period immediately or soon after shearing (generally 24 hours)
OP	Organophosphate; this *chemical group* acts by interfering with the *parasite's* nervous system
Over-spray	Aerosol produced by *pesticide* applicators (for example shower *dips* and *AJRs*) that drift away from the application device
Parasite	An animal that lives on or in another (the sheep) from which it obtains nourishment
PE	Laboratory performance evaluation; conducted as part of the *NRS* to assess Australian and international laboratories for their proficiency in testing greasy wool for *pesticide residues*
Persistency	The period during which a *pesticide* continues to act or be effective against the target *parasite*
Pesticide	A chemical used for killing *parasites*

Pesticide residue	The *pesticide* remaining on the wool at shearing that has been applied during the wool *growing season*
Pizzle	The penis of a wether or ram
Plain bodied	A Merino sheep free of skin folds
Pizzle drop	A surgical operation that cuts the skin between the *pizzle* and the sheep's belly to allow the pizzle to extend beyond the belly wool
Poll	The area around the top of the sheep's head
Pregnancy toxaemia	A potentially fatal metabolic condition in heavily pregnant ewes that can be brought on by stress
Pre-mix	To mix chemical concentrates and water in a large bucket before mixing in a tank or sump
QA	Quality assurance; a system for documenting and certifying production procedures
Raddle	A scourable coloured marker used to distinguish individual sheep in a *mob*
Rehandling period	A stated period following *pesticide* application during which people should not handle the wool or sheep, so as to avoid contact with the pesticide; this varies from pesticide to pesticide
Reinforce	To add undiluted *pesticide* to a plunge *dip* tank or shower dip sump without adding water
Replenish	To add *pesticide* (pre-mixed) and water to a tank or sump; also know as *topping-up*
Residue	see *pesticide residue*
Ring	To remove wool from around the *pizzle* of rams and wethers by shearing
Rough shorn	A sheep that has ridges, tufts and irregular lengths of wool remaining after it has been shorn
Scour	The processing plant used for *scouring* wool
Scouring	The process of washing wool that removes wool grease and dirt
Scurf	Flakes on the surface of the sheep's skin that are cast off as fresh skin develops below
Sensitive market	A market where the presence of certain levels of *pesticide residue* could be unacceptable, such as the *EU*
Short wool	Less than six weeks wool growth on the sheep
SOI	Southern oscillation index; a meteorological index of the difference in atmospheric pressure between Tahiti and Darwin that generally indicates whether above average or below average rainfall can be expected in regions of Australia
Split shearing	Shearing different *mobs* from the one *flock* at different times during the calendar year
SP	Synthetic pyrethroid; this *chemical group* acts by interfering with the *parasite's* nervous system
Spray-on	A method of applying *pesticide* whereby it is applied over the *backline* and/or *breech* of the sheep
Stain	Discolouration of wool by urine, faeces, birth fluid or dip fluid

Stick pulled wool	Fleece that has been *deranged* by rubbing of sheep against low bushes
Straggler	The sheep missed in the muster at shearing and mustered after shearing
Stripping	Selective removal of the *active ingredient* from *dip* fluid by the sheep's wool grease, resulting in a lower concentration in the dip wash
Top	A continuous strand of untwisted wool, with fibres lying parallel and short fibres removed; this is the product needed for spinning into yarn
Topping-up	see *replenishment*
UK	United Kingdom (Great Britain and Northern Ireland)
Voluntary vendor declaration	Part of the AWEX Woolclasser's Specification that requires producers to keep a complete log of *pesticide* use for the wool *growing season* and indicate the *residue* status of the wool
WHI	Wool harvesting interval; a stated period that follows *pesticide* application during which wool should not be shorn and sold into a *sensitive market*
Wither	The area between the shoulders on the back of the sheep
WHP	Withholding period; a stated period that follows *pesticide* application during which the product (i.e. wool, meat or milk) should not be harvested or used
Wig	To remove wool from the *poll* and face of the sheep by shearing to prevent *wool blindness*
Wool blindness	Long wool around the face and eyes of the sheep that obstructs its vision
Wool broker	An agent who sells wool on behalf of a client
Wool buyer	A person who buys wool on behalf of a client
Wool grease	A natural wax that occurs in the fleece of the sheep
Yellow wool	Yellow colour in the wool that may or may not be scourable
Yield	The percentage of clean wool that is left after *scouring* the greasy wool

