Sheep lice treatments—chemical group characteristics

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In 2013, available lice treatment products fall into seven chemical groups. This means that there are seven different modes of activity available from which products can be selected to combat sheep lice. Product choice for successful louse treatment will also be determined by factors such as the formulation available, label registration for length of wool application, resistance status of the lice being treated, safety considerations, environmental impact and residue requirements.

Chemical group characteristics

Pesticide activity against sheep lice is defined by specific modes of action. Fundamentally, there are fast-acting pesticides (usually nerve poisons) and slow-acting pesticides such as insect growth regulators. In both cases, lice must contact and/or ingest the compound to be affected. Formulation type can influence the rate at which pesticides control lice. For example, even though fast-acting pesticides such as pyrethroids, neonicotinoids and organophosphates can kill lice within a few hours of contact, when applied as a backline up to six weeks may be required to kill all lice due to the time required for the pesticide to spread over the sheep.

Information about the different chemical groups is provided below and a listing of the different products within each group can be found in the Products Tool.

Neonicotinoid (Imidacloprid)

This fast-acting group of pesticides selectively acts on the central nervous system of insects by binding to nicotinyl receptors causing disruption of normal nerve transmission within the insect's central nervous system. The result of this disruption is louse paralysis and death.

Spinosyn (Spinosad)

These fast-acting compounds cause involuntary and prolonged tremors in the insect nervous system bringing about irreversible paralysis and death. Spinosyns exert negligible human health risks or environmental toxicity.

Organophosphate (OP: temephos, diazinon)

OPs kill insects by altering normal neurotransmission. OPs cause accumulation of acetylcholine (ACh) by blocking the enzyme (acetylcholinesterase), which normally breaks down this neurotransmitter. ACh is common to both insects and mammals and as a result, OPs are inherently toxic to humans. A review of diazinon product registrations in 2007 identified diazinon exposure during sheep dipping and jetting to be an unacceptable hazard to human health. Product re-labelling in 2009 subsequently disallows diazinon use for flock treatment by jetting or dipping except under the conditions of APVMA *Permit Number 12555,* and only specifically in the Richards submersible cage dip. One spray-on formulation containing diazinon for louse control is also still available.

Macrocyclic lactone (ML: abamectin, ivermectin)

MLs have potent broad antiparasitic spectrum against both nematodes (intestinal worms) and arthropods (e.g. insects) at low dose levels, and there is generally a wide margin of safety to mammals. MLs are fast-acting compounds that bind to glutamate-gated chloride channel receptors in nerve cells. The resultant sustained channel opening allows influx of chloride ions and paralysis of the louse neuromuscular system.

Magnesium fluorosilicate/sulphur (MgFSi, sulphur, rotenone)

This dip product causes rapid and severe desiccation of lice. The formulation can be difficult to keep in suspension; so high volume re-circulating pumps are required to prevent settling of product in dips. The label also claims activity against itch mite *(Psorobia ovis*) and an aid in the control of mycotic dermatitis. The product label includes a special note: Biodynamic Farmers Association approved and registered.

Insect growth regulator (IGR: diflubenzuron, triflumuron)

This pesticide group interferes with the production of chitin and insect growth and development. Chitin is the compound insects use to make their exoskeleton. Consequently, IGRs are slow-acting compounds that eliminate lice infestations over many weeks. They interfere with insect moulting thereby preventing insect development and viable egg production. As adult lice do not moult, they are not killed by IGRs and it can take up to 18 weeks for all adult lice to die. As these pesticides work on enzyme pathways that only occur in insects, they are less toxic to other organisms, including people.

Synthetic pyrethroid (SP: cypermethin, alphacypermethrin, deltamethrin)

SPs are very fast-acting pesticides. SPs affect the axons of nerves causing paralysis of target organisms by keeping sodium channels open in the nerve membranes. The resultant constant nerve excitement eventually causes insect paralysis. Pyrethroids can cause eye and skin irritation in some humans, but are generally regarded as compounds of low-toxicity. SPs resist degradation by light and air and so persist in the environment. This persistence has been a concern in UK wool scour plants.

Other Considerations

Louse resistance

Resistance is known to have developed to pyrethroid and to IGR pesticides in some sheep lice populations. These pesticides will not adequately control populations containing pyrethroid- or IGR-resistant lice. Resistance to either group is not restricted to any particular geographic region. Resistance can be suspected in pyrethroid treated sheep if live lice are present later than 6 weeks post-treatment. Resistance to IGRs should be suspected if live immature lice are seen on sheep later than about 10 weeks after treatment.

Use of products that treat lice and worms

Maverick® contains abamectin (an ML), which is also a widely used drench for intestinal parasites in sheep. When applied as a backline lice treatment, abamectin will move into the bloodstream and affect sheep worms as well. Abamectin remains an important drench chemical, although resistance in worms has been reported in all Australian States. If considering using abamectin for lice control, producers should consider the possible impact of this treatment on their drench resistance management strategy.

Withholding period/export slaughter interval restrictions

- The **Wool Harvesting Interval (WHI)** is defined as the time from application of a chemical to when the wool is shorn (also includes crutching).
- The **Meat Withholding Period (WHP)** is the time from chemical application to when an animal is slaughtered for domestic use.
- The **Export Slaughter Interval (ESI)** is the time from chemical application to when an animal is slaughtered for export.

The meat WHP appears on all labels, while the ESI may not appear on labels of older products. However, all new products will now include the ESI. Where an ESI is not on the product label, it can be

found on the current version of the National Sheep Vendor Declaration, the APVMA website or Meat and Livestock Australia website.

Consignments will be rejected at abattoirs where insufficient time has been allowed between treatment and slaughter as food safety regulations may be breached. Before applying a chemical it is essential that you check for compliance with the ESI. You are assuring compliance when you sign your name to the National Vendor Declaration used when selling sheep. If a trading partner detects a chemical residue, Australia's trade in animal products may be jeopardized.

Wool residues

Most off-shears and short wool treatments do not cause unacceptable residues in wool when it is scoured. The greatest residue risk occurs when pesticides are applied to sheep in long wool. This is because residues in long wool have had less exposure to natural degradation. It is a legal requirement to comply with the withholding intervals listed on product labels. However, to access some markets, more rigorous requirements apply for some treatments. Use the Residues Tool and see the Wool and meat residues LiceBoss Note for further information.

Mixing chemicals or altering chemical concentration

Under no circumstance should products be mixed or label rates altered in an attempt to improve the effectiveness of lice control. There are many different effective products from a number of different chemical groups currently available on the market. Mixing chemicals or increasing rates will not make up for a failure in lice biosecurity or inadequacies in application technique. Registered chemicals have undergone stringent testing in their registration process to ensure that correct application under field conditions will achieve the lice control stipulated on the label.

Mixing products increases cost, and carries an uncalculated residue burden. More generally, it represents unnecessary chemical use, and increases both human exposure and spent chemical. Altering chemical concentration without the written advice of a veterinarian is an illegal use.

Minimising use of chemical and Integrated Pest Management (IPM)

As a general principle, it is not appropriate to treat for lice every year just in case lice are present. Decisions around whether to treat or not should be based on structured monitoring for the presence of lice and what is known about the potential for the presence of lice in a flock. Factors to consider include the previous lice and treatment histories of the flock, the chance that strays may have entered the flock, other known biosecurity breaches and the likelihood of any previous treatment failure.

Regular thorough inspections of individual sheep, particularly any showing signs consistent with lice infestation, provides the best indication of whether sheep need to be treated. Unnecessary flock treatments are costly and increase the risks of resistance, residues, human exposure and environmental contamination.

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