

# Preventing resistance in sheep lice

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Resistance can be defined as a genetic change in response to exposure to a pesticide that enables lice to survive concentrations that would normally be lethal. With continued use of the same chemical or chemical group the more resistant lice breed and increase in numbers until they make up the majority of the population.

Theoretically resistance can develop to any group of chemicals. Historically, in Australia, resistance in sheep lice has been mainly a problem with chemicals applied as backline treatments. However, it can also affect chemicals applied by showering or dipping. For example, resistance was found overseas to organochlorine chemicals applied by dipping and showering.

In Australia, resistance has been found to three main chemical groups:

**Synthetic pyrethroids (SPs):** Resistance to SPs was detected in the mid to late 1980s and is now widespread.

**Insect growth regulators (IGRs):** Resistance to the insect growth regulator (IGR) pesticides diflubenzuron and triflumuron has been confirmed and has been shown to be responsible for lice control breakdowns in at least some instances. As diflubenzuron and triflumuron have the same mode of action, if resistance is present to one it will also be present to the other. The current extent of resistance to IGRs is unknown.

**Organophosphates (OPs):** Two strains with low level resistance to organophosphates have been reported but resistance is thought to be rare.

It is important to note that although resistance often gets blamed for lice treatment failures, the majority of breakdowns result from under-dosing, poor application or reinfestation, not resistance. It is essential to carefully review your application method, ensure that all sheep were treated and check that there has not been a new infestation before deciding that resistance is a problem.

## Why is resistance important?

Taking steps to prevent or retard the spread of resistance helps to control costs by avoiding control breakdowns and the need for extra treatments.

Extra treatments also increase the likelihood of residues in the wool.

Sometimes when resistance is present, treatment suppresses lice, but does not completely eradicate them. These suppressed infestations are difficult to detect and increase the chance of lice spreading between flocks, particularly on purchased sheep or agisted sheep. The upsurge in lice prevalence around Australia in the late 1980s and early 1990s was associated with the spread of resistance to the SP lousicides.

Preserving the efficacy of currently available compounds is also important as the costs of developing and registering new products continues to increase and new groups of lousicides are almost always more expensive, reflecting these costs.

## How resistance develops

Within any population of lice there will be some able to withstand higher concentrations of insecticide than others. If lice are exposed to concentrations of insecticide that do not kill all of them, for example by under-dosing or poor application, the more resistant individuals survive and breed, gradually increasing the level of resistance in the population.

Sometimes a genotype or mutation with high-level resistance develops that enables lice to survive even properly applied chemical treatments. With continued use of the same chemical group these more resistant individuals have a selective advantage and will predominate in the population.

If resistance develops to one insecticide in a group it also generally applies to others in the same group. The more often one product or products from the same chemical group are used, the more likely that resistance will develop.

## Know your chemical group

Knowing which chemical group your lice control products belong to is critical to resistance management. Table 1 gives a list of the different chemical groups and products that belong to them. For a full listing of flystrike and lice products, consult the LiceBoss products module.

Remember that flystrike treatments also expose any lice present and can increase selection for resistance in lice. It is important to use products from different chemical groups when treating for flystrike and lice in the same year and to consider flystrike chemicals when determining a resistance management plan. Fortunately the two main chemicals used for flystrike control, cyromazine and dicyclanil do not have any effect against lice and will not contribute to selection for resistance in lice.

## Avoiding resistance development

Resistance is most likely to develop when lice are exposed to sub-lethal concentrations of insecticide and when products from the same chemical group are used repeatedly.

Fortunately, many of the practices that help prevent resistance occurring are the same as for good lice control. If a property can have lice eliminated and kept lice free so that treatment is not necessary, there will be no pressure for the selection of resistance.

Lice can be exposed to sub-lethal concentrations of chemical in the fleece in the following ways:

### 1. Incorrect dose rate

With backliners the wrong dose rate often results from underestimating the weight of the heaviest sheep in the mob or using an application gun that is delivering the wrong dose.

With dips or showers under-dosing can occur if the volume of the dip sump is underestimated or the mixing rate is wrong. With products that strip, if the dip is not reinforced and topped up according to the label instructions the concentration may fall below the concentration required to kill all lice. This is especially likely to occur near the end of the mob and instructions for 'dipping out' should be followed carefully.

### 2. Poor application technique

To eradicate lice it is critical that effective levels of chemical are applied all over the sheep's body. Poor application technique can leave areas of sub-lethal chemical in the fleece where more resistant lice can breed.

With backline products the backline strip must be right down the middle of the back and all of the way from poll to rump. If the strip is off to one side or only part of the way along the backline this can also leave areas of low insecticide concentration where the more resistant lice can survive.

If the shower dip is not functioning properly or sheep are not left in the dip for long enough and are not properly wet to skin level there can be areas with no chemical or only low levels of chemical where more resistant lice can survive and breed. Similarly, if sheep are not wet properly in plunge dips, areas of low chemical concentration can remain where more resistant lice can survive.

