

FLY ADVICE

A FARMER'S GUIDE TO
BLOWFLY CONTROL IN
SHEEP



Schering-Plough
Coopers
the animal health company

INTRODUCTION

Blowfly strike is a major animal health and welfare issue in New Zealand. With an estimated 5 percent of the national flock struck annually¹, there are also significant impacts on production and profitability of sheep farming through weight loss, fleece and pelt damage and deaths. Control of flystrike requires an integrated parasite management programme, managing stock and the fly population as well as the provision of effective chemical control. **Fly Advice** outlines the knowledge and best practice principles required for effective blowfly control and prevention of flystrike on your sheep farm.

GLOSSARY:

Technical terms in this booklet are explained in the glossary. Where a term is included in the glossary, this is indicated the first time it appears in the main text by printing in blue underlined type.

DISCLAIMER:

While every attempt has been made to ensure the information in this publication is accurate and up to date omissions or errors are possible and advances in knowledge occur. The author/publisher assumes no responsibility or makes any warranty for results obtained based on the contents of this publication.

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FLY SPECIES

Only four of the 52 species of blowfly in New Zealand regularly strike sheep:

- *Lucilia sericata* (Green blowfly)
- *Lucilia cuprina* (Australian sheep blowfly, a.k.a. Aussie green blowfly)
- *Calliphora stygia* (Brown blowfly)
- *Chrysomya rufifacies* (Hairy maggot fly)

AUSTRALIAN SHEEP BLOWFLY

The 'Aussie green blowfly' is thought to have been introduced to New Zealand in the late 1970s. Since that time its distribution has expanded from the north of the North Island to include most of the county as far south as Gore. The introduction of this species has been associated with an increase in the prevalence of flystrike, changes in the relative influence of individual primary blowfly species and an extension of the flystrike 'season'¹². Australian sheep blowflies preferentially breed on live sheep rather than carcasses, with around 70 percent of strikes occurring around the rump and breech.

An issue complicating the control of the Aussie fly is the development of [resistance](#) to organophosphate (OP) insecticides in some areas, with reports of shorter protection periods than in the past. Some resistance to the IGR diflubenzuron has also been seen in this species of blowfly.

OTHER BLOWFLIES

The other species of sheep blowflies in New Zealand tend to strike live sheep and carcasses equally. No evidence of resistance has been found in any of these species.

- Brown blowfly strikes all year round and may deposit live larvae.
- Green blowfly strikes mostly from December-March.
- Hairy maggot fly strikes mostly from January-March, is rare in the South Island and is mainly a secondary striker (usually strikes sheep that have been struck by other, primary strike flies)

BLOWFLY LIFE CYCLE

EGG LAYING

Sheep blowflies cannot lay eggs until after they have had a protein meal. This may be from a carcass or from dung. After feeding they mate and develop eggs. Depending on the size of the female, up to 200 eggs can be laid in a single batch. Sheep blowflies can live for over a month and produce two or three egg batches.

Blowflies have an extremely sensitive sense of smell, which is used by the females to locate susceptible sheep, before making visual contact.

When a susceptible sheep is found, the preferred egg laying site is located using taste receptors on the feet, mouthparts and the ovipositor (egg layer). The sheep's breech area is most commonly struck in lambs and ewes, but any part of the sheep can be struck.

Eggs can dry out and die very quickly unless kept moist and protected. There is safety in numbers and pheromones produced by the egg laying female attract other females. A susceptible sheep may have thousands of eggs laid on it over a short period.

LARVAL STAGE

Maggots about 1mm long hatch about 12 hours after eggs are laid. They feed in damp fleece, in [lumpy wool](#), [fleecerot](#) lesions, in and around wounds, or in dags. Under favourable conditions, maggots first moult about 18 hours after hatching so that they can continue growing.

After a second moult about 36 hours after hatching, the maggots are very active and feed voraciously.

During this period, maggots grow rapidly (they increase their bodyweight by five times in just 24 hours). Maggots can be fully developed 3–4 days after hatching.

PUPATION

At full size, the maggots are 12 mm long, creamy white and very active. They drop from the sheep and burrow into the top few centimetres of soil where they will pupate as long as soil temperature is high enough. During pupation, chemical changes in the maggot's skin transform it to a rigid barrel-shaped

puparium (cocoon). Inside the puparium, the maggot metamorphoses into a fly.

Under ideal conditions, an adult fly will emerge 12 days after the egg was laid.

OVERWINTERING

When the soil temperature is low (e.g. under 15°C for the Australian sheep blowfly), larvae that have dropped from the sheep halt development and overwinter in the soil. As the soil warms in spring, larval development gradually recommences. This overwintering population will emerge en masse in mid to late spring as conditions become warmer.

