Controlling Ectoparasites on Welsh Organic Sheep Farms

A report prepared for Organic Centre Wales

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Executive Summary

1. Organophosphate (OP) based dips offer a broad spectrum control against all major ectoparasites in the UK. However, there is continuing controversy over the safety to dip operators and the environment. The use of OPs is prohibited by organic standards, primarily because of concerns about mammalian toxicity.

2. Organic farmers are permitted to use synthetic pyrethroids (SPs)(dip products and pour-on products) and/or macrocyclic lactones (injectable products) to treat/control ectoparasites providing a derogation has been obtained from the certifying body.

3. SPs have been shown to be considerably more toxic to aquatic organisms than OPs. The environmental impact of SPs is not limited to levels in dip but also to residues in sheep fleeces. SPs may be removed from the wool by climatic conditions and then deposited in the local environment.

4. The Environment Agency have indicated that the majority of sheep dip pollution incidents involve SP dips. Concerns have been raised that as organic farmers can only use SP based dips they may be contributing to the higher levels of SP based pollution incidents.

5. There is little information as to current practices amongst organic sheep farmers to control/treat ectoparasites or on how these farmers dispose of the spent dip. In order to address this lack of information a survey was carried out by ADAS Pwllpeiran to investigate current practices amongst sheep farmers in Wales. For comparison purposes both conventional and organic farmers were included in the survey.

6. In total, 134 questionnaires were completed with 96 completed by conventional sheep farmers and the remaining 38 being completed by either in-conversion organic farmers or fully registered organic farmers.

7. Results showed that 58% of organic farmers surveyed treated their flocks for ectoparasites compared to 67% of conventional farmers.

8. Of the organic farmers surveyed, 52.6% listed flystrike as a parasite for which they treated their flocks. This was comparable to conventional farmers where 58.3% listed flystrike. Only 21.1% of organic farmers surveyed listed scab compared to 61.5% of conventional farmers. Less than 10% of both conventional and organic farmers surveyed treated for other ectoparasites. Those who did listed lice and ticks as the main ectoparasites.

9. Despite a large percentage of conventional farmers listing scab as an ectoparasite to be treated, only 11.5% of those surveyed treated for ‘scab only’ compared to 51.0% who treated for scab in combination with other ectoparasite control. A similar pattern was seen amongst organic farmers

surveyed, where only 2.6% treated for 'scab only' whereas 18.4% treated for scab in combination with other ectoparasite control.

10. Of the organic farmers surveyed, 36.8% treated for 'flystrike only' compared to 7.3% of conventional farmers.

11. Despite other ectoparasites such as lice and ticks being listed by both conventional and organic farmers neither of these two parasites were treated singly but were always treated in combination with other ectoparasites.

12. Of conventional farmers surveyed who treated for ectoparasite control, 76.1% listed plunge dipping as the preferred dipping method compared to only 22.7% of the organic farmers surveyed who treated for ectoparasites.

13. The use of pour-on products was higher amongst organic farmers with 54.5% using pour-ons as a treatment method compared to 16.5% of conventional farmers.

14. Less than 5% of the organic farmers who treated for ectoparasites used a combination of treatments compared to 19% of conventional farmers who treated for ectoparasites.

15. When asked how often they treated for ectoparasites, 54% of organic farmers treated once a year compared to 42% of conventional farmers. 27% of organic farmers treated twice a year whereas 52% of conventional farmers treated twice a year. 14% of organic farmers treated three or more times a year compared to 7% of conventional farmers.

16. All organic farmers who carried out plunge dipping operations used a SP based product however of the conventional farmers who carried out plunge dipping, 39% used an SP based product. Overall, 16% of organic farmers surveyed used an SP based dip product compared to 24% of conventional farmers surveyed. Of all conventional farmers surveyed 38% used an OP based dip product.

17. Where farmers carried out plunge dipping, 53% of conventional farmers diluted spent dip before spreading to land compared to 83% of organic farmers who carried out plunge dipping operations. Of all the farmers surveyed who carried out plunge dipping only 1 treated dip with slaked lime before spreading.

18. Of all organic farmers surveyed, 5% used a mobile dipping contractor compared to 23% of conventional farmers surveyed.

19. Where contractors were used on organic holdings they were also responsible for the disposal of spent dip. The contractor was responsible for the disposal of dip on 74% of conventional holdings using contractors for dipping.

20. On 42% of the holdings using contractors, the spent dip was removed from the farm whereas on 32% of holdings the spent dip was spread on the farm land. 26% of farmers using contractors in this survey did not know how the contractor disposed of spent dip.

21. The percentage of farmers treating their flocks for ectoparasite infestations is similar for organic (58%) and conventional (69%) sheep farmers however there is a marked difference in the species of ectoparasites treated.

22. Of the conventional farmers who treated their flocks for ectoparasites, 86% listed scab as a major parasite compared to only 36% of organic farmers who also treated their flocks for ectoparasites.

23. Overall, only 3% of the organic farmers surveyed treated their sheep specifically for scab, compared to 11% of conventional farmers surveyed.

24. Of organic farmers surveyed, 37% treated their flocks specifically for blowfly strike compared to only 7% of conventional farmers surveyed.

25. Of the conventional farmers surveyed, 51% treated their flocks for more than one ectoparasite infestations compared to 18% of organic farmers surveyed.

26. From the evidence of several of the completed survey forms some farmers appeared to be using incorrect treatment methods and some were using multiple treatment methods to treat ectoparasite infestations. The use of incorrect treatments or multiple treatments is largely a reflection of the plethora of products available and suggests a lack of understanding as to which products are appropriate and licensed for the treatment of specific ectoparasites.

27. The survey found that fewer organic sheep farmers use SP dips than conventional sheep farmers do. As there are fewer organic sheep farmers overall, there is little evidence that organic sheep farmers contribute disproportionately to the level of SP based pollution incidents.

28. Summary of Recommendations:
    A. A further in-depth survey would be valuable to elucidate the extent of the scab problem in the national organic flock.
    B. Both organic and conventional farmers have difficulty in selecting the best/ most appropriate treatment for their flocks. An educational campaign would help to remedy this problem.
    C. Annual training courses for certifying bodies and advisors to keep up to date with developments in research and products are recommended.
    D. Given the potential for SP dips to cause major environmental damage if disposed of incorrectly it is a mandatory requirement that organic farmers are licensed by EA to dispose of spent dip. Inspectors should ensure cross compliance where organic farmers are using dip.

E. Certifying bodies need to consider all the available evidence as to what chemicals should be permitted to treat scab and other ectoparasites and where appropriate make alterations to the standards.

F. Inspection of dips facilities and EA licence should be part of the annual inspection procedures.

G. Certification bodies should collate information on dipping practices and dip disposal.

H. Where a pollution incident occurs on an organic holding this should be reported to the relevant certifying body.

I. Development and evaluation of IPM programmes should be assessed as a management tool to reduce use of chemical treatments whilst promoting good animal husbandry and management. IPM programmes should be incorporated with animal health plans.

1.0 Introduction

The Code of Recommendations for the Welfare of Livestock: Sheep (Defra, 2000) states in section 32 that

> *"Where external parasites, such as those causing scab or fly strike, ticks or lice, are likely to occur, sheep should be protected by dipping or by the use of an effective preventative chemical agent. Where sheep are clinically infected with such external parasites, effective treatment must be given without delay."*

Under UKROFS organic standards no specific regulations are laid down for the treatment or prevention of ectoparasite infestations other than in section 5.5 c which states

> *"animal treatment products involving the use of organophosphates, are not permitted. If any of these compounds are used in compliance with statutory requirements, then the animals must be permanently marked at the time of treatment. Such animals must not be used for organic meat production. For livestock products, any animals so treated must be subject to the relevant conversion period specified in section 2 [of UKROFS standards], before these products can be subsequently marketed as organic, subject to the agreement of the inspection authority or body."*

Sheep scab represents one of the most serious welfare concerns amongst sheep farmers. Until 1992, scab was a notifiable disease and it was compulsory to dip all sheep in the autumn. Dipping remains the most common method of prevention and treatment of scab, however the introduction of injectable products allows the sheep farmer a greater choice of control methods for ectoparasites other than scab mites (Parker, O'Brien & Bates, 1999).

Organophosphate (OPs) based dips offer a broad spectrum control against all major parasites in the UK. However, there is continuing controversy over their safety to dip operators and the environment. The use of OPs is prohibited by organic standards, primarily because of concerns about their effect on human health (Curl *et al*, 2002). Synthetic pyrethroids (SPs) which are also used for dips are more toxic to aquatic organisms than OPs (Grimwood & Criddle, 1994; Lewis,1998; Armstrong & Phillips 1998). The environmental impact of synthetic pyrethroids is not limited to levels in dips but also to residues in wools. SPs may be removed from the wool by climatic conditions and then deposited in the local environment. Systemic endectocides are currently administered as injections and have both acaricidal and anthelmintic properties. Injectable systemic endectocides are currently licensed as an acaricide treatment for scab only. However, scab lesions can take longer to resolve when injectable products are used (Bates, 1993) and this can result in animals continuing to exhibit severe bouts of irritation and hypersensitivity. Organic livestock farmers are currently permitted to use SPs and/or systemic endectocides for the treatment of ectoparasites in sheep.

Whilst there is a certain amount of risk to the environment associated with the dipping of sheep there is a further environmental risk associated with disposing of spent dip. It is common practice to spread spent dip on land either directly or after treatment with certain chemicals or after diluting the spent dip with water or mixing it with slurry.

However, recent studies have suggested that as the level of pesticide in dips increase the number of faecal coliforms and pathogens in slurry also increases. This has major implications for the time required before returning grazing livestock to slurry amended fields, the potential of transfer of pathogens to the animal food chain and the increased likelihood of coliforms being washed into streams, rivers and coastal bathing waters (Semple *et al*, 2000).

Whilst the environmental concerns of using permitted chemicals are justifiable there is little information on how many organic farmers use these chemicals as part of their flock management or how they dispose of the spent dip. Although dipping practices are subject to the annual inspection process, the certification bodies do not keep accessible records that can provide such information.

As part of this review project a survey was undertaken of sheep farmers (both organic and conventional) in order to identify current practices for control of ectoparasites.

2.0 Aetiology of ectoparasites

A number of ectoparasites are associated with sheep flocks. They can be split into two categories according to their life cycles; complete life cycle on the sheep (permanent) and partly complete lifecycle on sheep (semi-permanent) (see Table 2.1)

Table 2.1 Categorisation of Sheep ectoparasites

Permanent	Semi-permanent
Sheep Scab (*Psoroptes ovis*)	Blowfly Strike (*Lucilia* spp., *Calliphora* spp.)
Ear Mites (*Psoroptes cuniculi*)	Nasal Bot Flies (*Oestrus ovis*)
Chorioptic Mange (*Chorioptes bovis*)	Headflies (*Hydeotea irritans*)
Chewing Lice (*Bovicola ovis*)	Ticks (*Ixodes ricinus*)
Sucking Lice (*Linognathus* spp)	Forage Mites
Keds (*Melophagus ovinus*)	

2.1 Blowfly

Blowfly myiasis is the condition resulting form infestation of the living skin of sheep by the larvae of blowflies. Affected animals are restless, show excessive tail twitching and foot stamping. The most commonly affected area is soiled wool around the tail, but other parts of the body including the feet may be involved.

