Sheep Scab: The Disease, Diagnosis, Treatments and Current Legislation for its Control in the UK

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Alasdair Nisbet BSc, PhD
Moredun Research Institute
Pentlands Science Park
Bush Loan
Penicuik
Midlothian
EH26 0PZ
Summary

- Sheep scab, a disease caused by mites infesting the skin of sheep, is a major animal welfare concern for UK producers with economic consequences resulting mainly from the costs of treatment and prevention.

- The Sheep Scab Order 1997 addresses the movement and treatment of sheep affected by sheep scab in England and Wales.

- New Legislation is now in place in Scotland regarding the reporting and control of sheep scab. Producers in Scotland should make themselves familiar with the contents of the Sheep Scab (Scotland) Order 2010.

- It is vital that all flocks that are suspected of being infected with sheep scab be examined by a veterinary surgeon and a definite diagnosis reached. Flockowners should bear in mind that sheep may be infected with more than one ectoparasite (e.g. scab and lice) at the same time as effective treatments may be selected based on this.

- Good biosecurity can prevent the introduction of sheep scab into a flock. Good well maintained fencing will also control the introduction of sheep scab by preventing contact with neighbouring flocks.

- Quarantine all incoming stock for at least two weeks (three if possible) and observe for signs of infestation (nibbling, rubbing, scratching, deranged wool, areas of wool loss etc).

- Sheep scab mites can survive off the host for up to 16 days. Because infested animals seek relief from the irritation by scratching and rubbing on fence posts, trees, bushes, farm equipment etc., these can also be a source of infection. Vehicles and trailers used to transport sheep are also a potential source of infection and should be thoroughly cleaned and disinfected after use.

- Treatment options are currently limited to organophosphate plunge dipping or injection with macrocyclic lactones.

- All treatments should be administered strictly according to the manufacturers’ instructions. The selection of a suitable treatment for scab may depend on integration into the flock’s current worming strategy. Dip-baths must be accurately calibrated and where injections are considered sheep should be accurately weighed.
Introduction
A number of parasites live on or in the skin or fleece of sheep in the UK. Some of these ectoparasites can have a significant negative effect on both sheep productivity and welfare.

Sheep scab, or psoroptic mange, is a form of allergic dermatitis caused by infestation of the skin surface with the scab mite *Psoroptes ovis*. Sheep scab has been identified as one of the five most important diseases for Scottish sheep farmers from both financial and welfare perspectives is considered to be the most contagious endemic ectoparasitic diseases of sheep in the United Kingdom, costing the industry in excess of £8M per year including costs associated with lost performance, preventative measures and treatment.

The economic losses associated with lost performance are the result of loss of ewe condition, poor lamb growth rate, reduced quality of sheepskins and wool damage. Untreated infestations of sheep scab can, in some cases, be fatal.

The Disease
The financial and welfare implications of sheep scab mite infestation are all related to protein loss and the intense irritation and subsequent pathology associated with the feeding of the mites. The mites scrape the host skin with their mouthparts while feeding and deposit faeces directly onto the skin. This is thought to result in an allergic reaction, with intense irritation, resulting in the sheep rubbing, kicking, scratching and nibbling the affected area (see Figure 1 below), with the formation of raw skin and a scab at the site of damage. These welfare issues are compounded by the sheep being unable to rest due to such intense irritation.

Figure 1. Sheep showing the symptoms of sheep scab mite infestation, wool loss at the site of the lesion where the fleece has been pulled out by nibbling, attempts to scratch the affected area and rubbing against fence posts. Image © Neil Sargison
As the disease progresses, the mites move away from the drying scab, outwards across the body and therefore spread the lesion further. The severity of disease varies between individual sheep and also there is some anecdotal evidence of differences between breeds, with more extensive or severe lesions in Lowland breeds.

Sheep scab used to be thought of as a disease of autumn and winter but it is now common throughout the year, though the majority of outbreaks still occur between September and March. While sheep are the main host in the UK, *P. ovis* can also cause psoroptic mange in cattle and there has recently been a cluster of cases of bovine psoroptic mange in Southern UK. There is no evidence that these bovine psoroptic mange cases have resulted from contact with sheep with sheep scab.

The sheep scab mite is usually transmitted by direct contact between sheep. However, because mites can exist off the sheep for up to sixteen days and infested animals seek relief from the irritation by scratching and rubbing on fence posts, trees, bushes, farm equipment etc., these can also be a source of infection. Scab can also be introduced from neighbouring flocks, the introduction of new stock, animals returning from wintering or from shows and this has implications for treatment, quarantine and biosecurity.

