



MANAGING CHEMICAL RESISTANCE

KEY POINTS

- Flystrike is estimated to annually cost the Australian sheep industry in excess of \$170 million in terms of production losses and prevention and treatment costs.
- Chemical resistance in blowflies is more likely to occur with long term use and over reliance on just one chemical group.
- There are only a limited number of chemical groups registered against flystrike so increasing chemical resistance will have a significant impact on the industry.
- There is an urgent need for sheep producers to strategically manage the use of chemicals to maximise flystrike control and to maintain the efficacy of available products on their property.
- When selecting chemicals you need to consider chemical groups for flystrike prevention, lice control and treating struck sheep.

CHEMICAL RESISTANCE

Lucilia cuprina, the Australian sheep blowfly, initiates most cases of flystrike on Australian sheep. Like all insect pests, it has the potential to develop resistance to insecticide (chemical) treatments.

Resistance is the decreased susceptibility of a sheep blowfly population to a chemical that was previously effective at controlling blowflies. When exposed to a chemical, the more resistant individuals may survive and pass on this resistance to their offspring. Over time the proportion of resistant flies in the population may increase.

Long-term use and over reliance on just one chemical group for any type of pest control almost always results in resistance if good resistance management plans aren't in place. Some of the chemical groups that we used to rely on for blowfly control, such as dicyclanil and cyromazine, are no longer as effective because blowflies are developing resistance to them.

Resistance doesn't mean that the chemicals have completely lost effectiveness, it just means that the period of protection may be less than what you previously expected or what is on the label.

THE IMPORTANCE OF RESISTANCE MANAGEMENT

It is estimated that flystrike causes annual production losses of approximately \$105 million and costs the industry \$65 million in prevention and treatment each year. The average cost of this per head is \$2.37 annually.

Flystrike also has a significant impact on the welfare of sheep causing severe pain and suffering.

There are only a small number of chemical groups registered for flystrike control. It is important to prolong the usefulness of these chemicals on your property for as long as possible. By implementing resistance management strategies, sheep producers can slow the development of resistance, which will help maintain the effectiveness of the currently registered chemical products.

SIGNS OF RESISTANCE

Signs that indicate you may have resistance are:

- a shortening of the protection period (that is specified on product labels); or
- flystrike in multiple sheep that have been treated with the same chemical rather than just in a few sheep.