If the overwintering flies encounter susceptible sheep, the next generation will be much bigger. If conditions remain suitable for flystrike these flies will produce a population explosion, or flywave.

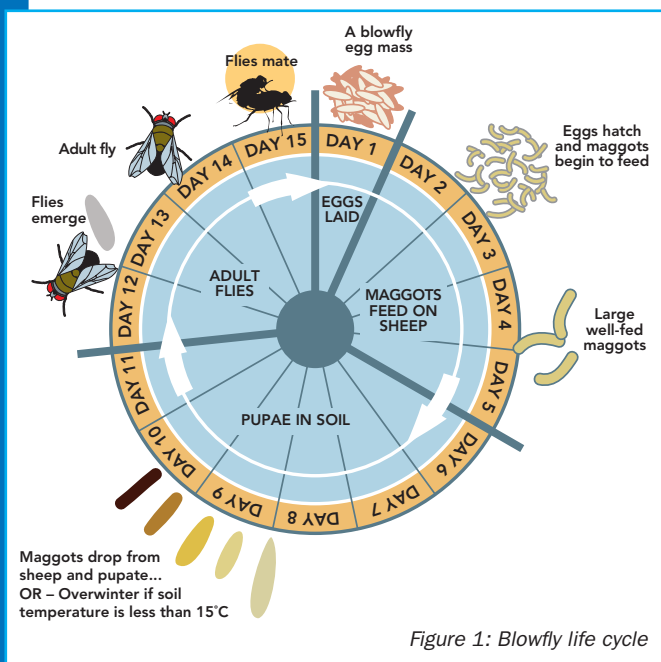


Figure 1: Blowfly life cycle

EFFECTS OF FLYSTRIKE

Once a sheep is struck, the infestation spreads rapidly. Even before the maggots start to burrow, their presence causes inflammation of the skin, loss of skin cells and oozing of protein-rich fluid. Burrowing maggots cause serious fleece and wool damage. Larvae vomit up stomach contents and the enzymes and acids digest tissue.

The intense irritation and inflammation causes the sheep to bite or rub the affected area leading to more damage. The damaged skin is very attractive to other female flies and even a small strike can rapidly escalate to become fatal.

Sheep become lethargic, stop eating and lose condition. Untreated, they will die from blood poisoning, skin and fluid loss.

Even in animals that survive there are reductions in wool growth, wool quality, weight gain and fecundity. Severe scarring seriously downgrades the value of the pelt.

FLYSTRIKE RISK FACTORS

During warm months, flystrike incidence depends mostly on the presence of susceptible sheep, not on the density of sheep blowflies in the area. As few as 7–10 blowflies per hectare are enough to cause extensive flystrike if susceptible sheep are present.

A number of factors act to make a sheep more attractive to flies and susceptible to flystrike:

SOILING AROUND THE CRUTCH (DAGS)

Faecal and urine staining occurs around the crutch area, especially in lambs. This predisposes the animals to breech strike. Larvae hatching from eggs laid onto dags will feed in the dags before moving onto the skin to feed. Urine staining around the pizzle of rams and wethers can also be attractive to blowflies.

FLEECE MOISTURE

Susceptibility to body strike is determined mainly by fleece moisture as eggs and maggots can dry out quickly if not kept moist and protected. Moisture can also make skin barriers easier to penetrate. Rainfall

and humidity are major factors in the susceptibility of sheep in New Zealand. Moisture at skin level can lead to moist dermatitis or bacterial or fungal infections in the wool (fleece rot). This, in turn, can cause serum to weep from the skin into the fleece. Blowflies find this highly attractive.

Lumpy wool also provides a prime site for blowflies to lay their eggs. Resulting maggots feed in the lumpy wool before invading the skin tissues. Wounds, tissue damage such as footrot, weeping eyes and sweat around the base of the horns of rams all make sheep susceptible to flystrike.

Contaminants in the fleece also increase the risk of flystrike and can reduce the effectiveness of chemical prevention methods..

CONFORMATION AND FLEECE CHARACTERISTICS

- body conformation can affect the ability of water to penetrate through the wool to skin level on the top of the body, rather than drain down the sides
- skin wrinkles can trap contaminants and provide a moist environment
- characteristics affecting ability to repel water and to dry out once wet, e.g. openness, [micron](#), staple length
- excess suint (part of the fleece secretion) production may also be associated with flystrike as this can dissolve the protective wax layer.

Age

- lambs are more susceptible than ewes.

Injury

- skin damage (e.g. cuts, grass seed infestation)
- shearing wounds
- photosensitisation (e.g. facial eczema)
- dog bites
- footrot
- scabby mouth.

Although these factors are important in the susceptibility of sheep, many sheep still get struck for no identifiable reason!