**Legislation**

Through a sustained control programme, sheep scab was eradicated from the UK in 1952 but was reintroduced in 1973, leading to a number of outbreaks and the introduction of twice-yearly compulsory dipping. In 1989, this was reduced to one compulsory dip in the autumn and, by 1993, responsibility for all sheep scab control had been devolved to the Industry following deregulation by central Government.

Following deregulation, the number of cases increased rapidly and sheep scab is now considered endemic in the UK. As a reaction to this escalating situation, the Sheep Scab Order 1997 was introduced and this legislation still covers the control of sheep scab in England and Wales. Within the Shetland Isles the Sheep Scab (Shetland Isles) Order 2003 applies, but for the remainder of Scotland new legislation, The Sheep Scab (Scotland) Order 2010 was introduced on the 17th December 2010 following a period of planning and consultation with The Scottish Sheep Scab Industry Working Group, working in partnership with Government to develop legislation to control and reduce the incidence of sheep scab in Scotland.

The current Sheep Scab (Scotland) Order places responsibility for the control of sheep scab on the owner or keeper of the sheep but is also designed to allow enforcement action to be taken against owners and keepers who fail to treat their animals and deal with the disease.

Guidance on the implementation of the Sheep Scab (Scotland) Order is available online at: http://www.scotland.gov.uk/Topics/farmingrural/Agriculture/animal-welfare/Diseases/disease/SheepScab/Guidance and farmers in Scotland should contact their Animal Health Office or Local Authority for full details of their obligations, but some of the key elements are listed on the page opposite:
Key Elements of Sheep Scab (Scotland) Order 2010

- Notification: A person who knows or suspects that sheep or carcases in their possession or in their charge have sheep scab is required to notify the Divisional Veterinary Manager (DVM) of this as soon as possible.

- Movement: Having given notification to the DVM, or received notification from them, the owner or keeper of sheep on the premises must not move any sheep onto or off of the premises unless for treatment, slaughter, as part of a clearance notice or under the authority of a licence.

- Treatment: If the affected sheep are to be kept, they must be treated as soon as possible and written notification of the treatment must be sent to the DVM. The treatment must provide at least 16 days’ residual protection against re-infestation.

Local Sheep Scab Eradication Campaigns:

Where no national eradication or control campaign is in place, locally-organised, collaborative approaches to sheep scab control can be effective in geographically defined areas where adequate biosecurity can be implemented. Such campaigns have previously been successful in the Angus glens, Cheviot hills and in the southeast of Scotland. The success of such regional control programmes revolves around cooperative implementation of control measures within a defined period of time, for example during early October after replacement breeding stock have been introduced but before the start of the mating period. Clearly, one of the main potential obstacles to regional sheep scab control programmes is the complexity of initiating and organising the campaign. Other issues such as farmer cooperation, meat withdrawal periods, feral sheep and the integration of organic farming ventures need careful consideration for the success of the campaign. Although sheep scab control on a collaborative regional basis can be effective, it is unsustainable in the long term unless it involves adjoining regions, ultimately reflecting the need for a nationwide approach.

Diagnosis

Whenever an outbreak of sheep scab is suspected (e.g. signs of persistent itchiness are evident), it is important that flock owners/keepers seek a definite diagnosis.

Scratching and rubbing may indicate sheep scab due to *Psoroptes ovis* infestation, but these signs can also indicate chewing lice infestation with *Boviclova (Damalinia) ovis*. Flockowners should bear in mind that sheep may be infected with more than one ectoparasite (e.g. scab and lice) at the same time and accurate identification of the cause of disease, through consultation with a veterinary surgeon, is critical in definitive diagnosis and selection of an appropriate treatment. Using an inappropriate treatment or treating for the wrong ectoparasite could be ineffectual and may also select for acaricide/insecticide resistance.

Clinical signs in sheep suffering from an advance stage of infestation of the sheep scab mite include yellowish scabs, restlessness, scratching, yellow-stained fleece, wool-loss, head tossing, bleeding wounds and loss of condition.
During early infestation of the sheep scab mite however, animals may exhibit minimal clinical signs but still represent a source of infestation. Similarly, animals which have been infested can become asymptomatic with subclinical infestations (presumably through the development of a protective immune response), and appear healthy but harbour small numbers of mites which reside in cryptic sites such as eyes, ears and the crevasses between the hind legs. Mites are difficult to find, even when their presence is suspected, and the efficacy of the microscopic detection of mites in skin scrapings from sheep can be low. At present, however, confirmation of *P. ovis* infestation is through microscopic examination of skin scrapings by a veterinary surgeon or at an AHVLA Veterinary Investigation centre in England and Wales or a SAC Disease Surveillance centre in Scotland.

