



EIP WALES

Cydweithio er ffyniant gwledig
Collaborating for rural success



European Innovation Partnership (EIP) Wales

Tackling Scab – a farmer-led approach

Final Report

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PROJECT SUMMARY

This project was funded by the European Innovation Programme (EIP) Wales. A group of farmers collaborated, over a three-year period (2019 – 2022), in the Talybont North Ceredigion area to identify the levels of scab infection within their flocks and the routes of transmission. The longer-term objective was to look to reduce the prevalence of scab in the area, and work undertaken in this project helped contribute to the achievement of this.

The project investigated the effectiveness of farmers from the same area working together to improve scab monitoring and treatment.

It was designed in consultation with local and regional veterinarians. Biosecurity risk assessments and blood sampling services were offered to farmers once they signed up to a protocol relating to treatment and information sharing principles.

A summary of project activity:

- Two face to face farmer orientation meetings at project design stage.
- Two information dissemination face to face farmer meetings -one on-farm.
- Regular OG/specialist project meetings -held virtually.
- Thirty-nine farms were invited to participate, twenty-three actually participated.
- Participating farms benefitted from between 1 and 10 sampling interventions.
- Twenty-three farms in total participated.
- 1,198 blood samples taken for 72 pooled tests.
- There was a total of 45 management groups tested across the 23 farms.
- The highest number of groups tested on one farm was five and the lowest was one.
- All twenty-three farms received veterinarian support, providing management and treatment advice specific to their flocks, based on ELISA blood sample results.
- Modelling of flock infection risk was provided by Moredun Research Institute and Bristol University.
- Specialist expertise from Kate Hovers, Moredun Research Institute, alongside Ystwyth Vet Group advice.
- Liaison and information sharing with Neil Paton regarding the Pan Wales scab management proposal.

The project:

- Increased the level of knowledge regarding scab status within the Ceulanamaesmawr parish
- Improved communication and liaison between the farmers, farmers and vet on the topic of scab management
- Allowed farmers and vet to trial the use of blood sampling as a means of ascertaining scab status within flocks, irrespective of clinical signs.

The project resulted in an increase in the management of scab levels in the parish.

The project provided farmers with increased understanding of flock specific infection routes, diagnosis methods as well as treatment options and the importance of monitoring for infection, even when there were no clinical signs.

It showed how useful the ELISA test is in detecting early outbreaks of scab and before clinical signs are present. The take up of blood testing to assess scab prevalence with or without clinical signs was achieved due to the financial support available, although uptake was not consistent across the farmer group.

Farmers with the majority of the sheep population in the parish participated. Whilst this does not mean that all sheep in the parish infected with scab were assessed as part of the project, the majority of the 'parish flock' participated in the project at some point during the 3-year period, with management groups from the majority of the key farmers in the area (in terms of flock size) participating.

Sheep scab will continue to present challenges as regards effective control, and this project continues to evidence this.

There are still barriers to overcome before effective control of sheep scab is achieved in specific geographical areas, the main risks being quality of communication and trust between farmers regarding farm scab status and subsequent treatment, the cost of infrastructure required to keep scab out of one's holding and the challenges of managing flock health in extensive sheep systems.

Ensuring complete coverage, with all contiguous holdings participating was difficult to achieve. Even when farmers were part of the project, getting them to participate in regular blood sampling to monitor status when there were no clinical signs of scab was challenging.

Funding the veterinary time and blood sampling helped with the uptake of these services, but for several target farmers (participants and non-participants) this funding incentive was still not sufficient to get them to actually take part, or take part regularly.

The project contributed to the evidence base indicating that scab eradication, or more realistically, scab monitoring and management is feasible. This can be achieved with collaboration and communication between farmers about flock management, coordinating sampling and treatment with each other, and being vigilant about sheep movements within and between holdings. The project helps to show that getting this range of activity, consistently and for the long-term, is challenging without external funding and wider industry drivers.

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1 SHEEP SCAB IN WALES

Sheep scab is an infection caused by the mite *Psoroptes ovis*, which spends its entire lifecycle on the sheep. It causes significant health and welfare issues within flocks and is highly contagious.

Each year, sheep scab is estimated to cost the Welsh sheep industry £5.86m¹ through treatment costs and loss of production. It causes serious economic and welfare losses at farm level from reduced stock growth, lower reproductive rate, wool loss and skin damage.

Transmission can occur through contact with infected sheep, fence posts, trees, housing/handling areas and handler clothing. The mites can survive for 16-19 days off the sheep, which makes infection prevention very challenging.

Symptoms of scab infection include intense pruritus (itching), loss of wool, skin lesions and abrasions due to an allergic reaction to allergens contained in the faecal material of the mite. Symptoms take several weeks to appear, which favours the spread of the infection within a flock. However, sensitivity to sheep scab and severity of infection varies between individuals. It is believed that some breeds of sheep may be more susceptible than others. Sheep scab clinical symptoms can be observed for other parasites such as lice. Thus, diagnosis of sheep scab based on observations only isn't necessarily accurate. Treatment options can differ for lice and scab infestations, as such an incorrect diagnosis is crucial, otherwise the wrong treatment may be given, resulting in a waste of time and money as well as prolonging damage to flock health.