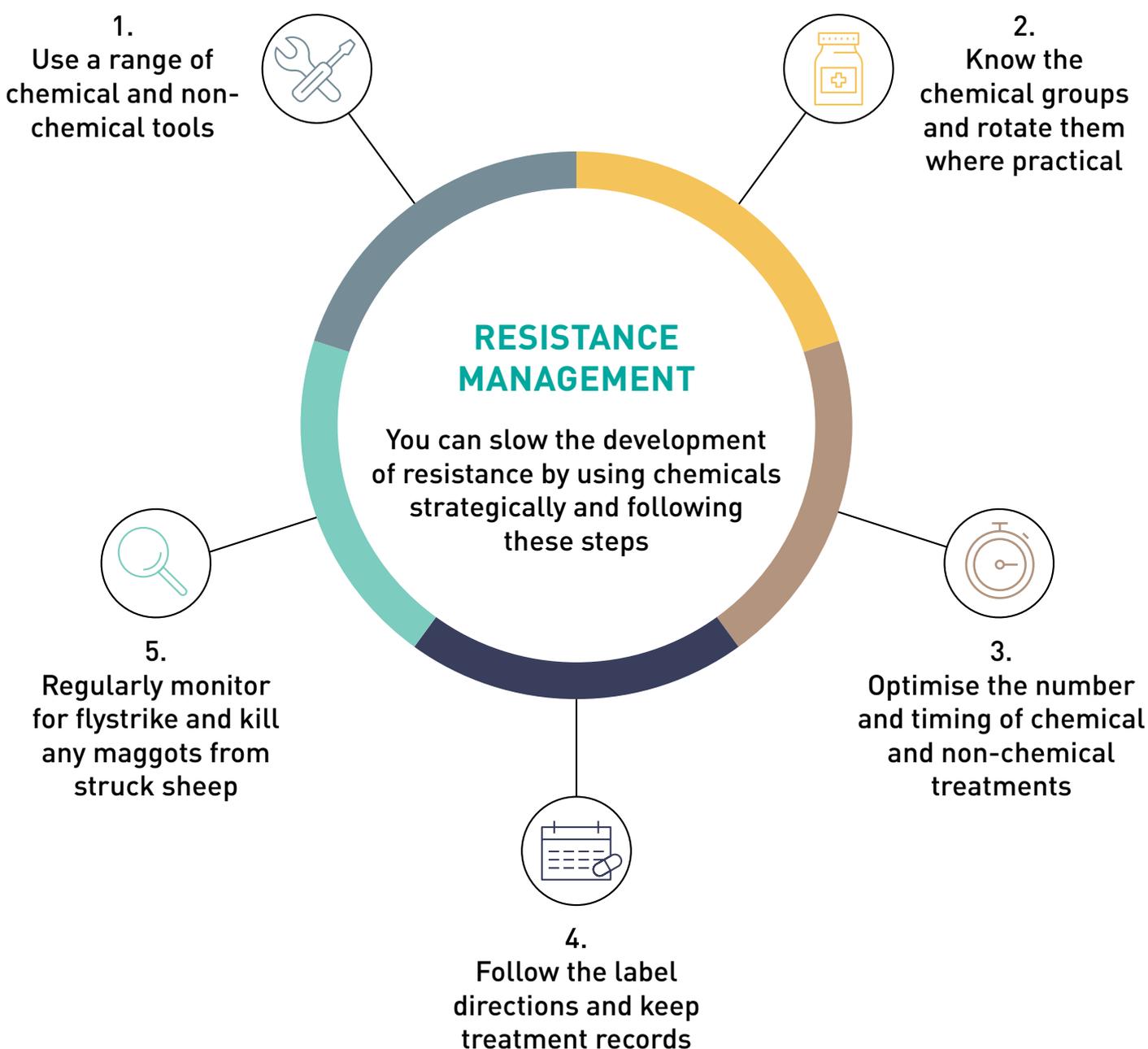
There are many factors that influence the protection period achieved on farm, so before you conclude your flies are resistant, check that:

- the sheep affected were actually treated;
- the chemical was applied following the label instructions and with the right equipment;
- the appropriate amount of chemical was applied;

- the wool length was adequate to retain the treatment;
- wool or dags did not make penetration of the chemical difficult; and
- there was not heavy or persistent rain following treatment, resulting in chemical wash out.

If these factors have been eliminated, you should arrange for a resistance test by contacting:

Narelle Sales
Elizabeth Macarthur Agricultural Institute
Email: emai.insectresistance@dpi.nsw.gov.au
Direct Ph: 02 46 406 446
Switch Ph: 02 46 406 333