FLY CONTROL METHODS

INTEGRATED PEST MANAGEMENT

Alongside chemical control there are many methods that can reduce fly numbers and minimise susceptible stock numbers. These measures use knowledge about the fly biology and local area conditions and combine this with good husbandry.

Control other parasites: Control of nematode worm burdens and larval challenge to stock is important in reducing the formation of dags (a major contributor to breech strike). Other external parasites such as lice can lead to wool and skin damage, increasing susceptibility to flystrike.

Good feed management: Well fed sheep rotationally grazed are more resistant to strike and better able to cope with internal parasites.

Keep sheep clean: Use crutching and shearing strategically. Shearing helps prevent flystrike for a few weeks as the eggs and maggots dry out. Shearing can be an effective, short term, control measure in the face of fly challenge; this usually will reduce the need for chemical treatment for four weeks or more. Under very high challenge, however, animals may have to be treated off shears or soon after shearing. Care needs to be taken with shearing wounds as these are prone to flystrike.

Crutching and dagging are standard precautionary measures to remove soiled wool. Treatment of pizzle rot, fleece rot and [dermatophilosis](#) will reduce numbers of sheep at risk of flystrike.

Lambs' tails should be docked correctly – remove the tail at the third tail joint to leave about 6 to 7 cm. (This means the tip of the tail will cover the vulva in ewe lambs.) If docked too short, folds will form by the tail and increase faecal and urinary contamination.

Genetic selection: Cull sheep that are frequently struck, sheep affected by fleece discoloration and chronic dermatophilosis or daggy sheep. Source resistant breeding stock.

Dispose of all carcasses: This can reduce fly breeding. Minimising rotten vegetation can further minimise fly breeding grounds.

REDUCE EXPOSURE TO FARM HOTSPOTS

Some parts of the farm will have a higher fly challenge than others. These areas will be warm and sheltered such as bushy gullies, in the lee of shelterbelts and at the bush margin. Windy, open ridges will have the least fly challenge. Identify high-risk mobs (such as hoggets) and avoid placing them in high-risk paddocks.

MONITORING

By anticipating the strike season, protection strategies can be implemented early in the risk period. Assessing the weather conditions and the history of fly activity on the farm can be useful in predicting the fly challenge. Monitor traps can also give an early warning of increasing fly numbers and identify high-risk areas of the farm.

BAIT TRAPS

These are used to attract flies away from stock. They are a possible means of reducing the blowfly challenge to stock, although there is some questions raised about the attractiveness of these traps to the Australian sheep blowfly which can preferentially strike live sheep rather than offal baits..

TREATMENT AND PREVENTION: CHEMICALS

Insect growth regulators (IGR) kill immature insects by interfering with moulting. Adult flies and third stage maggots are not killed by IGRs. They are not generally recommended for the treatment of active strikes.

Four IGR actives are available in pour-on (e.g. MAGNUM®) or saturation products (e.g. BLITZ®). Two IGR [actives](#) (diflubenzuron and triflumuron) control both lice and flystrike and two (cyromazine and dicyclanil) are active against fly larvae only. IGRs pose little risk to humans or animals.

Macrocyclic lactones (ML) rapidly kill adult and juvenile parasites by acting on the nervous system. Primarily used in drenches, one ivermectin product (ERASE® MPC) controls blowflies and lice when

applied by jetting. As MLs produce low wool residues and pose little risk to humans they are useful when hand-jetting as it is difficult to avoid chemical exposure. ERASE MP is also useful in treatment of active strike lesions.

Synthetic pyrethroids (SP) kill adult and juvenile parasites by acting on the nervous system. SPs are virtually harmless to animals and people. Occasionally, some people suffer skin and eye irritation if they come in direct contact with SPs.

Organophosphates (OP) (e.g. SUPREME®) rapidly kill immature and adult parasites by inhibiting enzymes within the nervous system. OPs are poisonous to humans, either through swallowing or absorption through the skin. However, if personal safety recommendations are followed, they pose few risks.

Spinosyns (S) rapidly kill adult and juvenile parasites by acting on the nervous system. They pose little risk to humans or other animals and produce low residues in meat and wool. Spinosyns can be used to treat animals with flystrike but only provide short term prevention.

TREATMENT OF INDIVIDUAL STRUCK SHEEP

Treat struck sheep as soon as possible. Moist wool that is attractive to flies should be clipped away from the lesion. Do not shear the area, however, as this can irritate the skin and expose sensitive tissues to UV light. This can cause further damage and delay healing. The wound should be cleaned and maggots removed.

Insecticide should then be applied to the area and the removed maggots. Pre-mixed preparations are available to treat blowfly strike. Alternatively, dip chemicals can be diluted to the appropriate concentration (i.e. the same concentration they would be in the initial charge in a saturation dip).