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index

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Integrated parasite management blowflies and lice HANDY GUIDE

Summer shearing practice

Winter shearing practice

Activity	January	February	March	April	May	June	July	August	September	October	November	December
Shearing	Shear prior to joining/lambing and autumn blowfly activity. Consider not treating if the flock is free of lice.					Shear prior to joining/lambing and spring blowfly activity. Consider not treating if the flock is free of lice.						
Crutching		Crutch prior to joining/lambing and autumn blowfly activity.			Crutch within 60 days prior to shearing to prevent blowfly strike in long wool and remove stain if it is a requirement of your QA scheme.			Crutch prior to joining/lambing and spring blowfly activity.			Crutch within 60 days prior to shearing to prevent blowfly strike in long wool and remove stain if it is a requirement of your QA scheme.	
Joining		Quarantine purchased rams until they are diagnosed free of lice.		Do not join ewes or rams that have been culled for blowfly strike.					Quarantine purchased rams until they are diagnosed free of lice.		Do not join ewes or rams that have been culled for blowfly strike.	
Lamb marking						Dock autumn drop lambs' tails at the correct length to prevent blowfly strike.					Dock spring drop lambs' tails at the correct length to prevent blowfly strike.	
Mulesing						Mules lambs at lamb marking. If lamb marking during drought, postpone mulesing of weaners till crutching or shearing.					Mules lambs at lamb marking. If lamb marking during drought, postpone mulesing of weaners till crutching or shearing.	
Weaning	Check and maintain fences of weaner paddocks.							Check and maintain fences of weaner paddocks.				
Selecting sheep					At classing cull blowfly susceptible hoggets (ewes and wethers).						At classing cull blowfly susceptible hoggets (ewes and wethers).	
	Cull any sheep that have had to be treated for blowfly strike (except for poll struck rams).											
Fly trapping			Replace lures in blowfly traps.				Replace lures in blowfly traps.				Replace lures in blowfly traps.	
	Monitor blowfly numbers in blowfly traps regularly.											
Monitoring for lice		Inspect at crutching.				Inspect at lamb marking.		Inspect at crutching.			Inspect at lamb marking.	
					Inspect 1–2 months before shearing.						Inspect 1–2 months before shearing.	
	Inspect whenever mobs are in the yards, such as for drenching.											
Introducing sheep	Quarantine purchased, stray and introduced sheep (including rams) until they have been diagnosed free of lice.											

Pesticide treatment record HANDY GUIDE

blowflies and lice

Keeping a record of pesticide use provides valuable information when assessing the level of pesticide residues on your clip, monitoring pesticide use and related costs, and dealing with occupational health and safety issues. A complete log of pesticide use for the whole wool growing season is essential if you intend filling in the voluntary vendor declaration that is part of the AWEX Woolclasser's Specification.

Always read the label, follow the directions and wear protective clothing.

Previous shearing date	Treatment date	Mob name and/or location	Number of sheep treated	Target parasite/s	Product name and batch number	Method of application	Dosage rate	Weather conditions	Earliest date for sale/shearing (WHP, WHI, ESI, rehandling period)		Expected shearing date	Protective clothing worn	Completed by
									Meat	Wool			

WHP: Withholding period WHI: Wool harvesting interval ESI: Export slaughter interval

User-friendly, up-to-date and comprehensive, the *Blowflies and lice information manual: a practical approach to producing low residue wool* is an essential management tool for anyone in the business of producing and marketing wool or providing services to the wool industry.

This innovative manual has been written to provide the essential, core information that you most regularly seek on managing blowflies and lice. It has been designed to help you save time by finding the information you need quickly and easily.

The manual takes you step-by-step through best practice management of blowflies and lice, following an integrated pest management approach to reducing pesticide use and pesticide residues on wool. Related animal welfare, environment, economic and occupational health and safety issues are included.

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