STEPS TO TAKE FOR MANAGING CHEMICAL RESISTANCE

Key steps	What to do (and not do)
 <p>1. Use a range of chemical and non-chemical tools</p>	<p>Don't rely on only one tool to manage your flystrike risk – chemicals alone cannot prevent flystrike.</p> <p>Consider the timing of crutching, shearing, lambing, drenching and changes in diet to reduce the risk of flystrike. Even a small shift in when you carry out these activities can have a big impact.</p> <p>Ensure optimal tail length at marking to minimise the risk of urine stain and dag accumulation. Tail length has a lifelong impact on a sheep's welfare and its susceptibility to flystrike. The optimal length is immediately below the third or fourth palpable joint.</p> <p>In the long term, aim to select and breed sheep that are less susceptible to flystrike. A balance between improved production and reduced flystrike risk can be achieved through a good breeding plan.</p>
 <p>2. Know chemical groups and rotate them where practical</p>	<p>There are six chemical groups registered for use for blowfly control. Within these chemical groups there may be only one or two active chemicals but there may be multiple products marketed with different brands, names and formulations.</p> <p>Some chemical groups can only be used as dressings to treat struck sheep, others can be used as preventative treatments and some groups are also used to control lice in sheep.</p> <p>Not all chemical groups can be applied using the same method (such as spray-on, pour-on, jetting or dipping). The protection periods provided by each chemical varies depending on its formulation within a product.</p> <p>If the same chemical group is used repeatedly, resistance can develop in blowflies.</p> <p>Always aim to use different chemical groups within the season if more than one treatment is required. When selecting chemicals to use you need to:</p> <ul style="list-style-type: none"> • Consider the chemical group that was last applied (either earlier this season or at the end of the previous fly season) and where practical, avoid using a chemical from the same group next. • Consider the chemical group that was last used to control lice and avoid using a chemical from the same group for the next preventative flystrike application in the same season. • Consider the chemical groups that were last applied to prevent flystrike and avoid using these as a dressing to treat struck sheep this season.
 <p>3. Optimise the number and timing of chemical and non-chemical treatments</p>	<p>When planning how you will manage your flystrike risk, consider the best combination and timing of all activities to extend the protection period. This will likely result in a staggered approach to preventative activities during the season rather than a 'once only hit'.</p> <p>Non-chemical tools such as shearing and crutching should be combined with chemical methods as required to reduce the incidence of flystrike during high-risk periods.</p> <p>You also need to keep in mind appropriate wool length, withholding periods and intervals, including the wool harvesting interval, associated with each product. Plan chemical treatments and other activities, such as shearing, crutching and slaughter of sheep, with these in mind.</p>

STEPS TO TAKE FOR MANAGING CHEMICAL RESISTANCE

Key steps	What to do (and not do)
 <p>4. Follow the label directions and keep treatment records</p>	<p>The protection period provided by chemicals can be dramatically reduced if they are not used properly. Don't rely on your memory of how to apply chemicals – check the label carefully every time. Also check that anyone applying chemicals to your sheep knows what to do.</p> <p>Make sure you:</p> <ul style="list-style-type: none"> • Use the right chemical group for the task. Chemicals used to treat flystrike as a dressing do not always prevent flystrike. • Use the recommended applicator, checking it works properly and is calibrated to deliver the right dose. • Apply the right dose and use the right dilution if relevant. • Apply the product to the wool length prescribed on the label instructions. • Apply the chemical using the recommended application pattern on each animal (there may be different patterns depending on the type of strike you are aiming to prevent). • Keep records on what chemical has been used on each mob of sheep (including lice treatments) to help you rotate the chemical groups used. <p>Anyone handling chemicals should undertake a chemical users' training course.</p>
 <p>5. Regularly monitor for flystrike and kill any maggots from struck sheep</p>	<p>Regular and rapid identification of flystrike is important to ensure effective treatment and to prevent further flystrike in the flock. The aim is to detect and treat strike as early as possible to minimise pain and suffering and reduce the fly population. If left unattended, flystrike can cause severe illness and death.</p> <p>Keep an eye out for flystrike regardless of time of year. During certain months, regular monitoring of sheep for flystrike should occur. At these times, remember to look for covert strikes which may develop into more severe cases. This can be carried out if you are handling or moving sheep.</p> <p>Monitoring is not just about detecting flystrike, it's also about keeping a check on current and forecast weather conditions, the presence of flies and the susceptibility of sheep to flystrike. This will give you the jump to implement some of your tactical activities to prevent flystrike.</p> <p>Treat any struck sheep as soon as possible. Make sure any maggots that are removed from struck sheep are collected and killed to prevent them from developing into the next generation of blowflies, some of which may be resistant to chemical treatments. Fly numbers can increase quickly and dramatically if maggots are not controlled.</p>

FREQUENTLY ASKED QUESTIONS

Q. ARE SHORTER PROTECTION PERIODS ALWAYS BECAUSE OF RESISTANCE?

A. Shorter protection periods provided by chemicals than those described on the label are often interpreted to be chemical resistance, but there are many factors that influence the protection period achieved on farm. Before you conclude your flies are resistant ask yourself the following questions:

1. Were the struck sheep more susceptible to flystrike because of heavy dags, urine stain, fleece rot, lumpy wool or other characteristics?
2. Did dags make penetration of the chemical difficult?
3. Was the wool length consistent with label instructions for application?
4. Was there persistent or heavy rainfall following treatment, resulting in chemical wash out or increased fly pressure?
5. Were the struck sheep actually treated?
6. Did you check the label instructions carefully before applying the chemical, paying particular attention to dosage, patterns of coverage, recommended applicator and whether the treatment should be applied off-shears or to longer wool?
7. Was the applicator calibrated and working properly, with no blockages or leaks?