The actives available include OPs, MLs (ERASE MPC can be used as a local application of ivermectin giving rapid kill of maggots with fewer concerns about human safety than OP products), spinosad and a ready-to-use SP spray.

APPLICATION METHODS FOR CONTROL

The aim of applying fly control chemicals is to achieve a high concentration in areas most at risk to repel flies and discourage oviposition (egg laying) as well as to kill maggots. It is important to read all labels and use products in accordance with the manufacturer's recommendations.

Timing is important. By dipping early in the risk period, losses are minimised and the build up in fly numbers can be reduced. Maintain a dip diary of treatment dates, mob details, wool length, chemical and application rates. It is a very useful reference for withholding times and dip failure investigations.

POUR-ON

Pour-ons (Table 1) are ready-to-use products applied by hand to the at-risk areas: the breech and along the back of each animal. Ease of use, low capital outlay and low sheep stress make pour-ons popular.

The main differences between pour-ons are found in the type and concentration of active ingredient and the type of *formulation* (aqueous or solvent). An aqueous formulation (e.g. MAGNUM) either suspends or dissolves the active in water. It tends to be less of an irritant to the skin and eyes and produces less vapour. Solvent-based formulations dissolve the active to make a solution.

Table 1:
Label claims for pour-on products sold in New Zealand.

Family	Active	Product	Conc (g/L)	Form*	Rainfast**	Meat WHP (days)	Lice & fly
IGR	Diflubenzuron	Magnum	25	Aq	yes	nil	yes
		Zenith Spray-on	20	Sol	no	7	yes
	Triflumuron	Zapp	25	Sol	yes	49	yes
		Epic ezy	25	Sol	yes	63	yes
		Clipguard	25	Sol	yes	63	yes
		Exit	25	Sol	yes	63	yes
	Dicyclanil	Clik	50	Aq	no	56 – Merinos 35 – Other	no
	Cyromazine	Vetrazin Spray On	60	Aq	no	21	no
		Cyrazin Spray On	60	Aq	no	21	no
		Cyrofly 60	60	Aq	no	21	no
SP	Cypermethrin	Cypor	12.5	Sol	no	7	yes
	Alphacypermethrin	Duracide	20	Aq	yes	21	yes
		Vanquish	50	Aq	yes	7	yes

* Form = formulation aqueous or solvent based.

** Can apply to wet sheep and rainfall after application will not effect action.

Table 2: Label claims for wet dipping products in New Zealand.

Family	Active	Product	Conc (g/L)	Meat WHP (days)	Lice & fly	Dilution ratio	
						CR Shower	Jetting
IGR	Diflubenzuron	Blitz	250	nil	yes	666	400
		Fleecemaster	250	nil	yes	666	400
		Zenith	250	nil	yes	666	400
		Ectoguard	250	nil	yes	666	400
	Triflumuron	Zapp jetting liquid	480	42	yes	nfu	1000
	Cyromazine	Vetrazin Liquid	500	7	no	500 - 1000	500 - 1000
		Cyrazin Liquid	500	7	no	500 -1000	500
Cyro-Fly 500		500	7	no	500	500	
OP	Chlorfenvinphos	Supreme DFF	1000	21	yes	1000	800
	Chlorpyrifos	Xterminate 10	100	21	yes	800	400
	Propetamphos	Enkamphos 1250	360	14	yes	2000	800
		Enkamphos 500	160	14	yes	800	n.c.
	Diazinon	Topclip 40	400	21	yes	2000	1000
	Coumaphos	Asuntol Liquid	160	7	yes	625	nfu
S	Spinosad	Extinosad	25	nil	yes	1250	1000
ML	Ivermectin	Erase MPC	16	7	yes	nfu	500

nc: no claim. nfu: not for use

Check the delivery of applicators and drench guns by filling with product and sealing the nozzles. With proper seal integrity, it should be impossible to compress the trigger.

Calibrate by setting the gun and squeezing a number of doses into a graduated measuring cylinder.

For products that provide both lice and fly control there will be a different dose rate for each. Depending on brand, products are 'sprayed' using a nozzle or 'poured' using a T-bar.

In larger flocks, for ease of application, powered applicators such as the Genesis Power Doser with T-bar can be used. Note this equipment requires additional checks.

WET DIPPING

Wet dipping is the application of diluted dip products (Table 2) by either saturation (plunge or shower) or jetting (hand or jetting races).

The aim (with the exception of plunge dipping) is to deliver large droplets of dipwash vertically to the back and to the breech area. The dipwash penetrates between the wool fibres to the skin – there is not the same requirement to saturate to skin level around the entire body as there is with lice treatment. However, for the maximum length of protection when wet dipping, the skin should be wet in the target areas. For requirements for wet dipping for lice control refer to Schering-Plough Coopers' LICE ADVICE booklet.

