

The use of spinosad in integrated pest management systems. The tactical control of blowfly strike and salvage treatment of lousy sheep with long wool.

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Summary

The application of 25 ppm spinosad to sheep with any length wool, does not lead to harmful residues in wool or meat or OH&S concerns for shearers. Spinosad kills lice quickly and thus rapidly halts the wool disruption caused by lice in sheep with any length wool. A farmer can confidently choose not to treat sheep considered to be lice-free after shearing knowing that if fleece derangement due to lice should occur sheep can be treated with spinosad anytime before shearing and have no problems with wool residues. Spinosad applied by hand jetting cures fly strikes, prevents further infestation of treated wounds or new strikes for 4 to 6 weeks. It is best used tactically in the face of a flywave. In situations where fly waves do not occur predictably every year tactical use of spinosad only when required obviates the need for preventative treatments. It is also very effective as a flystrike dressing at 25 ppm and as a mulesing dressing at 125 ppm.

Keywords

Spinosad, Extinosad, lice, flies

Introduction

Extinosad® is 25 g/L suspension concentrate formulation of spinosad launched by Elanco in Australia in late 2000. It is diluted 1:1000 in water and applied to sheep via a jetting handpiece to control lice and flies or poured into flystrike wounds. Extinosad® is the first global animal health product to utilise the activity of spinosad. Spinosad is a naturally occurring mixture of two active components, spinosyn A and spinosyn D. It is produced by the soil dwelling actinomycete, *Saccharopolyspora spinosa* discovered by Lilly scientists in the early 1980s. Structurally, spinosyns and their synthetic derivatives, known as spinosoids, are macrolides, based on a unique tetracyclic ring system to which two sugars are attached (Kirst *et al.*, 1991). Spinosyns bind to a novel site on the nicotinic acetylcholine receptors in the insect central nervous system leading to neuronal depolarisation, excitation, paralysis and death.

Spinosad has very low mammalian toxicity, is safe for shearers and operators and is relatively safe to the environment (Crouse and Sparks, 1998). Spinosad breaks down quickly in the wool (Russell *et al.*, 2000) leading to low wool residues but a briefer protection period against re-infestation than more persistent molecules. Such characteristics are very useful in sheep with long wool where other products leave unacceptable wool residues at shearing time. This paper summarises the safety, tissue and wool residues and efficacy of spinosad. The usefulness of Extinosad® in management programmes against sheep lice and blowflies is explored.

Overview of Extinosad®

Occupational health and safety

Shearers are the occupational group most at risk from chemical residues in the wool, because of their daily exposure to wool grease over the front of their bodies. Jetting contractors are the group most at risk to pesticide concentrate and diluted jetting fluid. Farmers are also at risk, especially to wound dressing products which are usually applied without wearing protective clothing. Margins of exposure (MOE) are the parameters used to assess risk from

chemicals. For toxicity data generated in animals a MOE of > 100 is required by the National Occupational Health and Safety Commission (NOHSC).

Shearers

NOHSC have prepared guidelines to calculate MOEs for shearers and they are currently based on the very conservative estimate of daily exposure to 22.5 g wool grease per day. Calculations have been made for the amount of spinosad contained in the wool grease of sheep jetted the day before shearing with 25 ppm spinosad. NOHSC assumed that 10% of the pesticide in the grease is absorbed. For a 70 kg shearer a MOE of 1260 is derived. If a more realistic amount of wool grease is assumed adherent to the skin and Elanco's estimates of 1% dermal absorption based on animal studies are used the MOE is > 1,000,000. If the sheep are left for more than a day after treatment before shearing, the spinosad residues decay and the MOE is even higher.

Jetting and dipping plant operators

Concentrate: NOHSC have assessed that there is minimal risk of exposure to quantities of spinosad leading to acute toxicity, although the concentrate could irritate the eyes. However the safety instructions on the label require the use of gloves, hat and overalls, which is good agricultural practice.

Diluted fluid: Extrapolation was made from the work of Smith *et al.* (1998) who measured exposure to 100 ppm diazinon in shower dips to assess the risk from spinosad in a shower dip as a worst case exposure exercise. Using 25 ppm spinosad, 10% dermal absorption and the lowest chronic no observable effect level (NOEL) available, a MOE of >200 was obtained. If the 1% dermal absorption figure was used the MOE was >2000. Exposure to spinosad from a jetting plant is likely to be lower than from a shower dip. Exposure following use as a wound dressing would be lower again.

Tissue residues

Forty Merino sheep in nine months wool were hand jetted with 5.1 L of 25 ppm spinosad. Groups of 5 sheep were slaughtered 5, 12, 15, 21, 39 and 56 days later. Spinosad residues were not detected in muscle or kidney. One liver only had a trace of spinosad (< limit of quantification) 12 days after treatment. Perirenal and back fat samples had trace residues (< LOQ) at 5, 12 and 15 days after treatment and were not detectable 21 days after treatment and later. Currently there is a nil withholding period following treatment for domestic consumption and export (0 ESI).

Wool residues and environmental impact of wool scoring effluent

This data has been presented by Russell *et al.* (2000) and the summary is presented here for convenience:

"Spinosad degrades rapidly on wool when it is applied to sheep as a jetting formulation (25 mg/L jetting fluid concentration), even when the sheep have 9 months of wool growth. The degradation rate under these conditions (mass-based half-life of 30 days) was substantially faster than for equivalent treatments for current ectoparasiticides applied under these same conditions. The average residues on band samples taken 1 day after treatment were 8 mg/kg, degrading to 0.7 mg/kg after 12 weeks."