If you answer 'yes' to any of the first four questions or 'no' to any of the last three questions, something other than chemical resistance may be reducing the protection period or the effectiveness of the chemical.

Q. HOW WILL I KNOW IF CHEMICAL RESISTANCE IS OCCURRING ON MY FARM?

A. There are a number of ways insects can develop resistance to a chemical, with different resistance mechanisms resulting in different observable symptoms. If you have not had any lab tests done, have you noticed that:

- some or all of the maggots survive knock-down chemicals and appear like they haven't been treated, despite high confidence that the chemical treatment has been thoroughly applied; or
- the residual period of protection appears to be getting shorter than it was over past fly seasons, despite no change in application rate, correct application and no significant differences in season outlook or fly pressure.

Growers noting either of these symptoms should urgently arrange for a resistance test.

Q. CAN I USE LESS OR MORE CHEMICAL FOR EACH APPLICATION?

A. Overdosing and underdosing can contribute to resistance. It is important to apply the correct dose to animals with the proper equipment that has been calibrated using the appropriate application pattern. This information can be found on the chemical label.

Q. SHOULD I JUST STOP USING CHEMICALS?

A: Resistance doesn't mean that the chemicals have totally lost effectiveness, it just means that the period of protection may be less than what you previously expected or what is on the label, and protection periods may also vary between properties.

Chemicals still remain an effective option for flystrike prevention and treatment. If you have treated sheep, even if they are within the protection period, you should continue to actively monitor them for signs of flystrike and treat them accordingly if they do become struck.

Q. IF FLIES ARE RESISTANT TO ONE CHEMICAL, WILL ANOTHER CHEMICAL KILL THEM?

A. This depends on whether the chemicals are within the same chemical group. There is cross-resistance between chemicals within the same group; however, rotating between different chemical groups should be effective.

Q. HOW DO I ROTATE MY CHEMICALS?

A. Rotation of chemical groups will help to prolong the usefulness of chemicals as one tool to combat flystrike. There are three things to consider when rotating chemicals:

1. Consider the chemical group that was last applied (either earlier this season or at the end of the previous fly season) and where practical, avoid using a chemical from the same group next.
2. Consider the chemical group that was last used to control lice and avoid using a chemical from the same group for the next preventative flystrike application in the same season.
3. Consider the chemical groups that were last applied to prevent flystrike and avoid using these as a dressing to treat struck sheep this season.

FREQUENTLY ASKED QUESTIONS

Q. WHAT CHEMICALS CAN I USE IN MY ROTATION?

A. There are six chemical groups available for use to prevent or treat flystrike. Within these chemical groups there may be only one or two active chemicals but there may be multiple products marketed with different brands, names and formulations.

You need to read the label to determine the chemical active and rotate based on the chemical group that the active belongs to as shown in the table below.

Chemical group	Chemical active
Organo-phosphates (OPs)	Diazinon
Synthetic Pyrethroids (SPs)	Alpha-cypermethrin (body strike only)
Neonicotinoids	Imidacloprid
Spinosyns	Spinosad
Macrocyclic Lactones (MLs)	Ivermectin
Insect growth regulators (IGRs)	Cyromazine [#]
	Dicyclanil [#]

[#]There is some cross resistance between these.

Rotating based on the group rather than the active or product name is important as some actives like cyromazine and dicyclanil are part of the same group and have cross resistance between them. Product names will be different, but the actives may be the same.

The protection periods provided by each chemical varies depending on its formulation within a product. In some cases, the strength or concentration of the chemical active may be different between products as well.

Not all chemicals can be used the same way, some can be used for dipping, some as a spray or pour-on, some for jetting and some are used to treat struck sheep. Some formulations can be used on different wool lengths or off-shears, and some have formulations that can also be used to control lice.