### 3. Exposing treated sheep to untreated lousy sheep

Untreated sheep in a mob will provide a source of ongoing infestation. While there are still protective levels of chemical on the treated sheep this will not be important as any lice that transfer will be killed. However, as chemicals break down on the treated sheep, more resistant lice will be able to transfer and survive to breed a more resistant population. This is particularly a concern with very persistent chemicals. In addition, sub-lethal amounts of chemical can rub onto untreated sheep that are running with treated sheep and may contribute to resistance development.

Therefore it is critical to eliminate sources of lice:

- ensure clean musters and, when necessary, that all sheep on the property are treated;
- keep strays out of the mob;
- quarantine newly purchased sheep;
- try to avoid split shearings or at least keep mobs shorn at different times separate; and
- avoid treating ewes with lambs at foot (unless the lambs are also treated) or pregnant ewes within six weeks of lambing.

Check the LiceBoss website for information to assist in developing a lice biosecurity program to prevent new infestations.

### 4. Strategic and effective use of chemicals

When treatments are necessary, product labels should be read carefully and instructions followed exactly. Check your method using the LiceBoss Treatments DSS module to maximise the likelihood of eradicating an infestation.

Where treatments are required there are some other rules that can also be followed to minimise the likelihood of resistance.

**Rotate products from different chemical groups.** Use chemicals from different chemical groups for consecutive treatments. Treating repeatedly with a chemical from the same chemical group exerts heavy pressure for the selection of resistance.

**Consider flystrike chemicals.** Treatment for flystrike also exposes any lice present to chemical (see Table 1). That is, lice treatments can also select for resistance in sheep blowflies. If possible, use chemicals from different chemical groups for controlling lice and flystrike in the same year. Flystrike control products containing cyromazine and dicyclanil, which don't affect lice, are listed in the LiceBoss products module.

Table 1. Flystrike control products and their effect against lice

Chemical/Group	Products	Effect against lice
Cyromazine	Vetrazin; Venus; Virbazine; Young's Cyromazine; Exi-fly; Cyro-Fly; Cy-guard; Cyrazin; Cyromazine 500; Lucifly; Proguard	No
Dicyclanil	CLiK; Magik*	No
Organophosphate	DiJet	Yes
Synthetic pyrethroid	Vanquish	Yes
Insect growth regulator -diflubenzuron	Fleececare; Strike; Magik*; Magnum; Duodip	Yes
Spinosyn	Extinosad	Yes
Macrocyclic lactone	Paramax; Blowfly and Lice Jetting fluid	Yes

\* Magik contains both dicyclanil and the IGR diflubenzuron.

**Avoid using long wool treatments where possible.** Long wool treatments do not eradicate lice and may leave the more resistant ones to survive and breed. Consult the LiceBoss Long Wool module to help determine if a long wool treatment is necessary.

**Where a long wool treatment has been used, ensure that a chemical from a different group is used at the next shearing.** Using a chemical from a different group maximises the chance of killing any resistant lice surviving the long wool treatment.

## What to do if resistance is suspected

1. The first thing to do if you think that resistance may have caused a treatment breakdown is to do a complete audit of your lice control program, including both treatment method used and biosecurity measures. The Treatment DSS module in LiceBoss can assist with this.
2. If no other reason for the breakdown can be found, then resistance is a possibility.
3. If a long wool treatment is being contemplated, consult the LiceBoss Long Wool module to determine whether it is warranted and which chemicals can be used.
4. If applying a long wool treatment, use a product from a different chemical group to that last used.
5. If a long wool treatment is used, it will not eradicate lice and all sheep will need to be treated after their next shearing. Use a chemical from a different group after shearing.
6. If problems continue to arise and no reason can be identified, seek advice.

**Table 2. Chemical groups and products registered for lice control in Australia**

Chemical group	Chemical actives	Products	Resistance detected
Organophosphates	Diazinon	Eureka Gold	Low level and rare Check
Synthetic pyrethroids	Deltamethrin Cypermethrin Alpha-cypermethrin Cyhalothrin	Clout-S Outflank; Spurt; Cypercure; Vanquish	Widespread to all
Insect growth regulators	Diflubenzuron	Magnum; Fleececare; Strike; Magik; Stampede; Crusader; Duodip	Yes
	Triflumuron	Zapp; Triffic; Clipguard; Exilice; Epic; Virbac IGR Pouon; Cannon; Command; Triflumuron 25	Yes
Spinosyns	Spinosad	Extinosad	No
Macrocylic lactone	Ivermectin	Paramax; Coopers blowfly and lice jetting fluid	No
Other	Magnesium fluorosilicate, rotenone and sulphur	Flockmaster MkII; X-lice Washdown	No

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