An alternative method to diagnose infestation with sheep scab mites, developed by researchers at the Moredun Research Institute, involves the detection and quantification of anti-*P. ovis* antibodies in blood. This diagnostic blood test can reliably detect the presence of *P. ovis* on sheep with high levels of sensitivity and specificity.

Perhaps the most important point for farmers is that this new test can detect *P. ovis*-specific antibodies in a natural outbreak before clinical signs are evident. Therefore, this blood test will be of particular use as an aid to control this highly infectious mite by monitoring and targeting those flocks that require treatment, for example during local eradication campaigns.

This new blood test is currently under development for commercial distribution and it is hoped that it will be available to veterinary investigation centres and disease surveillance centres in the UK in 2012. Moredun scientists are also developing a pen-side diagnostic blood test to enable early and rapid detection of sheep scab mites, and this may prove pivotal to effective control of this ectoparasite.

**Protecting your flock from sheep scab**

Good biosecurity can prevent the introduction of ectoparasites and other infectious diseases in a flock. For sheep scab, introduction of the disease may be through newly purchased infested sheep, direct contact with infested sheep, infested stray sheep, borrowed rams coming onto the farm. The sheep scab mites can persist in the environment for relatively long periods (up to 16 days) and infested livestock lorries or trailers, infested housing, shearers and other equipment can carry parasites from farm to farm.

Purchased sheep may pose a significant risk of introducing parasites in your flock. The early stages of scab infestations may not be easily noticed so it is important to inspect animals for signs of parasites before purchase. Ultimately, it is wise to assume that all sheep being brought onto the farm from whatever source; purchase, returning from away-wintering or summer grazing, stragglers etc. are infested and should be treated in accordance with a risk assessment and veterinary advice and with a product effective at killing sheep scab mites and held in a secure area for quarantine for at least two weeks before mixing with the main flock.
During quarantine observe for signs of infestation (nibbling, rubbing, scratching, deranged wool, areas of wool loss etc). If sheep scab is suspected then (following notification of the DVM if in Scotland in line with the sheep scab (Scotland) order 2010) the sheep should be examined by a vet who will professionally identify the parasite and advise on the correct course of treatment. If you are an organic producer ensure that the treatment advised is permitted by your certification authority.

If you suspect sheep scab on any animal (even one) consider the whole group to be infested. Some animals can carry significant numbers of parasites without presenting with obvious clinical signs.

If possible, ensure that the treatment selected offers residual protection against re-infestation for at least 16 days (see Table 1). Quarantined sheep must not be released into the main flock until treatment is completed and shown to be effective.

The quarantine area can be a barn or other building, a yard or a dedicated paddock/field. It is essential that it is secure and that quarantined animals can have absolutely no contact with other animals. If a group of quarantined sheep was shown to be infested with sheep scab and consequently treated, the empty quarantine area must be left for a minimum of 17 days before introducing new sheep.

It is important that all vehicles and trailers used to transport sheep are thoroughly cleaned and disinfected after use. It is not necessary to disinfect vehicles and trailers with a product approved for animal treatment, there are many conventional disinfectants that effectively kill mites and lice but cannot be applied to live sheep (e.g. Chloros or Virkon).

Anybody having contact with infested sheep (shearers, other contractors, veterinary surgeons) must disinfect their protective clothing and wash exposed areas of skin with hot water before leaving the premises.

Good well maintained fencing will also control the introduction of scab mites by preventing contact with neighbouring flocks. Ideally there should be two parallel lines of fence one metre apart, preventing total sheep to sheep contact. A cheaper alternative would be to use mobile electric netting as a second barrier where there is a potential for sheep to sheep contact.

**Treatment**

Under the terms of both The Sheep Scab Order 1997 and The Sheep Scab (Scotland) Order 2010, the owner/keeper may be served with a notice requiring treatment within a specified period. The sheep must then be either treated with an approved product or slaughtered adhering to the strict movement restrictions enforced where scab is confirmed.