A survey carried out in the mid nineties (French *et al*, 1995) found that 80% of sheep farmers in England and Wales had recorded at least one case of blowfly strike in their flocks. The authors estimated that half a million sheep were struck annually with an average of 1.6% of sheep within a flock reported as being struck.

Blowfly strike is a highly seasonal problem and is weather dependent. The majority of body strike cases occur after periods of heavy rain followed by warm weather or during periods of high humidity. Strikes can occur any time from March to December with the highest number of strikes occurring during May and October. Breech strike (where the hindquarters of the animal are affected) depends less on weather as the moisture supplied by urine or scouring is generally sufficient to attract flies (Bates, 1999).

The species responsible for blowfly strike have a free-living stage away from sheep. Adult flies lay eggs on the sheep generally in areas of damaged or soiled fleece. The larvae then hatch on the sheep and crawl to the skin which they lacerate and digest. The larvae then leave the sheep to pupate in the soil and remain in the pupae for 3 - 21 days in summer. Overwintering pupae remain inactive until the soil temperature rises above 7^{o}C. Blowflies attack in waves, classified as primary, secondary and tertiary fly waves. The primary flies (*Lucilia* and *Phormia*) create the strike lesion but do not necessarily invade the living tissue. Secondary flies (*Lucilia* spp., *Phormia* spp or *Calliphora* spp.) are then attracted by the smell of the primary lesion. The third wave of flies are then attracted by the increasing lesion and secondary bacterial infestation (Bates, 1999)

2.2 Scab
Sheep scab is the most contagious disease of sheep in the UK today. The disease is currently the subject of The Sheep Scab Order 1997 which is based on the treatment of infected sheep or those that may have been exposed to the mite rather than compulsory dipping of the national flock. The Sheep Scab Order 1997 is intended to give local authorities the means to improve the control of sheep scab when owners of affected sheep do not take appropriate measures voluntarily. The provisions of the order therefore only apply to sheep that are visibly affected i.e. where clinical signs of sheep scab are present.

Sheep scab is an acute or chronic form of allergic dermatitis caused by the mite *Psoroptes ovis*. The mite is an obligatory skin parasite whose life cycle and feeding habits are still not fully understood (Lewis, 1997). The faecal material excreted by the mites is rich in guanine, which acts as an allergen. There is a marked variation in the severity of allergic reaction between individual animals and different breeds.

The main transmission route for scab is from sheep to sheep, however despite the mite being an obligate ectoparasite it can exist off the sheep for at least 30 days given correct temperature and humidity (Bates, *pers comm*.), however, it is only infestive for 15-16 days (Lewis, 1997). Thus rubbing posts, handling facilities and transporters can remain a source of infection for a considerable period of time. Shearing equipment is also a transmission route including the shearer's footwear.

It is essential that scab is identified differentially from other ectoparasites for effective treatment and control. In the early stages of scab sheep may display symptoms similar to other ectoparasite infections such as restlessness, rubbing, soiled fleeces and head tossing. Sheep scab is a flock problem and needs to be differentiated from lice infestation. On an individual basis, scrapie and post lambing wool loss should be considered as differential diagnosis (Lewis, 1997).

Where a flock has been severely infested with scab mites, the symptoms are instantly recognisable with sheep scratching, large areas of wool loss and wool tags present in the sheep's mouth (Lewis, 1997). Further investigation of affected sheep will reveal severe crusting lesions. Samples taken from the edge of the lesion should be submitted to a laboratory for confirmation. However, the use of a hand lens will often reveal the presence of mites at the lesion's margins. The adult mite is just visible to the naked eye with the adult female being pearly white in colour, globular in shape and approximately 1.0mm in length (Bates, 1999b).

Where a flock is in the early stages of infection, has a mild infection or a chronic infection the symptoms are less visible and require more thorough inspection for diagnosis. There may well be a complete absence of rubbing or biting and frequently the only visible signs are areas of clean licked wool on the flanks or thighs of animals (Lewis, 1997). The lesions are generally present in an area different to the “licked” area and are more often than not found along the back line, usually in areas of the withers.

The infestation of mites is characterised by three phases, the early, the late and the decline phase. During the early phase the disease is characterised by low mite numbers and very small lesions. These lesions are virtually undetectable, with the mite adapting to its new host and the sheep becoming sensitised to the mite allergens. In simulated conditions where sheep have been artificially infested with sheep mites a lag phase of 20 –25 days can occur before symptoms become visible (Bates, 1999b). During the late phase of the infestation there is a rapid increase in mite numbers and lesion spread. During the later stages “flaker” sheep may occur where the sheep suffers extensive wool loss and the denuded areas are covered in flaky scabs which overlie thousands of active mites. It is during this phase that mites are more likely to pass to other sheep. The disease then enters the decline phase. The lesions begin to change in appearance and the active moist edge upon which the mites feed becomes less distinct and secondary infections may occur. The mite population begins to decline due to the lack of feeding sites and the development of an immune response from the host animal. After the decline phase it is not uncommon for animals to make a complete recovery, as the new wool begins to grow on previously denuded areas and the scab lifts away from the skin. However it is possible for some sheep to appear to recover completely but still be harbouring populations of mites either under dry scabs or in cryptic sites such as the ear. When normal skin conditions are established the mites can then re-infest. This is known as psuedorecovery (Bates, 1997).

2.3 Lice

Three species of louse infest sheep: the chewing louse (*Bovicola ovis*), the face louse (*Linognatus ovillus*) and the foot louse (*L. pedalis*). By 1999 there had been no cases of foot louse recorded in the preceding 20 years and it has been assumed that foot louse was eradicated from the national flock during the period of compulsory national dipping (Bates, 1999b).

The chewing louse is a small insect, red/brown in colour with a broad head and chewing mouthparts. The chewing louse feeds on epithelial scales, wool fibres and skin debris. It is generally to be found around the neck and back areas.

The chewing louse is an obligate parasite, however its lifecycle and population dynamics are greatly influenced by climate, particularly temperature. In hot climates (e.g. Australia) lice can spread quickly within flocks, in temperate climates (e.g. Great Britain) the spread of lice within a flock occurs more slowly. Adult lice can live for up to a month and the egg to egg cycle can be completed in 3 – 5 weeks.

Lice infestations manifest as a chronic dermatitis characterised by constant irritation, itching, rubbing and tagging and biting of fleeces. Infestations can cause considerable losses from unthriftiness, retarded growth and damaged wool and leather. In surveys carried out by VLA, the level of louse burden impacted on body condition score. The higher the louse burden the lower the condition score (Bates, *pers comm*.) In the same survey louse burden was also correlated with fleece length, the longer the fleece the higher the louse burden.

The face louse is blue in colour and has a thin elongated head with piercing mouthparts, which penetrate the skin and suck blood. The face louse can be found on both the haired and woolled areas of the face. Dense populations can discolour the white hair or wool to a definite grey.
Since the deregulation of scab in 1992 the prevalence of chewing lice has increased with significant infestations being recorded in Dyfed, Gwynedd, Northumbria, Devon, Yorkshire, Staffordshire and the Scottish Borders (Bates, 1999c).

2.4 Ticks

Ticks (*Ixodes ricinus*) spend only a short time on the host to feed but are effective vectors of disease. Ticks are to found mainly on the hairy areas of the head, neck, axillia and groin in the spring and autumn. *I. ricinus* is a three host tick, it leaves its host before each moult and then seeks a new host. Each host does not need to be of the same species. *I. ricinus* transmits "tick borne fever" in sheep, louping ill and causes "tick paralysis" in both sheep and cattle.

2.5 Keds

The sheep ked (*Melophagus ovinus*) is wingless and lives on the wool and skin of the sheep. They are much larger than lice and are readily visible.
The sheep ked can cause severe anaemia when present in large number and in severe cases can result in death. Keds present on the sheep can cause restlessness, biting, kicking and rubbing of the affected areas.

3.0 Aetiology of foot-rot

Lameness is often seen in flocks at pasture and at housing. The affected animals may display mild and transient lameness to severe and persistent lameness. In addition to causing the individual animal pain and suffering, lameness if left untreated can result in severe production losses.

Foot-rot is a term used by many (both farmers and professionals) to describe lameness in sheep. However, foot-rot only describes one condition and sheep may be suffering from any one of a number of conditions. Correct diagnosis is essential if lameness in sheep is to be treated correctly and without causing any unnecessary suffering due to incorrect treatment.

Bacterial infections of the skin and other tissues of the hoof are the most frequent cause of lameness in sheep. Table 3.1 details some of the characteristics associated with the most common bacterial infections of the foot.

Table 3.1 Major characteristics of the principal dermatoses of sheep

Disease	Tissue Affected	Bacteria Involved	Severity of Lameness	Prevalence within flock (%)
Toe abscess	Sensitive laminae	Non-specific	++++	1 – 5
Foot abscess	Joint capsule	*Fusobacterium necrophorum Actinmyces pyogenes*	++++	2 – 10
Ovine Inter-digital dermatitis (Scald)	Inter-digital skin	*Fusobacterium necrophorum*	±	5 – 30
Benign Foot-rot	Inter-digital skin	*Fusobacterium necrophorum Dichelobacter nodosus*	+	5 – 100
Virulent Foot-rot	Inter-digital skin and sensitive laminae	*Fusobacterium necrophorum* Dichelobacter *nodosus*	++/+++	5 – 100

Adapted from Egerton 1999 and Hindson & Winter 2002

3.1 Scald (Ovine interdigital dermatitis)

Scald is caused by *Fusobacterium necrophorum* and rarely progresses beyond the foot cleft. The lesion is interdigital dermatitis. Symptoms include a reddening or whitening of the skin between the heels along with swelling and hair loss. Although the lesions look relatively benign, affected animals are very lame. Predisposing factors for the development of scald include dirty or damp bedding when animals are housed, dirty or muddy areas around feeding or drinking troughs and long wet grass outdoors. The presence of scald can facilitate the invasion of *Dichelobacter nodosus* if it is present in the environment and can result in the development of footrot.

3.2 Foot-rot

Foot-rot is still the most common foot problem within flocks, as repeated infection does not induce a useful immune response. Foot-rot is caused by *F. necrophorum* and *D. nodosus* acting synergistically. There are number of strains of *D. nodosus* which vary in invasiveness, hence the distinction between benign and virulent footrot.