On the basis of a pilot-scale scouring study, and using bioassay data supplied by Elanco, acceptable average wool concentrations for wool processing lots in UK and maximum processing lot concentrations in Australia of 15 mg/kg and 66 mg/kg have been tentatively and conservatively established. However these numbers need to be verified after a detailed assessment by regulatory authorities. When market share arguments are taken into account, acceptable

concentrations of spinosad on farm lots can be much higher, provided they are randomly blended with other wool lots.

Together, these sheep and scouring studies demonstrate that the average and maximum acceptable environmental concentrations of spinosad are unlikely to be encountered on single farm lots of wool from sheep treated late in the growing season, even if the wool is harvested immediately after treatment.”

Based on this work, Extinosad® has been granted a nil wool with-holding period.

Farm environmental impact

Spinosad adsorbs to soil and does not leach into waterways or ground water. There is rapid photodegradation of spinosad in the environment as well as aerobic and anaerobic microbial decay. Therefore spinosad does not accumulate in the environment, presents no risk for vertebrates or aquatic environments and has a transient effect on insects that come into contact with jetting fluid.

Efficacy

This data has been presented by Rothwell et al. (2000) and the summary is quoted here for convenience.

“25 ppm spinosad was applied by hand jetting to 5718 lice-infested Merino sheep with 4 to 9 months wool growth at 7 trial sites in Australia. At one of the sites 25 ppm spinosad was also applied by an automatic jetting race to 1013 Merino sheep. Lice numbers were reduced by 88 to 99% 1 month after application of 25 ppm spinosad. Lice numbers were reduced by 79 to 97% 3 months after jetting and by 70% 3 months after spray race treatment. Rubbing and chewing had not returned in flocks 3 months after treatment. Six months after treatment fleece damage and lice numbers were still lower than at treatment in 2/3 studies but were higher in one study. For sheep 6 months or more from shearing a second treatment maybe required.

A total of 1578 Merino sheep and 300 Romney sheep were jetted with 25 ppm spinosad to treat and prevent fly strike. 25 ppm spinosad when applied to flystrike wounds as a jetting fluid or individual wound dressing was effective at killing maggots, allowing healing of the wound and preventing re-strike requiring treatment in all but 3 of 248 treated wounds. Spinosad applied at 25 ppm to Merinos gave complete protection against strike for 4 weeks and only 3 cases of flystrike were seen in 1578 sheep (0.2%) 6 weeks after treatment. Protection lasted for between 2 and 3 weeks following treatment with 25 ppm spinosad in the coarse wool Romney breed.”

Recent studies have shown that application of 40 to 80 ml of 125 ppm spinosad to the wool around mulesing wounds gives good protection against flystrike and fly worry and is superior to a commercial fly dressing.

Use of Extinosad® in lice control programmes

A great deal has been written in the last five years about residues of pesticide in wool after treatment for lice and Integrated Pest Management (IPM). To illustrate the views of opinion leaders reference is made to the Australian Wool Innovation Limited website (www.cleangreenwool.com), Lice and Fly Control Technotes. There are two main themes:

- i) Reduce the overall use of chemicals and time their application relative to shearing to protect and enhance export opportunities for low residue Australian wool (Williams and Brightling, Technote 1; Brightling, Technote 2).

- ii) Utilise chemicals within a well designed programme to give effective and sustainable control of lice, minimise selection for resistance (Karlsson, Technote 8) and ensure human safety (Joshua, Technotes 5, 6 and 7).

Within the context of IPM the best solution is to eradicate lice by effective treatment of every sheep after shearing and prevent re-infestation by effective quarantine such as secure boundary fences, shearing and treating introduced stock etc. However as Dr Karlsson has put it (Karlsson, Technote 8) "Many farmers are apprehensive about giving up routine treatment as they fear finding lice in half wool sheep, and the fleece damage that could occur before the next scheduled shearing." Until recently the use of the registered products for long wool sheep, diazinon, diflubenzuron and alpha-cypermethrin, in the six months before shearing led to high wool residues with potential wool export and shearer OH&S problems. Extinosad® is very effective at reducing a lice population in long wool which leads to rapid cessation of fleece derangement, generally until the next shearing. Unlike diazinon, diflubenzuron and alpha-cypermethrin, spinosad can be used until the day before shearing and has no wool handling or harvest period restrictions. Therefore advisers can recommend no routine treatment at shearing in lice-free flocks confident that if undetected lice were present or if lice are introduced Extinosad® can be safely and confidently used at any time before shearing.

Use of Extinosad® as a tactical treatment in the face of a flywave

The preventative chemicals cyromazine and dicyclanil do not present a problem from a wool residue point of view. However diazinon is still used either alone or in a tank mix with cyromazine to treat existing strikes and prevent further strikes in the face of a fly wave, causing serious wool residue and OH&S issues. In some areas where heavy fly activity occurs in a predictable way each year, the routine use of a preventative is common sense. However in the context of IPM, where selection for reduced fleecesrot and improved body confirmation, mulesing and worm control to reduce breech strike and other ancillary measures such as fly trapping are practiced, the routine use of a preventative is counter productive and costly. Nevertheless an occasional warm, wet spring or autumn will cause problems in any system. It is suggested that spinosad fills that niche perfectly. If no routine chemical preventative is used and a fly wave does occur with clinical cases of strike, the sheep can be brought in and jetted with spinosad. This will cure existing strikes, prevent restrike and new strike for four to six weeks without causing wool residue or OH&S problems at any point until shearing.

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