For the most comprehensive and effective treatment, the owner/keeper should warn neighbouring farms and let them know when treatment will begin. This allows co-operation and co-ordination of treatments to ensure that all adjacent flocks are treated within a 2-3 week period. In addition, the suspected source of the infestation should also be alerted to allow treatment to be put into place.
For effective treatment of sheep scab, only injectable endectocides and plunge dippers can be used (see Table 1 below). The application of dips using spray races or jetters is not thought to be effective against sheep scab mites and pour-ons are also considered ineffective. Field populations of sheep scab mites have developed resistance to synthetic pyrethroid treatments and, in the UK, high cis-cypermethrin dips were voluntarily withdrawn by their manufacturers in early 2010, leaving organophosphate (OP) dips based on diazinon and injectable macrocyclic lactones (endectocides, MLs) as the remaining practical treatments.

In terms of product selection, this should be discussed with the veterinary surgeon and/or licensed animal health distributor / SQP to ensure effectiveness, economic usage and also adherence to legislative guidelines.

Table 1. Products for sheep scab treatment and control

<table>
<thead>
<tr>
<th>Class</th>
<th>Active Ingredient</th>
<th>Method of Application</th>
<th>Meat withdrawal period</th>
<th>Comments</th>
<th>Length of persistent protection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organophosphate (OP)</td>
<td>Diazinon</td>
<td>Plunge dipping</td>
<td>70 days</td>
<td>Allow at least 14 days between OP dip and oral drench with levamisole</td>
<td>21-28 days</td>
</tr>
<tr>
<td>Macrocyclic lactone (ML, milbemycin)</td>
<td>Moxidectin</td>
<td>Injection</td>
<td>70 days after second injection</td>
<td>Prevention needs single injection; treatment needs two injections, ten days apart</td>
<td>28 days</td>
</tr>
<tr>
<td>Macrocyclic lactone (ML, milbemycin)</td>
<td>Moxidectin</td>
<td>Injection</td>
<td>104 days</td>
<td>Single injection for treatment and prevention</td>
<td>60 days</td>
</tr>
<tr>
<td>Macrocyclic lactone (ML, avermectin)</td>
<td>Ivermectin</td>
<td>Injection</td>
<td>Variable depending on formulation and manufacturer (28-42 days)</td>
<td>requires two injections to be given 7 days apart for treatment</td>
<td>No claim</td>
</tr>
<tr>
<td>Macrocyclic lactone (ML, avermectin)</td>
<td>Doramectin</td>
<td>Injection</td>
<td>63 days</td>
<td>Single injection for treatment</td>
<td>No claim</td>
</tr>
</tbody>
</table>

Source: VMD website. This list is for guidance only and the full datasheet should be consulted before using any of these products.
The advantages of using ML injections over plunge dipping with an OP, (i.e. safety, ease of use, less stress on the animal, reduced need for specialist facilities, reduced environmental impact) must be weighed against their disadvantages which, as well as the potential for selection for worm resistance, include the following:

- The narrow anti-ectoparasite range of efficacy with MLs means that additional treatments may be required for other ectoparasites;
- ML treatments may have long withdrawal periods (currently 70 days for moxidectin 1%; 104 days for moxidectin 2%);
- After ML treatment, the mites are killed in situ and their faecal allergens and breakdown products may continue to cause irritation and thus sheep scab symptoms for some time after successful treatment;
- It is vital to ensure that the injectable ML selected has a residual action long enough to comply with any legislation [e.g. the Sheep Scab (Scotland) Order 2010].

Plunge dipping using an OP compound remains an effective method for control of sheep scab but the continual use of a single mode-of-action treatment is highly likely to result in the emergence of resistance to OP compounds in sheep scab mites. Plunge dipping in an OP (diazinon) based dip formulation (carried out according to the manufacturer’s instructions) however is still the most effective method of controlling sheep ectoparasites including sheep scab mites. Diazinon is effective (cure and protection) against all sheep ectoparasites and there is currently no known widespread resistance in the UK, though there have been reports of OP resistance in sheep scab mites in South America. Following a single dipping sheep will be protected from re-infestation for approximately 4 weeks. Sheep dips, dipping and dip disposal are all strictly controlled by legislation to protect the user, consumers and the environment. A Certificate of Competence is required to buy sheep dip, a COSHH Risk Assessment is required if staff are employed to dip sheep and under Groundwater Directive 80/68/EEC it is prohibited to discharge dip into groundwater – disposal requires authorisation from the appropriate agency (see below).