Early lesions are similar to those of scald affected animals however as the disease progresses separation of the sole occurs usually beginning at the heels with necrosis of the laminae and development of the characteristic foul smell. Virulent strains can cause separation right across the sole and up the wall of the hoof. More than one foot can be affected at the same time. Carrier sheep are common and all feet must be subject to a detailed examination to detect all such animals.

3.3 Digital dermatitis

The cause of this apparently new disease is unclear and its differentiation from classic foot-rot is also open to debate. In contagious ovine digital dermatitis (CODD) the infection normally begins at the coronary band. Rapid shedding of the whole horn case can occur resulting in a raw digital stump. Infection can spread rapidly through the flock thus accurate veterinary diagnosis is required quickly.

3.4 Abscess

Abscesses (either toe or foot) are an acute infection, which usually involves one digit of the foot. Toe abscesses are usually confined to the sensitive laminae under the hard horn of the toe whereas foot abscesses begin in the interdigital space and extend into the deeper structures to involve the distal interphalangeal joint. In infected sheep acute lameness occurs to such an extent that complete non-use of infected foot occurs along with extended periods of recumbency. Damage to the interdigital space is required before bacterial invasion of the subcutaneous tissue can occur.

4.0 Control methods

A number of different control methods are available to farmers to prevent and /or treat ectoparasites and foot infections. These control methods can be broadly split into chemical (including veterinary medicines) or cultural. However, in recent years there has been a move to bring the best practices of both control methods into an Integrated Parasite Management programme.

4.1 Chemical

Early treatment methods for sheep ectoparasites involved the use of substances such as sulphur, mercury, hellebore, arsenic and nicotine applied in various ways (Wall, 1999). In Marcus Cato's treatise "On agriculture" his recommendations for scab control was to "take equal parts of old strained amurca, water in which lupines have been boiled and the dregs of good wine and mix all together. After shearing, smear the whole body with this and let them sweat two to three days. Then wash in the sea or if you have no sea water, make a brine and wash them in it."

The first attempts at total immersion of sheep in insecticides was carried out by William Cooper in 1843 (Wall, 1999) and to this day remains one of the most effective forms of insecticide application.

4.1.1 Ectoparasites

There are three classes of compounds available for the treatment and/or prevention of sheep scab;

1. organophosphorus compounds (OP) e.g. diazinon
2. synthetic pyrethroids (SP) e.g. flumethrin and high cis-cypermethrin
3. macrocyclic lactones e.g. ivermectin and doramectin

There is a large array of chemical compounds available within these three classes to treat ectoparasite infestations in sheep however this can be confusing to the farmer as not all products treat all ectoparasites and different concentrations are required to treat different ectoparasites. A summary of available products and their efficacy in treatment and control of sheep ectoparasites is given in Table 4.1.

A summary of currently available approved products for the control/treatment of scab can be found at www.vmd.gov.uk. It is always in the farmers interest to check with the Veterinary Medicines Directorate as to the currently available products and in the case of organic farmers to check with their certifying body.

Table 4.1 Compounds available for the treatment and/or prevention of ectoparasites of sheep.

		Sheep Scab		Blowfly strike		Lice, ticks & keds	
COMPOUND	**Application**	**Treat**	**Prevent**	**Prevent**	**Treat**	**Prevent**	**Treat**
Organophosphorus compounds							
Diazinon	Dip	✓	✓	✓	✓	✓	✓
Non-organophosphorus compounds							
High cis-cypermethrin*	Dip	✓	✗	✓	✓	✓	✓
Flumethrin**	Dip	✓	✓	✗	✗	✓	✓
Amitraz	Dip	✗	✗	✗	✗	✓	✓
Dicyclanil	Pour-on	✗	✗	✗	✓	✗	✗
Delamethrin	Pour-on	✗	✗	✓	✗	✓	✓
Cypermethrin	Pour-on	✗	✗	✗	✓	✓	✓
High cis-cypermethrin	Pour-on	✗	✗	✓	✓	✓	✓
Alpha-cypermethrin	Pour-on	✗	✗	✓	✓	✓	✓
Cyromazine	Pour-on	✗	✗	✗	✓	✗	✗
Cyhalothrin	Pour-on	✗	✗	✗	✗	✓	✗
Macrocyclic Lactones							
Moxidectin	Injectable	✓	✓	✗	✗	✗	✗
Doramectin	Injectable	✓	✓	✗	✗	✗	✗
Ivermectin	Injectable	✓	✓	✗	✗	✗	✗

* for treatment and control of scab caused by pyrethroid sensitive mites

** effective against pyrethroid sensitive strains of sheep scab, ticks, lice and keds

NOTE: Readers should check with their certifying body as to which treatments are permitted.

Scab

Before the changes in sheep scab legislation in 1992 all products licensed as "scab approved" had to meet the rigorous criteria of being able to produce a 100% kill of all mites in a fully fleeced sheep during a single plunge dip lasting one minute. A further requirement was the prevention of reinfestation within 21 days in sheep with a fleece length of 1cm. Currently only diazinon and flumethrin meet these stringent requirements. Since 1992 licences have been issued to products (SP and macrocyclic lactones) where only 95% kill has been achieved with no protection against reinfection. In order for these products to achieve an effective kill of mites, two treatments must be administered at prescribed intervals. This includes ivermectin (two injections seven days apart), moxidectin (two injections 10 days apart) and high cis-cypermethrin (two dips 14 days apart). Doramectin has also be licensed as an injectable product for the treatment of scab and only a single injection is required for treatment but protection from reinfection is limited (Lewis, 1997).

When plunge dipping, it is essential that the insecticide present is maintained at the correct concentration within the dip bath throughout the operation. This requires knowledge of the exact volume of the bath so that it can be correctly charged and replenished during dipping. Replenishment of the dip must be carried out in accordance with the manufacturer's instructions to maintain correct concentrations. The fleece length of sheep is also an important consideration when dipping as there is evidence to suggest that in flocks with greater than six weeks of growth of fleece not all sheep will be effectively dipped (Lewis, 1997).

Where injectable products are used the correct dosage is essential in order to treat effectively. The amount of dosage used should be based on the weight of the heaviest animals therefore some sheep should be weighed prior to injecting. All animals must be injected to achieve effective control.

Where two treatments are required to achieve 100% kill of mites treated animals should be returned to pastures which have been free of sheep for at least 16 sixteen days.

Blowflies

Only two groups of chemicals are approved for the treatment and prevention of blowfly strike by the VMD in dip products and these include diazinon (OP) and high cis-cypermethrin (SP). However a range of spray and pour-on products are licensed for the treatment of blowfly strike (but are not authorised for the treatment of scab) and these include dicyclanil (non-OP), delamethrin (SP), cypermethrin (SP), alphacypermethrin (SP), cyromazine (Non-OP) and cyhalothrin (SP). Not all these products will be approved for use within organic standards and farmers need to check with their certifying body as to which products are permissible to use. Some certifying bodies have now placed SP products in the "restricted" category and prior permission is required from the certifying body before they can be used. Permission for use is likely to be given when a reasonable case is made that a specific problem exists and that treatment is required on animal health and/or welfare grounds. Organic livestock farmers are required by the standards to prepare health plans in conjunction with their nominated veterinary surgeon where issues relating to ectoparasites should be addressed.

The range of pour-on products available to farmers for the treatment and control of blowfly can lead to confusion as some are only suitable for treating blowfly strike whereas others are only licensed for the prevention of blowfly strike (see Table 4.1). Many believe pour-on products to be better as they are perceived to less environmentally damaging than dipping, they present a reduced health risk to the farmer and are less stressful for the sheep than being put through a plunge dip.

When plunge dipping for blowfly control and treatment the same conditions as for dipping for scab control need to be considered i.e. maintaining correct concentrations within the bath, fleece length etc. However it is important to note that although chemicals may be approved for both scab and blowfly control, different concentrations are required to treat different ectoparasites.

Other Ectoparasites

Sheep can also suffer from infestations of lice, ticks, keds and headflies. Currently all dip products (both OP and SP) available to treat and control scab can be used to treat and control these ectoparasites. In addition a fourth dip product is available containing Amitraz (this is not approved for scab treatment or control). Not all the pour-on products are suitable for the control of ectoparasites such as lice, ticks keds and headflies. Where pour-ons are being used to treat such parasites it is crucial to ascertain a correct veterinary diagnosis as indiscriminate use of pour-ons can contribute to the development of SP resistance in both scab mites and lice.

SP resistance in scab mites was first documented by Synge *et al* (1995). Further cases in different areas of the country have subsequently been documented including areas of South Wales (Bells, 1997). Lewis (1997) has indicated that "there is a very real danger of a rapid development of resistance if products are not used exactly as prescribed and only when an accurate diagnosis has been made." SP resistance in lice is also not uncommon making the treatment of these ectoparasites more complicated and almost impossible under current organic regulations.

4.1.2 Foot-rot and other lameness problems

In order to treat foot-rot it is useful to know if it is benign or virulent. In the case of benign foot-rot it can be controlled by foot bathing without paring. Footbaths should contain either 5% formalin or 10% zinc sulphate. Ideally footbaths should be 6 m long and 10cm deep. Afflicted sheep should be walked through a footbath once a week until conditions improve.

Where virulent foot-rot is present then two treatment routes are available to the farmer. Treatment can either be by paring and footbathing or by antibiotics injected intramuscularly. Where paring and footbathing are chosen as the treatment method, care must be taken when paring. All hoof material overlying the necrotic tissue must be removed. This is a slow process and can cause considerable pain to the sheep. If the paring is inadequate then topical treatment by footbathing will be unsuccessful. However, over zealous paring can cause greater damage than the disease and sheep can be lame for a considerable time. After paring, sheep should be walked through footbaths containing either 5% formalin or 10% zinc sulphate.

Using antibiotics to treat virulent foot-rot removes the necessity to pare the foot of the animal other than to confirm diagnosis. However, the successful outcome of this treatment method is highly dependent on sheep being kept in a dry environment for 24 hours after treatment. If animals are returned to a wet pasture immediately after treatment the antibiotic is inhibited from diffusing to the affected tissues.

Where only a small number of animals are affected, scald can be effectively controlled by oxytetracycline spray. Where large numbers of animals are affected then walking them slowly through a footbath containing a weak formalin solution (2 – 3%) should be effective. Alternatively a zinc sulphate solution (10%) can be used in the footbath but animals will have to stand in the bath for a few minutes. Animals treated in this manner should be allowed to stand on a hard surface for a short period before being returned either to pasture or housing.

Where other lameness problems occur, such as abscesses, penicillin is recommended as the principal treatment method. However, it may be some time before the lameness is diagnosed as abscesses, by which time damage will have been done to the underlying structure of the foot.