To check adequate wetting has occurred, test some of the first few sheep dipped. Part the wool along the back straight after dipping and draw a line on the skin using an indelible pencil. If the ink runs, the skin is wet. If a single line remains, the skin is dry.

The working volumes of supply (reservoir) tanks, sumps and plunge dips must be known accurately. Volume can be measured by adding water from a 500-litre container, use of a water meter or by calculation (Fig. 2).

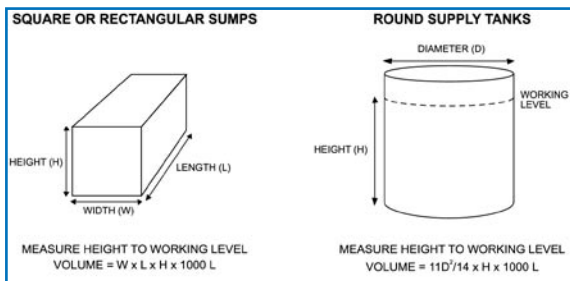


Figure 2: Calculating tank or sump volume.

Adhere to the label [dilution ratios](#) during [charging](#) and [replenishment](#) of sumps and supply tanks.

Mix thoroughly, initially with a paddle by either recirculating jetting equipment, running the top sprays in an empty shower dip for 3 minutes, or by dipping 20-30 sheep in a plunge dip. Note these sheep should be re-dipped later. Dipwash may settle so ensure it is re-mixed if left for even a few hours.

Most dips are compatible with zinc sulphate and [bacteriostats](#), but always check the label. Copper sulphate (bluestone) stains wool and must not be used. Wetting agents should not be added as they alter the [stripping](#) rate.

Ideally dip shouldn't be left unused overnight. If dip is held, a bacteriostat should be added to clean dipwash prior to dipping any sheep.

The volume of dip concentrate roughly required can be estimated by using the formula $V \times N/R$, where V = volume of dipwash per sheep, N = number of sheep and R = dilution ratio.

Allow 1-1.5L for lambs and 2-3L for ewes in sprayraces and 3L plus 0.25L per week (strong wool) or 0.5L per week (fine wool) in saturation.

Example: 2500 Romney ewes 8 weeks off-shears using BLITZ® (1:666) in a shower dip. $3L + 2L = 5L \times 2500/666 = 18.8L$ of BLITZ = $4 \times 5L$.

Automatic jetting races (AJRs)

AJRs are convenient and provide clean chemical to the at-risk areas. There is variation of time of exposure and the volume of dipwash applied to each animal. Fly control will vary depending on how well the fleece is saturated. This, in turn, will depend on the contact time and the amount of chemical delivered as well as wool length.. Following treatment, a number of sheep should be checked for level of saturation, using an indelible pencil or absorbent paper.

Hand jetting

Hand jetting is a useful means of applying chemical for flystrike control. The skin is thoroughly wet by combing the multiple nozzles of a jetting wand (Dutjet is best) through the fleece in a band about 25 cm wide from poll to tail and on the sides of the tail (Fig. 3).

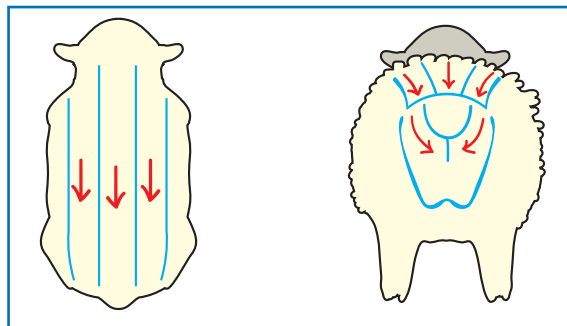


Figure 3: Correct placement of hand jetting wand.

The minimum requirements for jetting is pumping 30 L/minute delivered at 700 kPa (100 psi) to each handpiece while returning enough jetting fluid via the recirculating hose to provide sufficient mixing in the sump³.

Saturation dipping (shower or plunge)

As initially there is no suint (the water-soluble fraction of wool grease) in the dipwash, the first few batches of sheep are harder to wet. It is therefore recommended that the first two or three batches be re-dipped.

To minimise dipwash contamination, ensure that:

- dips are covered when not in use
- races leading to the dip entry are of rough concrete or slats to remove dirt from the feet
- filter screens, dip enclosures and forcing draining pens are cleaned before and during dipping
- sheep are dag free and yarded overnight with access to water only.

Sumps should be emptied and cleaned after one sheep for every 2L of the volume of the sump has been dipped. For example, a 4000-litre plunge dip = 2000 sheep, or 1000-litre shower sump = 500 sheep dipped before cleaning out. Under very dirty conditions, e.g. muddy yards, fewer sheep per volume of dipwash can be dipped before cleaning out is necessary. Plunge dips are dirtier as the dipwash doesn't pass through dirt traps and filter screens.