Other Considerations:

- **Current Worming strategy** One important consideration when using injectable MLs is the integration of the treatment with parasitic nematode control. The MLs are broad spectrum anthelmintics as well as being highly effective against *P. ovis*, allowing scab mite control and worming to be integrated but also providing a means of the acceleration of selection for anthelmintic resistance in parasitic nematodes if the compounds are routinely used for scab control. It should be noted that, while ML oral drenches are highly effective anthelmintics, they are less than 50% effective against scab when administered by this route.

- **Use of Concurrent Medicines:** Dipping in an OP (diazinon) dip formulation must not be carried out within 14 days of administering an OP or levamisole based anthelmintic drench. Moxidectin should not be injected after administration of certain foot-rot vaccines.
Practicality: All treatments should be administered strictly according to the manufacturers’ instructions. Dip-baths must be accurately calibrated and, for injections sheep should be weighed. Weigh the heaviest sheep in the group and use the dose calculated for this animal to treat all the other sheep.

Size of Flock: Inaccurate application at the expense of speed must be avoided. All contact sheep have to be treated, not just those presenting with clinical signs.

Physiological Condition of the Sheep: Ensure that the selected product is suitable for the age of sheep being treated. Some application methods (e.g. plunge dipping) can be stressful to in-lamb ewes. Studies carried out at the Royal Vet College showed that sheep are stressed through the smell and sight of the dipbath.

End Product: Consumer safety is ensured through the identification of maximum residue limits (MRLs) and withholding times for the sale of meat or milk following treatment. Choice of a treatment may therefore depend on how close finished lambs or cull ewes are to market.

Operator Safety: In the UK, plunge dipping is strictly controlled under the terms of Health and Safety Executive legislation (www.hse.gov.uk/pubns/as29.pdf). OPs can be acutely toxic to man. When using diazinon it is now a legal requirement to use closed transfer systems developed by the manufacturers and introduced in 2001. These consist either of pre-measured, 100 ml, water-soluble sachets or one of two systems involving cans and pumping equipment to add the OP dip concentrate safely to the dip bath. Handling of sheep post-treatment should be avoided. Foot trimming etc should be carried out before or as long as practically possible after treatment.

Environmental Safety: Disposal of sheep dip requires authorisation from the relevant environment agency (SEPA in Scotland, the Environmental Agency elsewhere in the Great Britain). There is some evidence that the MLs administered by injection and voided with the host faeces onto pasture can adversely affect the normal arthropod fauna associated with faecal decomposition.

Purchase: The sale, supply and use of OP dips is restricted to those holding a ‘Certificate of Competence’ (COC).

Weather: Plunge dipping should be avoided in extremes of hot or cold and dipping during heavy rain should be avoided. Sheep should be plunge dipped early in the day, allowing enough time for sheep to dry out before night fall.

Concurrent Husbandry: Shearing, bloom dipping or washing should not be carried out for at least four weeks following treatment.

Frequency of Administration: Some products require more than one application to be fully effective. Frequency of injection of MLs varies with the product.

Organic Producers: If you are an organic producer ensure that the treatment advised is permitted by your certification authority. If a blanket chemical treatment is permitted then it is possible to eradicate sheep scab completely from a flock. Once the ectoparasite has been shown to be eradicated a closed flock policy, based upon the above recommendations for biosecurity can be followed to prevent re-introduction.
The Future

The development of resistance to current chemical classes of ectoparasiticide presents a real threat to the long-term viability of the animal health industry. Alternative control strategies including vaccines, biological control and novel chemical control agents are being actively investigated at Moredun and elsewhere but are unlikely to be widely available in the near future and even then they will be integrated with chemicals used to treat and prevent infestation with scab mites.

Targeted control of sheep scab will rely on accurate diagnosis of the disease. Therefore, the blood test being developed at Moredun will be of particular use as an aid to control this highly infectious mite by monitoring and targeting those flocks that require treatment, for example during local eradication campaigns.

The significant cost of research and development of new therapeutics for livestock, together with the small market share of animal health products is a disincentive for drug development. The ectoparasiticides that are currently available are all that we are likely to have for the foreseeable future and they must be used more effectively. As we have seen regarding SP dip formulations, ectoparasiticides available to producers will probably be "lost" at a greater rate than the registration of new compounds. It is therefore important that we use the remaining products wisely. While the licensed products remain effective, the judicious use of these, coupled with good management systems, will help to control this disease. It will be both interesting and informative to see how the return of sheep scab to “notifiable” status impacts on the incidence of sheep scab in Scotland and this may herald the introduction of new legislation elsewhere in the UK.

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