4.2 Cultural

Cultural control methods generally include areas such as pasture management, animal nutrition and breeding for resistance/resilience. For the purpose of this report biological controls will also be included in this section. Biological controls include nematophagous fungi, parasitic wasps, bacteria and pheromone traps.

Farmers, advisers and certifying bodies may overlook the importance of cultural control methods as in many cases these are preventative control measures. For example, if a ewe is in good condition she is less likely to succumb to a severe ectoparasite infestation. Many farmers are aware that sheep in particular fields are more likely to get blowfly strike. Avoiding these fields where possible can reduce the number of animals struck. Breeding for resistance/resilience, although a long term approach, is one many owners of closed flocks have been practising for generations.

One of the most important cultural control methods all farmers should practice, whether they operate a closed flock policy or not, is biosecurity. Newly bought in stock should be isolated from the main flock. Under organic management, new bought in stock should be observed daily for signs of ectoparasite infestation and foot diseases. Where problems occur animals should be treated appropriately. Only after an isolation period should they be allowed to mix with the main flock. Straying sheep are also a major source of incoming disease to a farm so where possible all boundary fencing should be maintained in good condition. Some certifying bodies recommend double fencing between organic and neighbouring land to prevent cross infection. Where animals are grazed on common grazings then the graziers should work together to develop a programmes to eradicate major problems such as scab or footrot.

A strict biosecurity protocol should also be enforced when contractors are used to carry out work on-farm. This particularly applies to contract shearers and contract dippers. Where contractor shearers are used all equipment should be cleaned between farms, particularly shearing combs and moccasins. Shearing combs should be cleaned and disinfected before leaving each farm. Parasites which have become attached to moccasins can be killed by micro-waving the shoes for a few minutes.

4.2.1 Ectoparasites

Cultural control methods for ectoparasites are less well developed than those for other parasite infestations. This is partly due to the effectiveness of chemical control which has reduced the emphasis for research on parasite lifecycles.

Cultural and biological controls have been developed for blowfly strike. Blowflies are attracted to areas of the sheep fleece which are damaged or soiled. Crutching and dagging of lambs can reduce the areas of soiled fleece and reduce the likelihood of strike. Work carried out in New Zealand has demonstrated that if animals are grazed on pastures containing condensed tannins this will reduce the amount of faecal output and can result in drier dags both of which make the sheep less attractive to blowfly strike (Leathwick & Atkinson, 1995). Odour traps have also been used with success to lure flies away from sheep and to waste energy in pursuit of stronger olfactory stimuli (Heath, 1998). Avoidance measures can also be employed against flies such as keeping sheep away from field margins with hedgerows or shelter belts which provide habitat for blowflies. Permanent or temporary electric fencing could be used to fence sheep out of such areas. Blowflies do not fly in high winds so keeping sheep in breezy areas will also help to reduce the chance of attack.

4.2.2 Foot-rot and other lameness problems

As footrot is caused by *F. necrophorum* and *D. nodosus* working synergistically it can be prevented by eliminating *D. nodosus* from the environment. *D. nodosus* is a strict parasite whose only known habitat is in the hooves of ruminants affected with foot rot and its survival away from this habitat is less than a week. Some animals can recover from foot-rot but remain infected with *D. nodosus*, these animals can then infect other susceptible individuals. Other host and environmental factors can contribute to the development of foot-rot within the flock. Some breeds are more susceptible than others (Egerton, 1999). Within breeds some individuals are more resistance and this resistance is heritable (Raadsma *et al*, 1994).

Scald is caused by the invasion of *F. necrophorum* into the interdigital skin. However, eliminating *F. necrophorum* from the environment cannot control scald. This is because *F. necrophorum* is present in the environment as it is voided in the faeces of sheep.

As scald tends to occur in animals exposed either to wet pasture or wet bedding most cultural control methods include limiting exposure to wet pasture or bedding. In animals kept outdoors wet and or muddy areas tend to be centred round water and/or feed troughs and in gateways. Placing hardcore in these susceptible areas can prevent muddy areas developing. Where animals are grazing grass swards these should be kept short where possible.

Where animals are housed, keeping the bedding material dry is paramount to preventing scald. In pens where there is a single common feeding face the bedding can become compacted and less well draining. Where this occurs treating the feeding face area with a drying agent (i.e. lime) can reduce the incidence of scald.

Routine inspection of feet should be carried out in order to identify problems before they result in severe lameness. Where animals are grazing pastures the sward should be kept short where possible. Handling areas should be kept clean in order to prevent reservoirs of disease build-up.

4.3 Integrated Parasite Management

Integrated Parasite Management (IPM) is the integration of chemical, biological and cultural control methods to reduce parasite populations below an economic threshold. In addition, IPM programmes seek to maximise the effectiveness of parasite control actions whilst conserving beneficial insects and minimising pesticide residue (Rutz, Geden and Pitts, 2000). IPM in practice is a combination of the strategic use of chemicals, grazing management, nutrition, breeding programmes and management practices. The application of IPM will however be dependent on the livestock production system in use, the biology of the parasites associated with the system and being targeted by IPM, the relationship between the parasite populations and the damage to the production system and the extent to which these influence the ability of the farmer to implement control options. The construction of an animal health and welfare plan for each farm will play an important role in developing IPM programme for individual farms.

IPM programmes are becoming increasingly developed as part of extension programmes in the USA, Australia and New Zealand. Despite being developed under different economic and environmental conditions, the underlying principles of each programme are the same. These principles are;

- Correct parasite identification
- Monitoring
- Management Action
- Evaluation of Action

4.3.1 Correct Parasite identification

In order to manage parasite problems each farm must be able to identify which parasites are/may be present and can/will cause a significant problem. For instance, farmers should record fields where flystrike has been a problem and identify the potential reasons why i.e hedges, low-lying fields etc.

The correct identification of scab and lice is crucial in order to apply correct treatment and to prevent chemical resistance developing in mite and lice populations.

In cases of lameness, the correct diagnosis is also important to avoid inappropriate treatments which can lead to further lameness problems.

4.3.2 Monitoring

The monitoring of parasite populations is an important element of developing a risk strategy. Knowing levels of populations will give an indication of when management intervention is required. In both American and Australian IPM programmes the use of baited traps, sticky ribbons or spot cards have been recommended to monitor populations of flies. Indeed, in some Australian programmes, farmers have been recommended to hang sticky ribbons or bait traps near to the farmhouse and when a certain number of flies have been caught on the traps it is then time to take preventative action.

Weather monitoring is also important for strike attacks. Blowfly strikes tend to occur after periods of heavy rain followed by warm weather or during periods of high humidity. Noting weather conditions when treating for strike will allow farmers to build-up a record of when they are most susceptible to strike.

A considerable amount of research has been applied to the modelling of blowfly populations in order to create predictive models which would give early warnings of imminent blowfly waves. Much of this research is still on-going, however, a website has been created which combines weather monitoring with predictive models to create blowfly strike alerts. This website can be found at www.strikewise.com

Monitoring of bought-in stock is also crucial to prevent ectoparasite infestations infecting the home flock.

4.3.3 Management Actions

It is important to take the appropriate management action to control and prevent ectoparasite infestations and lameness problems in flocks. Inappropriate management may will result in further problems. Management actions can be split into four areas; animal husbandry & flock management, genetic improvement, biological/environmental control and the selective use of effective chemicals.

4.3.3.1Animal husbandry & Flock management

Identify high risk sheep (such as weaned lambs) and avoid placing them in high risk paddocks (i.e. low lying fields or sheltered areas).

Crutch sheep to remove soiled wool. In Australia farmers are recommended to clip the wool from the struck are close to the skin and for at least 5 cm (2 inches) into un-struck wool.

Minimise scouring in sheep. There are many different causes of scouring and these should be investigated thoroughly in order to minimise scouring and prevent inappropriate treatment. The causes of scouring can be split into five general categories and include, digestive, infective, parasitic, genetic and toxic. In neonate lambs digestive or infective causes will be the most common causes of scour. In growing lambs dietary, infective, parasitic or toxic causes will be most common. The adult sheep is more likely to suffer from scour caused by dietary, parasitic, infective or genetic in origin. With growing lambs, in particular, many farmers will reach for the drench when they have lambs that are scouring. However, before drenching a Faecal Egg Count (FEC) test should be carried out to ascertain if the lambs are carrying a parasite burden. Inappropriate drenching can lead to anthelmintic resistant populations of worms, which in turn will become impossible to eradicate on a farm.

Re-examine shearing practices. On many farms the blowfly season is relatively predictable due to farm conditions. By changing time of shearing to just before the annual strike season can help to reduce the number of individual animals struck.

Breed type also plays a role as some fleece types create ideal conditions for blowfly strike.

4.3.3.2 Genetic Improvement

Genetic improvement of flocks can be done by two methods; using appropriate selection indices or by culling susceptible stock whilst sourcing replacement stock from flocks that select for the desired trait.

Much of the research relating to genetic resistance to ectoparasites has taken place in Australia. Much of the work has concentrated on resistance /resilience to blowfly strike as this has a high genetic correlation with fleece rot severity in merino sheep (www.dpi.qld.gov.au/sheep). This has created the development of three selection strategies for the farmers

- Direct selection, through exclusion or culling of strike affected animals from the breeding flock
- Indirect selection, using correlated traits such as susceptibility to fleece rot
- Combination of both approaches

In addition farmers should where possible buy in replacement lambs from flocks with known resistance/resilience.

In the UK, however, very few flocks will select animals based on susceptibility to fleece rot as this is not a criteria used in selection indices. What is becoming more common is using a dag scoring criteria. Soiled areas round the rectum provide an ideal habitat for blowfly (moist and protein rich). Dag scores are heritable and ewes and rams which tend to have high dag sores will tend to have offspring that also have high dag scores. Selecting ewes with low dag scores as breeding will result in offspring with low dag scores. This reduction in dags will help to reduce the incidence of breech strike in flocks. The Suffolk Society sire reference scheme now include dag scores along with production criteria for selecting breeding stock.

4.3.3.3 Biological/environmental control

Many of the developments in biological/environmental control of ectoparasites have focussed on blowfly. The research has concentrated on the use bait traps to reduce fly populations. Much of the bait trap work has been carried out by Richard Wall's group at Bristol University over a number of years and the results have been used to build models of fly populations and to predict fly waves. Although the work of Wall's group (Smith & Wall, 1998a, b, Fisher, Wall & Ashworth, 1998) have demonstrated that bait traps can be used successfully to reduce fly populations, there appears to be no or little commercial uptake of the research. Prior to 2001, the company Pestech was set-up by the University of Bristol to develop the commercial aspects of bait traps. However, Foot & Mouth Disease severely affected the market for fly traps and the company folded shortly afterwards. Currently there are no commercial companies in the UK producing bait traps for blowfly trapping.