Shower dipping: Shower dipping is the dilution and pumping of dipwash from a sump through an overhead boom and (possibly) bottom spray nozzles.

Most shower dips are of the [constant replenishment](#) (CR) type (Fig. 4).

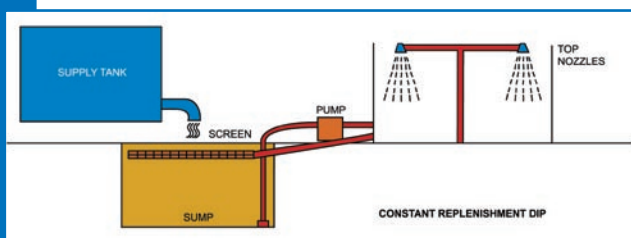


Figure 4: Components of a constant replenishment shower dip.

These have a small capacity sump and a large supply tank. The supply tank contains charged dipwash for replenishment. Because the sump is kept topped up, the operation is cleaner, and concentration of the dipwash is kept relatively constant.

The top spray boom must be centred and level. This ensures dipwash is sprayed evenly on the backs of all sheep. Check by walking around the dip holding a rod that just touches the side. When operating, the arm should rotate at 5 revolutions per minute. The speed usually can be altered by changing the angle (typically 26°-28°) of the driving nozzle. Increasing the angle increases the speed. The other nozzles should be facing vertically downwards.

The top nozzles (the most important) must be clean and ideally have one long slit. Nozzles with many small openings (e.g. old Buzacott) should be replaced.

Older standard (non-CR) dips are not recommended and they should be converted to a CR system. Two articles^{4,5} available on the web (www.agric.nsw.gov.au/reader/nsw-agriculture) outline how to convert a standard dip to a CR shower dip and how to upgrade existing CR shower dips to meet the minimum requirements suggested in recent research.

Sheep in the dip should be of uniform size, and able to move freely.

Plunge dipping: In addition to the general guidelines on saturation dipping above, sheep should swim at least 9m and remain in the dip for at least 60 seconds. This can be an issue in some mobile swim dips. Sheep should be dunked (ideally backward) at least twice, not including the 'splash' entry. Note one of the dunkings can be replaced by a spray bar or nozzle. Use constant replenishment in preference to traditional intermittent replenishment and [reinforcement](#).

STOCK HEALTH

Mustering, holding and shearing sheep increases the risk of conditions such as smothering, [pneumonia](#), [clostridial disease](#) and [cold stress](#).

Wetting the fleece and holding wet sheep increases the risk of lumpy wool, fleece rot and [cheesy gland](#). Saturation (in particular plunge) dipping presents the further risk of drowning and [post-dipping lameness](#).

Reduce the risk of these bacteria spreading by:

- dipping lambs first and chronically infected

- sheep last
- using bacteriostats
- allowing sheep to move slowly back to their paddock so avoiding close contact before sheep are dry.

Minimise the risk of poisonings by not dipping thirsty sheep and preventing dogs and other animals from drinking dipwash.

LENGTH OF PROTECTION

Many factors influence the length of protection afforded by chemical fly control. The method of application and dose of chemical delivered affect the concentration at the at risk areas on the animal. With shower dipping or jetting, fly control will be achieved even if the wool is not saturated to skin level but, as mentioned earlier, the length of protection will be reduced. Pour-on products must be applied to all at-risk areas and at the recommended dose rates to achieve maximum length of protection. Chemical concentration in the fleece can be influenced by environmental factors such as rainfall and U.V. light.

Skin and wool diseases as well as contaminants in the fleece and dags will reduce the period of effectiveness of fly control chemicals. The active ingredients will be bound and inactivated by organic matter and, with wet dipping, contamination of the dip wash will reduce the effectiveness of the dip. These contaminants also make the animals more attractive to blowflies.

Fly challenge and sheep susceptibility have a large influence in the length of protection. To maximise the length of protection it is important to include the other aspects of the integrated parasite management programme.

Development of resistance seen in the Australian sheep blowfly may in some cases influence the length of protection. The effect of an increase in resistance to a chemical is that individual flies or maggots need a higher dose of chemical to kill them. This means the length of time taken for the chemical in the wool to deplete to sub-lethal levels for these flies or maggots is reduced.

OTHER ECTOPARASITES

Many producers try to treat for lice and fly at the

same time. If lice are present, optimal timing is best, otherwise lice control is at risk. If both fly and lice are to be treated at once, shower or plunge dip no later than 8 weeks (fine wool) or 12 weeks (strong wool). Pour-ons should be used off shears or use a pour-on with a long wool lice claim. For further recommendations regarding lice control refer to Schering-Plough Coopers' LICE ADVICE booklet. Control of other ectoparasites such as keds, itchmite and mange should be discussed with the manufacturer or your veterinarian.