USEFUL RESOURCES

For flystrike control information visit the FlyBoss website www.flyboss.com.au

Insecticide resistance www.flyboss.com.au/treatment/insecticide-resistance.php

Breeding and selection www.flyboss.com.au/breeding-and-selection.php

Treatment www.flyboss.com.au/treatment.php

Management options www.flyboss.com.au/management.php

ParaBoss Products Search tool www.flyboss.com.au/tools/products.php

Flystrike decision support tools, customised to your location www.flyboss.com.au/sheep-goats/tools.php

AWI also has a range of resources to help you manage flystrike on your property, available at www.wool.com/flystrikeresources

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FLYSTRIKE PREVENTION AND TREATMENT CHEMICAL GUIDE

The table below is a guide only and summarises information specific to flystrike prevention and treatment only. Not all products containing the following chemical actives are registered for use in flystrike control. It is important to read the label for full details about the products' permitted use for flystrike control, application method, wool length, label protection period and withholding periods or intervals.

✔ Chemical is registered for use in flystrike control based on the application method
 ✘ Chemical is not registered for use in flystrike control based on the application method
 ⚠ Consider your chemical rotation strategy when using products that have formulations for both fly and lice control

For treating struck sheep, use a different chemical group from the one used for long term protection from flystrike.

Chemical Group	Chemical active	Application method for fly ¹			Label protection period ²	Withholding periods/ ³ Intervals (in days) ⁴	Formulation available for lice control ⁵
		Pour/Spray-on	Jetting	Dipping			
Organo-phosphates (OPs)	Diazinon	✘	✘	✔	Not specified	SR: 42 WH: 60 ESI: 21	⚠
Synthetic Pyrethroids (SPs)	Alpha-cypermethrin (body strike only)	✔	✘	✘	Up to 10 weeks	SR: 14 WH: 60	⚠
Neonicotinoids	Imidacloprid	✔	✘	✘	Up to 10 weeks OR Up to 14 weeks ⁶	SR: Dry WH: 60-180	⚠
Spinosyns	Spinosad	✘	✔	✔	4-4 weeks as preventative application	SR: Dry WH: 6	⚠
Macrocyclic Lactones (MLs)	Ivermectin	✘	✔	✔	Up to 12 weeks under low to moderate fly pressure	SR: Dry WH: 42	⚠
Insect growth regulators (IGRs)	Cyromazine [#]	✔	✔	✔	Up to 12 weeks spray/pour on Up to 14 weeks for other methods	SR: Dry WH: 60	⚠
	Dicyclanil [#]	✔	✘	✘	12 Up/L, Up to 11 weeks 50g/L, Up to 29 weeks	SR: Dry WH: 20-90	⚠

SR: Sheep Retarding Interval; WH: Wool Harvest Interval; WPH: Withholding Period (week/interval); ESI: Export Slaughter Interval

¹ Application method, appropriate wool length and protection period must be verified on label. ² Some chemical sub-groups may also be used in products for lice control and this should not be taken to mean that the product formulation or application method for flystrike control is the same as for lice control. ³ Different label protection periods depend on wool length - carefully check product labels before use. ⁴ Although cyromazine and dicyclanil are different chemical actives, there is a strong cross-resistance between them. ⁵ ESI refers to withholding or formulation applied - carefully check product labels before use.

ALWAYS READ AND FOLLOW THE PRODUCT LABEL Visit www.flyboss.com.au for more information on flystrike management

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AWI has developed a handy one-page guide that can help you consider which chemicals to use for flystrike prevention and treatment. It can be downloaded from www.wool.com/flystrikeresources or the FlyBoss website www.flyboss.com.au.

Q. CAN I MIX CHEMICALS TOGETHER?

A. Apply chemicals strictly according to label directions. Do not mix two or more chemical products as such combinations will not have been tested for efficacy or safety. Even if they are the same chemical active, they may be different strengths. It is unnecessarily expensive and does not improve the effectiveness of the chemicals.

Q. WHY IS IT IMPORTANT TO DESTROY MAGGOTS ON STRUCK SHEEP?

A. Maggots removed from the sheep are often not killed by the treatment, particularly when some resistance is already present. If maggots are not collected or destroyed the most resistant ones can burrow into the soil, complete development and contribute to the next generation of resistant flies.