In Australia commercial traps are available and farmers are advised to set traps six weeks before the expected fly season. In addition it is recommended that greater control will be achieved if neighbours also use traps.

Some research has been done with phermone traps for house flies, however the traps only work over relatively short distances and are only attractive to male house flies. It is unlikely that phermone traps will be developed that are effective in a field situation (Wall, *pers. comm.*)

4.3.3.4 Effective use of chemical treatments

A major tenant of IPM is the effective/selective use of chemical treatments. In order to use chemical treatments effectively the farmer must assess the situation and identify the risks and benefits associated with using chemicals. This can be a daunting task, however, the Environment Agency in conjunction with LSSC have produced an ectoparasite risk assessment strategy for sheep farmers (2002). The risk assessment takes the farmer through each stage allowing the farmer to identify the risks and giving options on minimising the risks. Adopting such processes can help to reduce ectoparasite infestations, reduce unnecessary dipping, reduce stress to animals and ultimately reduce costs.

Where chemical treatments are to be used in most cases it is best to treat individually affected animal and susceptible groups. This will minimise the amount of chemicals used, avoid unnecessary handling of animals and reduce stress to both animals and operator. However, in the case of scab or lice effective control will only be achieved if the whole flock is treated at the same time.

Where chemical treatments are being applied as a preventative treatment, applying treatment at the appropriate time will achieve the best control. In the case of blowfly strike modelling work carried out at Bristol University has demonstrated that appropriate timing of treatment can have a major impact on the incidence of strike in a flock (Wall *et al*, 2002). Three scenarios were tested where treatments were applied mid-season, early in the season or once in early season and once in mid-season. The results predicted from the model suggested that the latter scenario would achieve the best control for flystrike (www.strikewise.com).

Inappropriate use of chemical treatments can lead to chemical resistance developing in the parasite. SP resistance has already been documented in both scab mites and lice (see section 4.1.1). Chemical resistance is accelerated not only by unnecessary treatments but also by inadequate treatments. For chemicals to work effectively, the manufacturers recommendations and guidelines must be followed at all times and the appropriate equipment used.

4.3.4 Evaluation of action

For an IPM programme to be effective, each management action taken must be evaluated. If a management action has little or no effect in reducing the severity of the infestation then it should be discontinued and the reasons for failure investigated. This management action should then be removed from the IPM programme until such times as it becomes a viable management action.

IPM programmes, like animal health plans, are dynamic. They should evolve and adapt to the current circumstances on farm. They should not be seen as tablets of stone that cannot be changed.

5.0 Environmental impacts of approved chemicals

Chemical control of ectoparasites is now widely accepted as an efficient means of treatment. However, many of the chemicals used also have a potential to damage the environment should they come into contact with non-target organisms (Armstrong & Phillips, 1998). The disposal of spent dip presents a particular problem as incorrect handling could lead to a major pollution incident.

During the dipping process chemicals may enter the environment due to splashing, spillage or run-off from drying areas. They may also be carried into water courses on the fleeces of freshly dipped sheep. Once the dipping process is complete there remains the problem of disposing of spent dip. The dip remaining in the bath cannot be covered and retained for use at a later date due to the build up of organic material within the dip. At levels of just 3 –5% of organic material the active ingredient of dips becomes inactive by binding to the organic material, thus rendering the remaining dip in the bath unsuitable for treatment of sheep (Bates, 1999).

Pour-on formulations of ectoparasiticides appear to create less risk to aquatic organisms since the solution is used in lower volume and is better targeted on the sheep's body. However, some concerns have been raised as although smaller volumes of chemical are used it is more concentrated. The potential damage from a pollution incidence with pour-ons could in fact be greater than for dip products. Little information appears to be available on the environmental impacts of these chemicals (Armstrong & Phillips, 1998) as only the chemical group is identified in a pollution incident.

In 2002, 50 sites in England and Wales failed the Environmental Quality Standards (EQS) due to sheep dip pollution incidents. The failures were caused by cypermethrin and diazinon and were mostly due to dipping or wool processing activities. Although the number of incidents in 2002 was higher than in 2001 it was thought to be a reflection of an increase in dipping due to restocking after FMD, greater access to the land by EA field officers for monitoring or improved targeting of the monitoring programme. The increase in diazinon incidents was also thought to be a reflection of its reintroduction after a temporary ban in 2000. In 1997, 52% of pollution incidents associated with sheep dipping were due to SPs and in 1998, 70% were due to SPs. (Environment Agency)

Synthetic pyrethroids are safer than organophosphates in terms of mammalian exposure however, they are of two to three orders (100 to 1000 times) of magnitude more toxic to aquatic fauna than OP compounds (Armstrong & Phillips, 1998). The lower toxicity of SP to mammals may have resulted in the false security in the minds of users, standards committees and certifying bodies with regards to the environmental safety of SP compounds. However, although SP compounds do not accumulate in the body, SP compounds can present short term health hazards such as contact dermatitis and asthma-like attacks. It should be stressed however, that most cases of acute short term SP poisoning have been associated with mosquito control in USA. Symptoms of acute exposure last approximately 2 days.

The toxicity of SP to aquatic invertebrates is such that a similar polluting incident would result in a far greater impact on the receiving watercourse than if the pollutant were an OP compound (Armstrong & Phillips, 1998). SP compounds are also moderately toxic to birds with most LD_{50} values greater than 1000mg/kg (Mueller-Beilschmidt, 1990). Birds and fish are also at risk due to the impact of SP on the primary step in the food chain.

In a survey carried out by the Environment Agency (1998) in Wales in 1997, 26% of farms visited were found to be at high risk of polluting a water course from sheep dipping practices. The major concerns were location of dipping structures, leaky or poorly maintained dip baths and presence of drain holes in baths. The results of the survey were similar to surveys carried out in Scotland (Virtue & Clayton, 1997, Morris, 1997) where poor siting of dipping structure, poor maintenance of structure and poor disposal arrangements were the major factors contributing to high risk farms. It is likely therefore that these poorly sited, badly designed and neglected dipping facilities will be contributing to pollution incidents.

Two surveys undertaken in 1997 and 1998 indicated that the poor management of the dipping operation was a major factor responsible for water pollution by sheep dip chemicals (Scottish Agricultural Pollution Group, 1997; Environment Agency, 1998). Allowing sheep sufficient time to drain off after dipping is a common failure. In addition, draining pens are often of insufficient size relative to the number of sheep being dipped.

Another potential area where pollution incidents can occur is during the disposal of spent dip. The active ingredients of spent sheep dip have the potential to cause pollution to surface or ground waters if disposed of inappropriately. Land disposal is used in order to retain the contaminants at or close to the surface of the soil in order for active ingredients to be degraded by biological processes.

There are at least three routes where spent sheep dip may reach a water source as a result of disposing to land; surface runoff, through-flow or movement downwards to a water table. Where any of these processes are rapid the chemicals carried by the liquid are less likely to interact with the surrounding land and are carried directly to the watercourses.

It should be noted that in order to dispose of spent dip to land by spreading an authorisation is required from the Environment Agency. The authorisation will seek to minimise the environmental impact of the disposal.

In order to spread dip to land using a vacuum tanker it is normally mixed either with water or slurry at a rate of three parts water or slurry to one part spent dip. Disposal of spent dip by mixing with the contents of a slurry store is not recommended by the Groundwater Protection Code: Use and disposal of sheep dip compounds. This is because the whole volume of slurry would then have to be treated as contaminated waste and all areas where contaminated slurry was spread would have to be recorded and grazing animals excluded for the relevant time period.

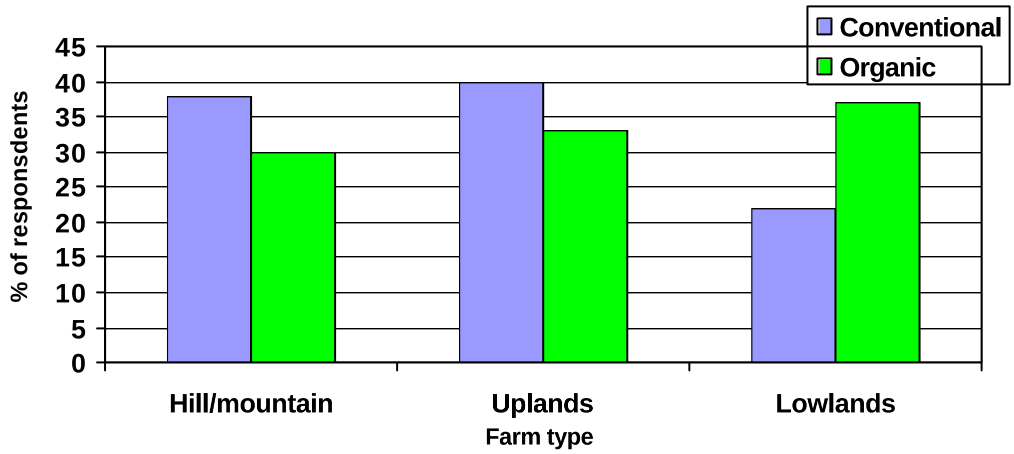
Recent studies, however, suggest that spent dip should not be mixed with the contents of slurry stores as this can lead to an increase in the numbers of faecal coliforms and pathogens present in the slurry (Semple *et al* 2000). These findings have implications for the disposal of sheep dip amended slurries to land such as the amount of time required between spreading and returning grazing animals to the land and the potential for faecal coliforms to enter water sources.

Spent dips also providing a significant risk for bacterial infections if they are not disposed of at the end of the day. In order to minimise the build up of bacterial infections in dips, some manufacturers now include a bacteriostat with their products. A bacteriostat is an antibacterial agent incorporated into the undiluted product or added separately to the dip to minimise bacterial contamination of the dip. Bacteriostats will usually be added at the end of each day's dipping if the dip is to be retained for use the next day or disposed of the next day.

6.0 Current practices amongst Welsh sheep farmers

In order to assess current practices amongst Welsh sheep farmers for the treatment of ectoparasites a survey was carried out. A small pilot trial was conducted at an open day at ADAS Pwllpeiran. Refinements were made to the initial questionnaire and then run at the Welsh Winter Fair. Further refinements were then made and surveys conducted either by telephone or by post. In total 134 questionnaires were completed, with 96 being completed by conventional sheep farmers and the remaining 38 being completed by either in conversion organic farmers or fully registered organic farmers.

Figure 6.1 Percentage of respondents that are farming in the hills, uplands or lowlands



The percentage of respondents farming a particular system is depicted in Figure 6.1. Current statistics for Welsh Agriculture estimate that 79% of holdings with sheep are in the hills and uplands and 21% in the lowlands. The population of conventional farmers surveyed reflect the national trend however the population of organic farmers surveyed had a higher proportion of lowland sheep farmers than the national trend.