The traditional diagnosis for sheep scab involves examination for clinical signs and skin scrapings to look for the presence of scab mites, however, this can be challenging, particularly during the early stages of disease or in sub-clinical infestations, when lesions may be small and difficult to find. As such, the sensitivity of this method can be as low as 18%. Another method, based on an ELISA blood test has been developed by Moredun, which enables earlier diagnosis of infection, potentially before clinical symptoms are seen .

Once infection within a flock is established, it is necessary to treat the entire flock and not just those individuals with signs of infection. Current treatment can be administered by injection using Macrocytic Lactones (MLs) or by an Organophosphate (OP) plunge dip. However, since MLs are also used in the treatment of roundworms, the prevention of drug resistance must be considered.

After consultation with key veterinarians in Wales, it is considered that dipping sheep positive for scab is a more consistently effective treatment than using injectables.

A survey of farmers across Wales was undertaken for an industry led-sheep scab group to assess the prevalence of non-treatment of sheep scab and the economic cost to the livestock industry². Of the 574 Welsh sheep farmers surveyed, almost 30% reported that they did not routinely test or treat their sheep against scab. More worryingly, a further 8.5% of farmers did not treat infected animals. A further 36.5% of the surveyed farmers admitted to having sheep scab in their flocks in the past five years.

Tackling scab is a challenge as sources of infections are not limited to one farm. Risks of infection are either increased by the presence of scab within neighbouring flocks or reduced if those flocks are prophylactically treated. Thus, the risk of infection and optimum treatment approach depends on

¹ Presentation by Arjen Brouwer, Welsh Government, quoting 2010 figures
https://www.organicresearchcentre.com/manage/authincludes/article_uploads/annual_producers_conference/2012/M2%20AB.pdf

² A report produced for an industry-led Sheep Scab group, a sub-group of the Wales Animal Health and Welfare Framework Group (AHWFG)

neighbours' behaviour, especially in the case of extensive/upland grazing systems, and common grazing. The long-term solution is to work towards the eradication of the disease from Wales and the rest of the UK. The best chance of achieving this is if farmers take a collaborative approach to tackling the disease, working with each other, veterinarians and support agencies such as Government, Unions and other specialist bodies.

The project aimed to identify the levels of scab infection within their flocks and the routes of transmission, and then work collectively to reduce the incidence of the parasite in the locality. This collective approach was achieved by regular farm-based risk assessments, knowledge exchange and communication within the farmer group, facilitated by both the vet, the EIP broker and support from other ADAS staff.