OPERATOR SAFETY

Users are responsible for safe transport, storage, dilution, application and disposal of dip, dipwash and used containers. Additionally, users are responsible for the prevention of human exposure to treated sheep following application.

Handle all chemicals with care – though an active ingredient may be considered low risk, other components of the [formulation](#) may not be. Read the label and [MSDS](#) carefully.

Avoid insecticide contact with skin, eyes or mouth. Wear and maintain appropriate protective clothing (as recommended on the label) when handling chemical, dipping or dipped sheep.

Don't rub your face, smoke, eat or drink during dipping. Wash hands, arms and face thoroughly with soap and water after handling insecticides, especially before eating, drinking or smoking. Wash all clothing (including gloves and leggings) separately from other clothing. Use an alkaline cold water washing detergent such as Cold Water Surf or Cold Power.

Use well-designed facilities that minimise chemical fumes, spray drift, splashing and contact with wet sheep. Ensure dipping is the last procedure if sheep are to be handled a number of times.

DISPOSAL OF USED CONTAINERS AND DIPWASH

All modern chemicals bind readily to soil and break down rapidly. However, they are all potentially harmful to non-target insects, especially aquatic invertebrates. Every effort must be made to prevent contamination of waterways with the product or empty container.

If a potential environmental emergency occurs with a dip concentrate or dipwash, specialist advice can be sought by phoning:

0800 CHEMCALL (0800 243 622)

USED CONTAINERS

These should be triple-rinsed or pressure-washed with water. Add the rinsings to the used dipwash. The cleaned empty containers should be punctured and crushed and taken to an approved landfill. Empty containers and product should not be burnt.

DIPWASH AND SUMP SLUDGE

This is best deposited onto flat ground high in organic matter away from dwellings, dams, ponds and waterways. The site should have a deep layer of old silage or hay and be surrounded by a low soil bund about 15cm high. Stock or people should be excluded from the area.

If applied to pasture, apply at a maximum of 5000 litres per hectare, preferably to recently cultivated land high in organic matter. Stock must not graze the area for at least 28 days. Do not allow puddles to form, as these may lead to ground or surface water contamination.

WITHHOLDING PERIODS

MEAT

Meat withholding periods (WHP) are rigorously reviewed by the New Zealand Food Safety Authority, and reflect the importance of preventing chemical residues in meat. All withholding periods on product labels should be strictly adhered to.

WOOL RESIDUES

[Wool harvest periods](#) are not generally reviewed by registration authorities and most have a recommended period of 60 days on the label.

If treating sheep with longer wool the following wool harvest periods are recommended:

- 60 days for crossbreds (strong wool)
- 100 days for mid-micron (medium wool)
- 180 days for fine wool breeds.

While these standards are generally effective, some residue may remain. The rate at which insecticide residues break down in wool depends on the product applied, the breed of sheep, wool length and application method.

Residues are removed during scouring. However if the remaining scour effluent (which contains most of the residues) is not fully treated, then there is a potential to contaminate waterways and the environment⁶. Concerns about the environmental impact of insecticides in raw wool and wool scour affect the marketing of New Zealand wool.

Note wool harvest periods apply to fleece wool following shearing; not to crutchings or fellmongered wool.



GLOSSARY

Active: chemical component of a dip formulation that acts on the target parasite. Active families include insect growth regulator, macrocyclic lactone, organophosphate, spinosyn and synthetic pyrethroid.

Bacteriostat: chemicals added to dipwash that slow (not prevent) bacterial growth. They are used prior to dipping to help control bacterial infections. They don't prevent all infections and are not a substitute for correct dip hygiene. Bacteriostats are only effective if added prior to dipping any sheep. An example is Hibitane (chlorhexidine) added at 2L per 1000 litres of dipwash.

Charging: initial mixing of the insecticide with water at the manufacturer's recommended dilution rate.

Cheesy gland or caseous lymphadenitis (CLA): chronic bacterial disease of sheep caused by *Corynebacterium pseudotuberculosis*. It has little effect on the health of sheep, but abscesses in lymph nodes affect carcass value. The bacteria are spread to the skin of other sheep by contact with discharges from ruptured lymph nodes. Infection can spread readily in dipwash. Use of pour-ons significantly reduces the spread of CLA.

Clostridia: family of bacteria that cause a number of (usually fatal) diseases. They are prevented by vaccination. (See *Coopers' Guide to Clostridial Disease and Vaccination for more information.*)

Cold stress: an often fatal condition caused by prolonged exposure to severe cold, wet and windy conditions often associated with shearing. Prevention includes avoiding shearing or dipping in unsuitable conditions; dipping early enough in the day to give sheep time to dry; avoiding dipping sheep with long wool (this non-insulating wool takes considerably longer to dry); cover comb shearing options.