Figure 6.2 The percentage of respondents in differing farm size categories

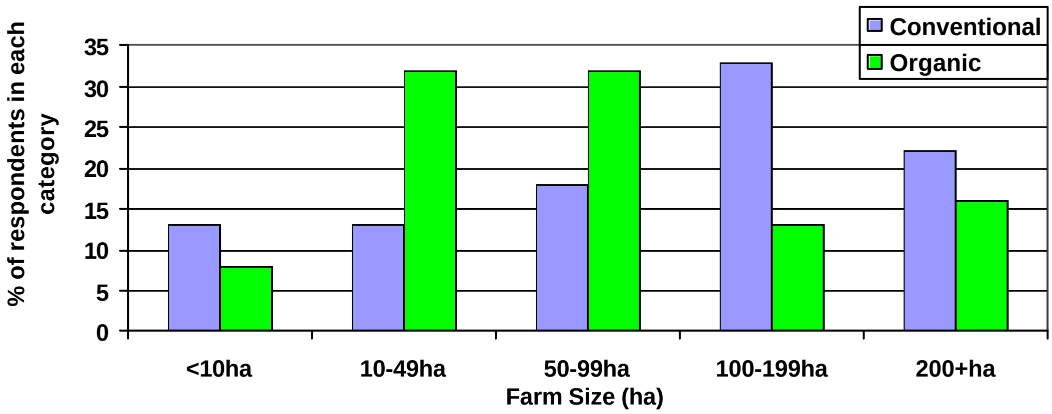
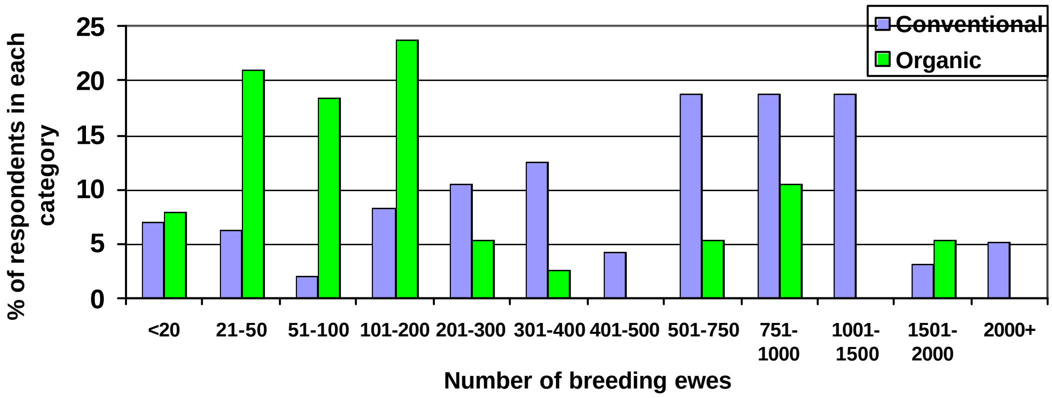


Figure 6.3 Percentage of respondents in differing flock size categories



The average flock size of breeding ewes for farmers surveyed was 716 for conventional farmers and 313 for organic farmers. The average flock size of breeding ewes in Wales in 2001 was 373. The range of flock sizes was 4 breeding ewes to 3000 breeding ewes for conventional farms and 20 breeding ewes to 2000 breeding ewes for organic farms.

22 different breeds were listed for all farms with 10 different crossbreeds listed. 11 different breeds were listed for organic farms with 8 different crossbreeds listed. The most popular breed for conventional farmers was the Welsh Mountain ewe however for the organic farmers was the Welsh Hill Speckle Face ewe.

In the survey, farmers were asked to list the ectoparasites for which they treated their sheep flocks. They were also asked to indicate if they treated their flocks for a combination of ectoparasites or only for scab or only for fly strike.

Figures 6.4 and 6.5 demonstrated the ectoparasites treated and if they were treated in combination or singly. 52.6% of the organic farmers surveyed listed fly strike as a condition for which they treated their flocks. This was comparable with 58.3% of conventional farmers who also listed fly strike. Only 21.1 % of the organic farmers surveyed listed scab compared to 61.5% of conventional farmers. This higher figure amongst conventional farmers is probably a reflection of the fact that they can still treat their flocks prophylatically to prevent scab whereas organic farmers can only treat their flocks with restricted products if they have an actual scab infestation or are at risk from neighbouring sheep. Less than 10% of both conventional and organic farmers surveyed treated for other ectoparasites. Those who did listed lice and ticks as the main ectoparasites.

Figure 6.4 Percentage of respondents who treat to prevent/control for specific ectoparasites

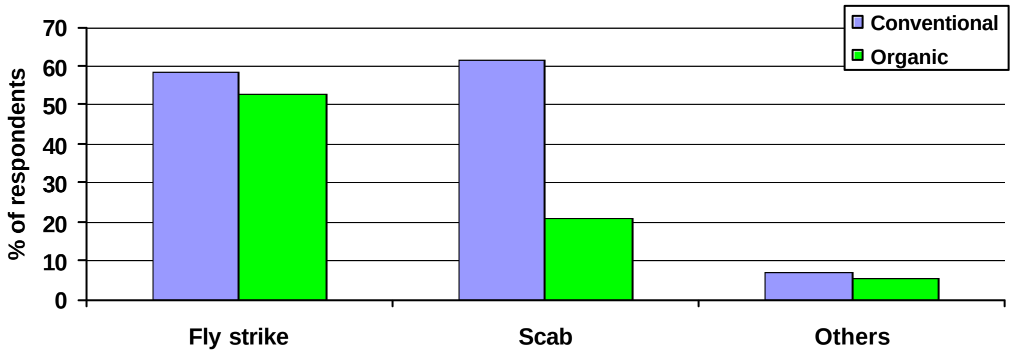
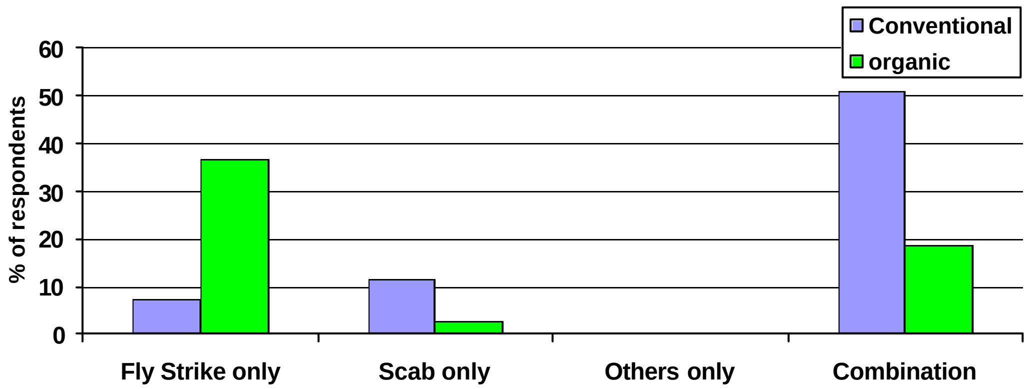


Figure 6.5 Percentage of respondents who treated to prevent/control ectoparasites either singly or in combination



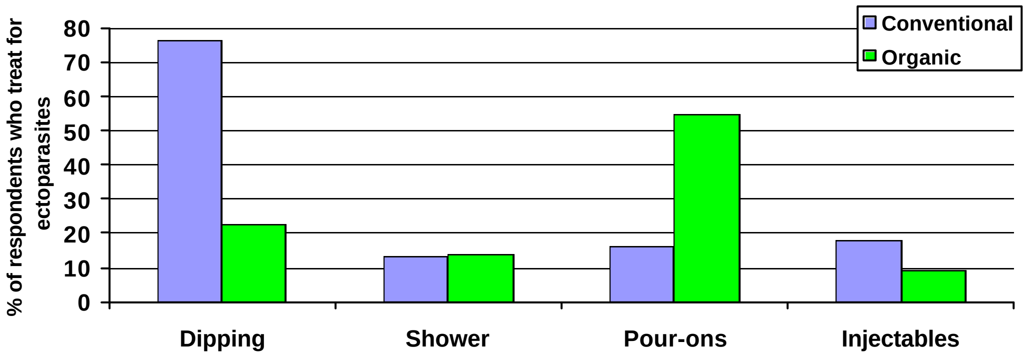
Despite a large percentage of conventional farmers who listed scab as an ectoparasite to be treated only 11.5% of those surveyed treated for scab only compared to 51.0% who treated for scab in combination with other ectoparasite control. A similar pattern was seen amongst organic farmers surveyed where only 2.6% treated for scab only whereas 18.4% treated for scab in combination with other ectoparasite control.

Of the organic farmers surveyed 36.8% treat only for fly strike compared to only 7.3% of conventional farmers. A relatively low proportion of conventional farmers treat for fly strike only given that 58.3% of those surveyed listed fly strike as an ectoparasite that they treated. However, it is likely that most conventional farmers will treat for fly strike in combination with other ectoparasites.

Despite other ectoparasites such as lice and ticks being listed by both conventional and organic farmers neither of these two parasites were treated singly but where always treated in combination with other ectoparasites.

If farmers answered yes to the treatment of ectoparasites questions they were then asked to list treatment methods and these are given in Figure 6.6. 76.1% of conventional farmers who treated for ectoparasites used plunge dipping as the preferred treatment method compared to only 22.7% of organic farmers. The use of pour-ons was higher amongst organic farmers with 54.5% using pour-ons as a treatment method compared to 16.45 of conventional farmers. Sheep showers were only used by just over 13% of both organic and conventional famers. A higher proportion of conventional farmers (17.9%) used injectables compared to 9.1% of organic farmers. This is probably a reflection on the fact that a derogation to use injectables must be sought by organic farmers.

Figure 6.6 Current treatment methods used by respondents to treat ectoparasites

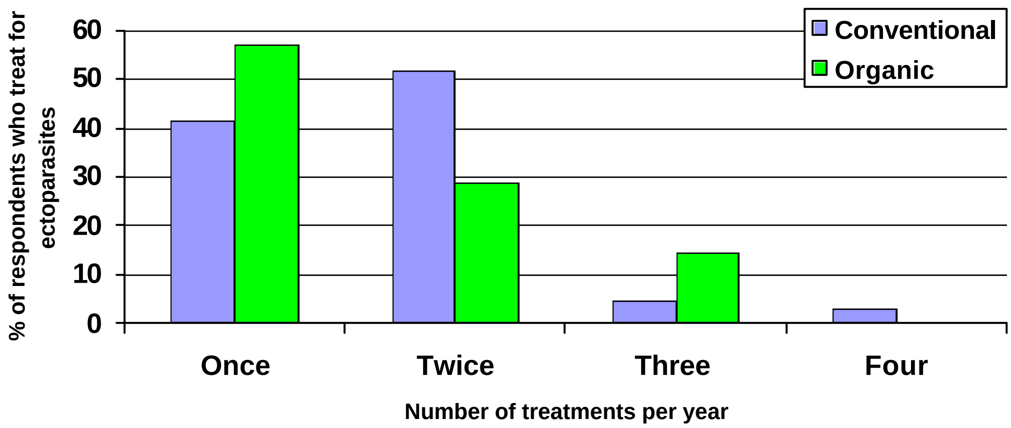


It is interesting to note that some conventional farmers use more than one treatment method and in fact one respondent had used all four treatment methods in one year. The use of multiple treatments was the subject of much discussion within the project team and workshop speakers. The use of multiple treatments is most likely due to mis-diagnosis of the ectoparasite present (P. Bates, *pers.comm*.). When a mis-diagnosis occurs this can lead to inappropriate treatment and can contribute to SP resistance in ectoparasites. The following example highlights the need for a correct diagnosis; A farmer observes itchy sheep in his flock, he assumes it is scab and uses an injectable product. This doesn't solve the problem, so the farmer then assumes the sheep have lice and uses a pour-on product. Unfortunately he still has a problem as the lice population present is SP resistant and consequently he has to dip his sheep to deal with the problem. Such a situation would prolong the suffering of the sheep, impact on animal performance and incur considerable costs as each treatment method was used. A correct diagnosis can reduce the animal suffering and the cost of treatment.

Not all the organic farmers who treated ectoparasites used one of the four main methods of treatment, unfortunately, they did not give further details on the survey form.

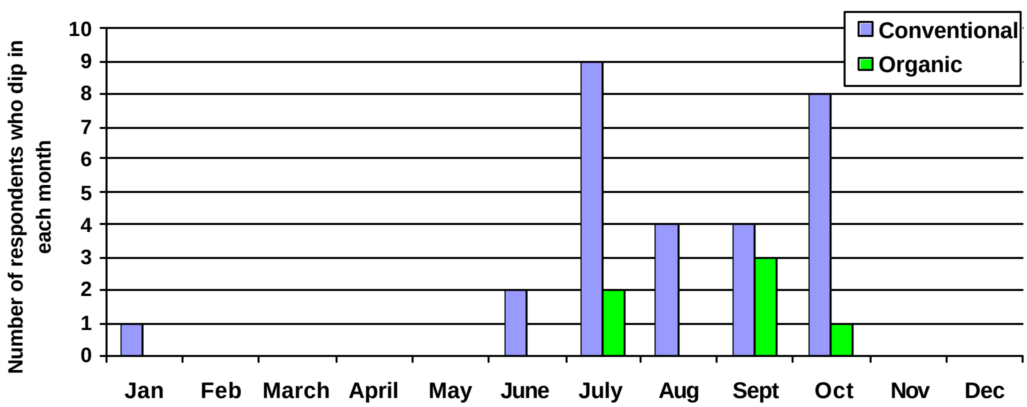
Respondents were also asked to indicate how many times in each year they treated for ectoparasites and the results are given in Figure 6.7. The majority of both conventional and organic farmers treated their flocks no more than twice a year. 57.1% of organic farmers who treated for ectoparasites treated their flocks once a year compared to 41.2% of conventional farmers. 28.6% of organic farmers treated their flocks twice a year compared to 51.5% of conventional farmers.

Figure 6.7 Frequency of ectoparasite treatment



Farmers who used plunge dipping as a control method were asked at what time(s) in the year they carried out dipping. In total 70 of the respondents used plunge dipping as a control/treatment method for ectoparasites of which 10 were organic farmers. 34 respondents dipped once a year (6 organic farmers) and 34 respondents (4 organic farmers) dipped twice a year with 2 respondents dipping three times a year. Figure 6.8 depicts the number of farmers and time of year when they dip for a single treatment only of ectoparasites. Figure 6.9 depicts a similar pattern for respondents who dip twice a year.

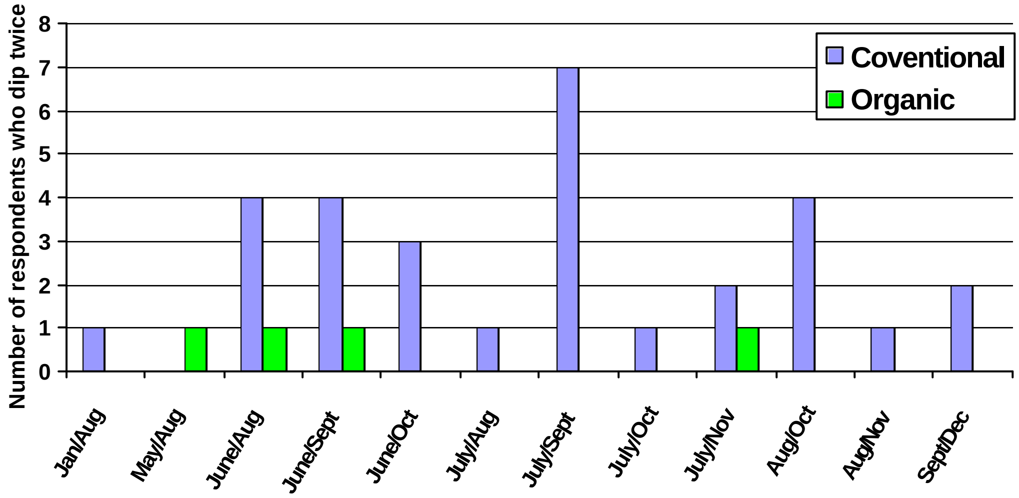
Figure 6.8 Number of respondents who dip only once to treat ectoparasites



Of the respondents who dipped three times a year the dipping strategy was to dip in Jan/July/Oct or July/Sept/Nov.

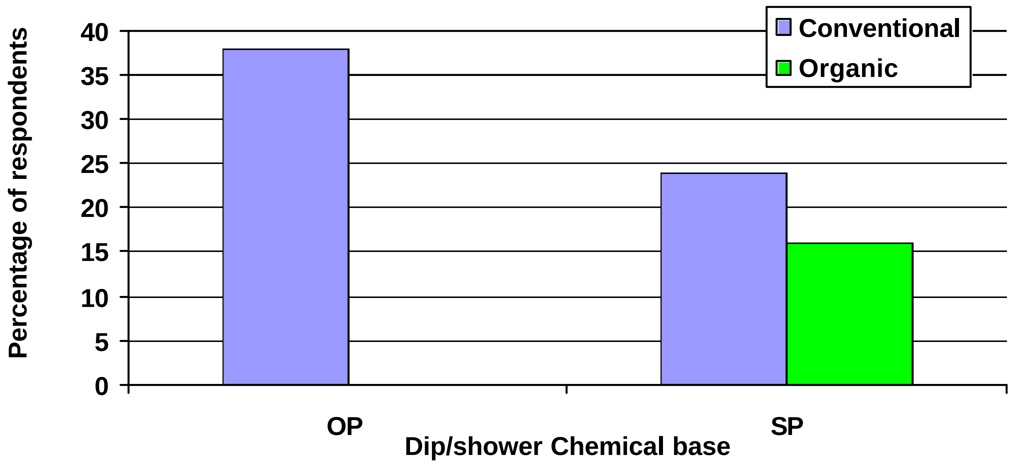
The most common months for dipping were July, August and September for conventional farmers whereas as July and September were the most common months for organic farmers

Figure 6.9 Number of respondents who treat twice a year for ectoparasites



Respondents were also asked a series of questions relating to handling and disposing of dip/shower chemicals, however many of the respondents did not answer all the questions. Figures 6.10 – 6.18 relate to this series of questions.

Figure 6.10: Percentage of respondents who use either OP or SP based dip/shower products



Overall 16% of organic farmers surveyed used an SP based dip product compared to 24% of conventional farmers surveyed. 38% of all conventional farmers surveyed used an OP based dip product. All organic farmers who carried out plunge dipping operations used a SP based product however of the conventional farmers who carried out plunge dipping, 39% used an SP based product.