Constant replenishment: continuous addition of new dipwash during dipping to maintain a constant volume and concentration of insecticide.

Dermatophilosis: Infectious disease caused by *Dermatophilus congolensis* which causes skin lesions (see [lumpy wool](#)).

Dilution ratio: ratio of dip to water; usually expressed as 1 part dip concentrate to x parts water, e.g. BLITZ is diluted for jetting at 1:400.

Dipping out: lowering shower sump or plunge dip volume at the end of dipping by stopping [replenishment](#). This practice is generally not recommended. [Stripping](#) dips require [reinforcement](#) to replace lost insecticide.

Fleece rot: bacterial dermatitis caused by infection with *Pseudomonas* spp. in association with recent rainfall or high humidity. It causes (red, blue or green) discolouration of the fleece near the skin. Lesions occur most commonly over the withers and along the back in young sheep.

Formulation: all the components that form a finished dip (insecticide). Aqueous formulations either suspend or dissolve the [active](#) in water. Solvents dissolve the [active](#) to form a solution. Aqueous products tend to be less irritating to the skin and eyes and produce less vapour. The IGR-based wet dips (e.g. BLITZ) and one pour-on (MAGNUM) are aqueous-based suspensions. Macrocyclic lactone, synthetic pyrethroid and spinosyn products are all aqueous-based solutions. New formulations tend to be aqueous based whenever possible, due to their favourable safety properties.

The active ingredient and emulsifying agents of most organophosphate-based dips are dissolved into a suitable solvent. These formulations, emulsifiable concentrates, can irritate the skin and eyes and can be easily absorbed through the skin. The solvent may cause deterioration of equipment over time, and they are generally more difficult to mix with water.

Lumpy wool or mycotic dermatitis: common bacterial dermatitis caused by *Dermatophilus congolensis* in association with recent rainfall, wet dipping or high humidity. It causes scabby lesions on the back, flank, face and ears. The scabs bind wool together. Most lesions heal once sheep dry, but may reoccur after further rain. Lambs are the most susceptible to lumpy wool because their natural skin and wool waxes are not fully developed.

Zinc sulphate 1% (heptahydrate type) can help control the spread of infection. If compatible, add 9-6 kg zinc sulphate/1000 litres of dipwash.

Material safety data sheet (MSDS) also known as safety data sheets: information sheets available from manufacturers and distributors with every product that detail the chemical properties, hazard information, transport information, precautions for use and safe handling information.

Micron (μ): unit of measure (1/1000 millimetre). As a rough guide: ultra-fine (<15 μ), fine (<25 μ), medium (25-30 μ), strong (>30 μ).

Post-dipping lameness: bacterial disease caused by *Erysipelothrix rhusiopathiae* that have multiplied in dipwash. Infection enters via skin cuts and causes a severe lameness several days after dipping. Death is rare but loss of body condition can be significant.

Pneumonia: complex contagious condition caused by the interaction between many different micro-organisms and stress due to mixing of mobs, yarding, droving, dust, open mouth breathing, dipping and adverse climatic conditions. Note the actual inhalation of dipwash is rare.

Reinforcement: addition of undiluted product to dipwash to maintain chemical concentration while the dipwash reduces in volume at the end of dipping (see [dipping out](#)).

Replenishment (topping-up): addition of chemical and clean water to maintain dipwash concentration and volume.

Resistance: genetic trait carried by certain flies enabling them to survive exposure to an [active](#) family. The increased concentration of chemical needed to kill maggots can translate to a reduced length of protection against flystrike if there are resistant blowflies present.

In New Zealand there have been no published cases of resistance to ML or S active families. Some OP-resistance has been documented⁷. While the actual prevalence is unknown, anecdotally it is thought to be widespread. There has also been some resistance reported to the IGR diflubenzuron but the prevalence and distribution is also unknown.

Stripping: where [active](#) is removed from the dipwash as it passes through the fleece; the concentration in the dipwash dripping off the sheep is lower than that

retained in the fleece. To ensure adequate chemical in the dipwash, the [dilution ratio](#) is greater for [replenishment](#) than [charging](#) with stripping dips. OP, ML and other fat-soluble insecticides will strip.

The [active](#) in water-soluble dips (IGR and SP) is deposited in the fleece as the dipwash dries and they are non-stripping. The [active](#) concentration in dipwash dripping from sheep is the same as that in the sump. The dilution rates for [replenishment](#) and [charging](#) are therefore the same. Furthermore, [reinforcement](#) is not required.

Wool harvest period: time from dipping sheep to subsequent shearing.

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