Figure 6.11 Percentage of respondents who owned their own dipping facilities

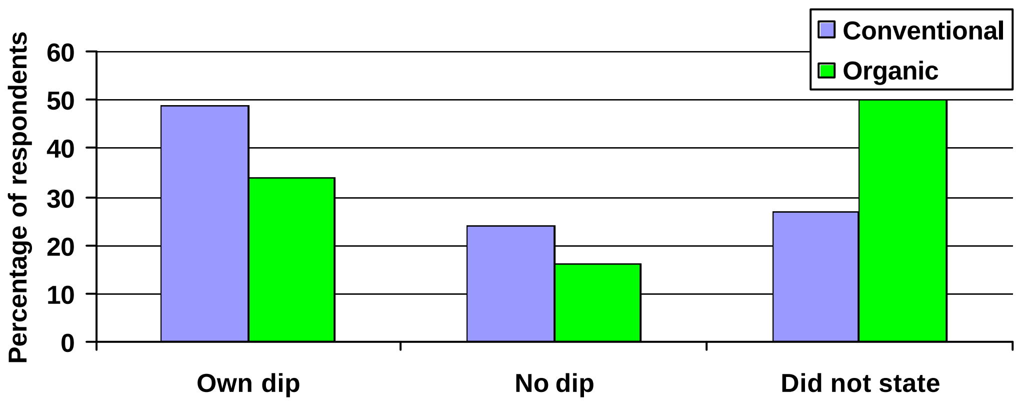


Figure 6.12 Percentage of respondents who used a mobile dipper/shower

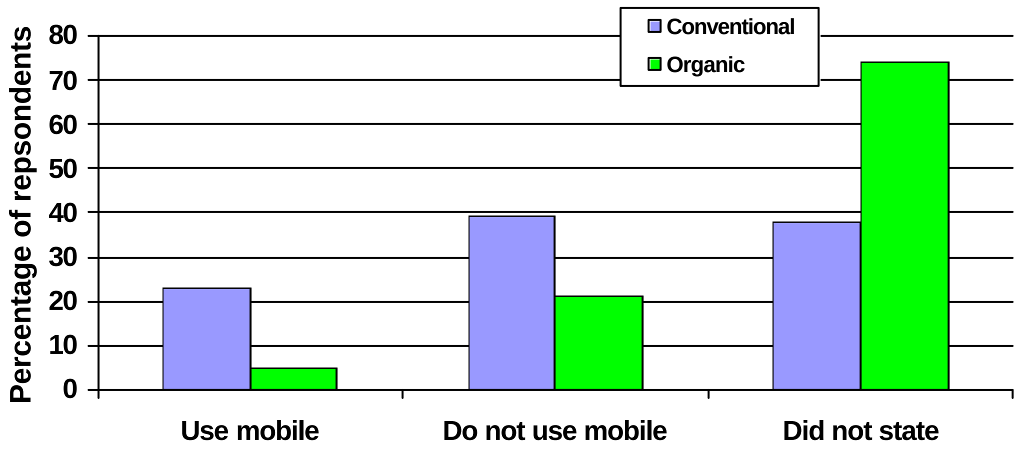
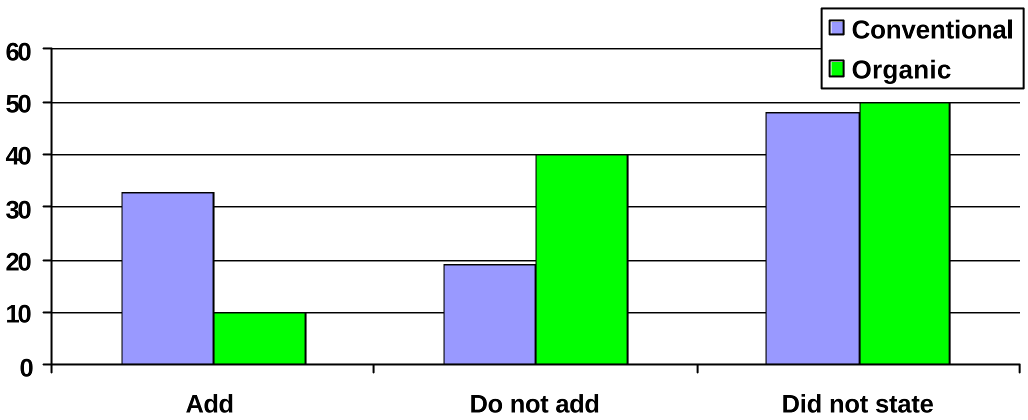
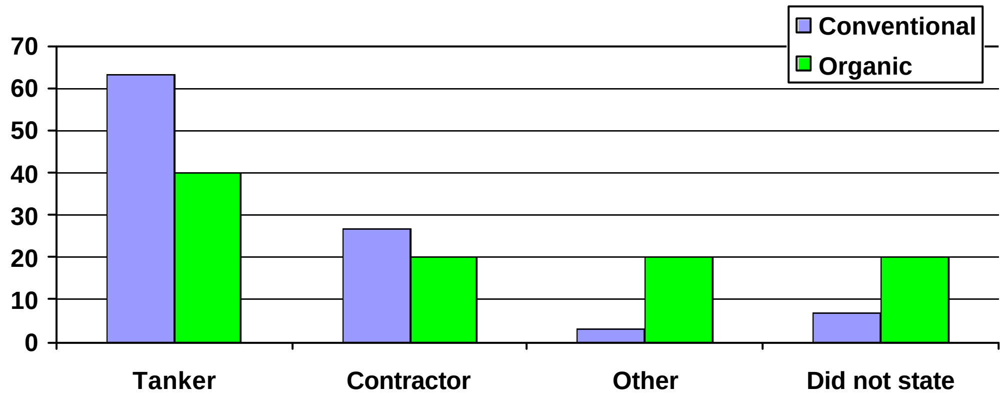


Figure 6.13: Percentage of respondents who use dip/shower products who add a bacteriostat to spent dip either before disposal of dip or when product remains in dipper overnight to be used the following day.



Farmers were asked if they used a mobile dipping contractor to carry out dipping operations and 5% of all organic farmers surveyed used a mobile dipping contractor compared to 23% of conventional farmers surveyed (Figure 6.14). Where contractors were used on organic holdings the contractors were always responsible for the disposal of spent dip, whereas on conventional holdings using contractors for dipping 74% of contractors were responsible for the disposal of dip. On 42% of the holdings using contractors the spent dip was removed from the farm whereas on 32% of holdings the spent dip was spread on the farm land. It is interesting to note that 26% of farmers using contractors in this survey did not know how the contractor disposed of spent dip.

Figure 6.14 Percentage of respondents who dip/shower chosen disposal method



Where farmers carried out plunge dipping, 53% of conventional farmers diluted spent dip before spreading to land compared to 83% of organic farmers who carried out plunge dipping operations. Of all the farmers surveyed who carried out plunge dipping only 1 treated dip with slaked lime before spreading.

7.0 Discussion

The percentage of farmers treating their flocks for ectoparasite infestations is remarkably similar for organic (58%) and conventional (69%) sheep farmers however there is a marked difference in the species of ectoparasites being treated. It is interesting to note that 86% of the conventional farmers who treated their flocks for ectoparasites listed scab as a major parasite compared to only 36% of organic farmers who also treated their flocks for ectoparasites. Overall only 3% of the organic farmers surveyed treated their sheep specifically for scab compared to 11% of conventional farmers surveyed. By contrast, 37% of organic farmers surveyed treated their flocks specifically for blowfly strike compared to only 7% of conventional farmers surveyed. However 51% of the conventional farmers surveyed treated their flocks for more than one ectoparasite infestations compared to 18% of organic farmers surveyed. Despite other ectoparasites such as lice and ticks being listed by both conventional and organic farmers neither of these two parasites were treated singly but were always treated in combination with other ectoparasites. This may be a result of conventional dipping practice where most commercially available dips will treat more than one parasite. However, it may be that many farmers are mis-diagnosing the problem. Many farmers see sheep itching, wool loss and then treat for scab, however in many cases it is more likely to be a lice problem. With lice resistance to SP dips increasing, correct diagnosis is crucial to prevent a nation-wide problem.

From the evidence of several of the completed survey forms however, some farmers appeared to be using incorrect treatment methods. Table 7.1 below attempts to summarise the different control strategies adopted by both organic and conventional farmers to deal with ectoparasites. Some were using injectable products to treat blowfly and/or lice infestations. Injectable products, however, are only licensed for scab treatment. Some were using pour-on products to treat both blowfly and scab but pour-on products are only licensed for blowfly treatment and prevention. In some cases farmers were using multiple treatment methods to treat ectoparasite infestations. The use of multiple treatments or incorrect treatments is largely a reflection of the plethora of products available and suggests a lack of understanding as to which products are appropriate and licensed for the treatment of specific ectoparasites

Over the years several welfare campaigns have been run at a national level by both Defra and NAW to inform farmers about ectoparasites and their treatment. From the results in Table 7.1 it would appear that not all farmers are receiving the message. Effective technology transfer is essential if ectoparasite infestations are to be reduced in the national flock. A consistent message in the control of parasites must be given by all bodies working with livestock farmers.

Table 7.1 Treatment methods used by farmers to treat ectoparasites

	Pour -on	Dip	Shower	Inject	Combination	Other
Flystrike only	2 10	3 1	1 1	1		Combinex
Scab only		9 1	1		Shower + injection	
Flystrike + Scab	1	27 1	4 3	1	Pour-on + Injection (3) Dip + Injection (2) Injection + Jeyes Fluid Dip + Pour-on (5) All treatments Dip + Pour-on + Injection	
Flystrike + others	1				Shower + Pour-on + Injection	
Scab + others		1				
All		2 1			Shower + Pour-on + Injection Dip + Pour-on + Injection	

Blue text and numbers refers to conventional farmers, green text and numbers refer to organic farmers, red text denotes inappropriate treatment.

A number of respondents used showers to apply chemical treatments, however to date no chemicals have been approved for sheep showers in the UK. Although sheep showers are gaining in popularity, their efficacy in the treatment of ectoparasites has yet to be well demonstrated. Research in Australia has demonstrated that showers are less effective than dipping as a treatment method for ectoparasites.

The survey found that fewer organic sheep farmers use SP dips than conventional sheep farmers do. As there are fewer organic sheep farmers overall, there is little evidence that organic sheep farmers contribute disproportionately to the level of SP based pollution incidents.

New control strategies for the treatment and prevention of ectoparasite infestations are needed now for two reasons; increasing resistance to currently available chemicals and new vaccines are some years away yet. The development and evaluation of IPM programmes offer a way forward, which reduce the reliance on chemical treatments whilst promoting good animal husbandry practices and management methods.

8.0 Recommendations

1. 21% of organic farmers surveyed treated their flocks for scab. If this sample is representative of the national organic flock and assuming that the correct diagnosis has been made, it would appear that scab is a major problem with over a fifth of flocks carrying a scab burden. **A further in-depth survey would be valuable to elucidate the extent of the scab problem in the national organic flock**.

2. Both organic and conventional farmers have difficulty in selecting the best/ most appropriate treatment for their flocks. This could either be because the farmer has misdiagnosed his flock or because the farmer is not fully aware of all treatments available. **An educational campaign would help to remedy this problem.**

3. Products are continually appearing in or leaving the market place therefore advisors and certifying bodies need to be continually updated on product developments in order to advise farmers appropriately. **Annual training courses for certifying bodies and advisors to keep up to date with developments in research and products are recommended**.

4. Some certifying bodies recommend that spent dip is treated prior to disposal to land and that stock must not be grazed on such areas for at least one month. Given the potential for SP dips to cause major environmental damage if disposed of incorrectly it is a mandatory requirement that organic farmers are licensed by EA to dispose of spent dip. **Inspectors should ensure cross compliance where organic farmers are using dip**.

5. Certifying bodies will allow the use of SP based dips were an obvious need to dip occurs i.e. in the case of scab. The permitted use of SP dips is based on the lower risk to mammals than OP dips. However, providing the person carrying out the dipping operation has a certificate of competence the risk to human health is minimised for both OP and SP dips. The risk to aquatic fauna is greater with SP than OP dips if correct dipping practices are not followed. With resistance to both SP dips and ML injectables increasing the options open to organic farmers are becoming more limited. **Certifying bodies need to consider all the available evidence as to what chemicals should be permitted to treat scab and other ectoparasites and where appropriate make alterations to the standards**.

6. **Inspection of dips facilities and EA licence should be part of the annual inspection procedures.**

7. **Certification bodies should collate information on dipping practices and dip disposal**.

8. The majority of pollution incidents associated with sheep dip are due to SP compounds. **Where a pollution incident occurs on an organic holding this**

should be reported to the relevant certifying body. The inspector should then work with the farmer and the local EA field officer to prevent such an incident occurring again.

9. Development and evaluation of IPM programmes should be assessed as a management tool to reduce use of chemical treatments whilst promoting good animal husbandry and management. **IPM programmes should be incorporated with animal health plans**

9.0 Technology Transfer

In order to facilitate the transfer of information from the survey a number of initiatives were undertaken as part of the project which included a workshop, a factsheet, and articles in the Cambrian News, Gwlad and Pwllpeiran News. In addition a conference paper has been accepted for BGS/AAB/COR 2004.

The workshop was held at ADAS Pwllpeiran to inform policy makers, advisors, certification bodies and other interested parties of the results of the survey. In order to set the survey results in context the programme also included a presentation on the aetiology of ectoparasites and a presentation on environmental damage of sheep dips. Dr Peter Bates of VLA presented the former and Mr Bob Merriman of EA Wales presented the later. After the three presentations a general discussion was held.

Copies of the factsheet, articles and paper can be found in Appendix 2

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