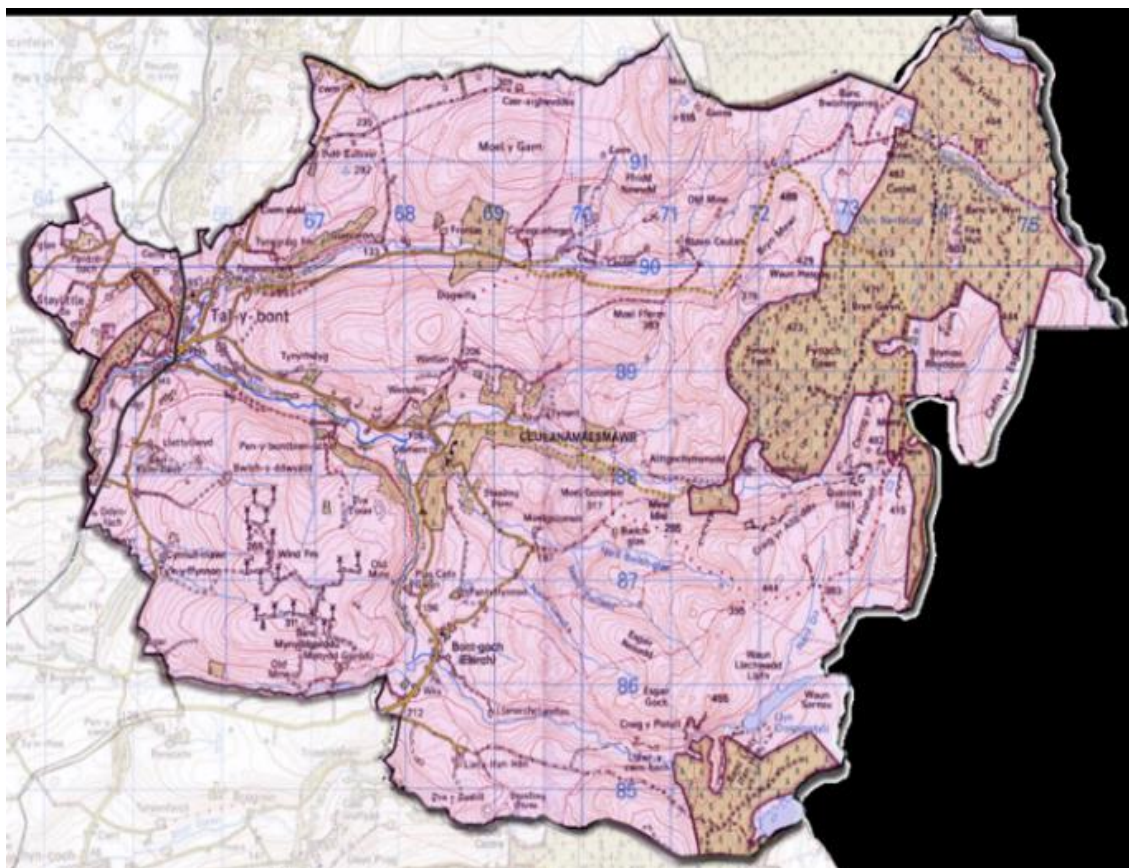


Figure 2: Project area

The outcomes and learning points from the project were collated to share with the group members and for the wider industry in Wales. The project faced challenges related to the Covid situation from 2020 onwards.

The project looked at the effectiveness of farmers from the same area working together to improve the efficacy of scab treatment to increase flock productivity, manage scab and save on animal treatment costs. It relied on using existing, plus new scab diagnosis and treatment techniques in a coordinated way across all farms within the Ceulanamaesmawr parish.

2.3 Project design

At the expression of interest stage of the project, to inform the subsequent application for EIP funding, a literature review was undertaken by IBERS (Aberystwyth University). This is provided in the report appendix and helped guide the project design.

The project was designed and implemented in consultation with:

- Neil Paton, the Royal Veterinary College veterinarian involved in the design of the pan Wales scab management proposal

- Kate Hovers, current National Sheep Association Wales chair, sheep specialist at Wales Veterinary Science Centre
- Dafydd Jones, Ystwyth Veterinary Group, who was the principal vet contact for the farmers
- Stewart Burgess, Moredun Research Institute

The project was divided into several phases, based on farmer–vet interactions (see Figure 3).

2.3.1 Phase 1: Recruiting farmers

This phase was the entry point into the project. Farmers signed up for a scab eradication protocol which outlined the principles of information sharing and consistent scab management. This constituted a signed commitment to partnership working within the group regarding scab management and was the route into accessing blood sampling and support services.

2.3.2 Phase 2: Determination of current scab presence on farm

The second stage of the project was determining the scab status of all involved farms, using the blood sampling ELISA test. Contact was made with each farmer by the project vet (Dafydd Jones), to undertake risk assessments and the blood sampling, which were sent off for analysis using the ELISA test. The vet had to carry out the blood sampling, and this was then sent away for analysis. This service was initially provided by Biobest laboratories in Scotland, and then latterly by the Wales Veterinary Science Centre in Aberystwyth.

Sampling was undertaken on participating farms during 2019 through to end of March 2022, with a halt in activity during the COVID pandemic.

2.3.3 Phase 3: Recommendations and risk assessments depending on farm status

Depending on the results received in Phase 2, the farms followed one of two routes of scab infection management.

Farms that received a positive test were declared as “INFECTED”, while the farms that received a negative test were declared as “CLEAR”.

Phases 2 and 3 were repeated each year, a maximum of three times per sheep group selected by the farmer. Farmers were able to ask for testing on several groups over their holding, depending on funding availability.

2.3.4 Phase 4: Opinion surveys

The last data collection element of the project was the completion of a farmer opinion survey on the project, the current scab status of the farm and their management changes between the beginning and the end of the project.

The project relied on ongoing knowledge transfer and risk assessment work, which included topics such as:

- the efficacy of the chemical treatments used
- trialling of other methods of treatment
- the persistence of scab in the environment
- the level of implementation by the farmers of their risk assessment action plans
- the level and effectiveness of information sharing across the project period

2.3.5 Phase 5: Modelling results by the Moredun Research Institute and Bristol University

With funding available for some additional activities within the project, and emerging closer collaboration with Moredun Research Institute, the project was able to fund the further analysis of the sample results via the modelling tool developed by Moredun and Bristol University, assessing the risk of scab infection across the flocks sampled.

2.3.6 Phase 6: Knowledge exchange via farmer meetings

Farmer meetings were held at the project development and during the project period. These were both face to face meetings, including one on-farm meeting, and virtual calls with the specialists and lead farmers to discuss project progress and emerging results.

The farm-based meeting in summer 2021 provided a networking opportunity, reactivating the project in the final year of activity, to re-establish sampling activity, with farmer liaison support from ADAS. This resulted in an increase in sampling across engaged farmers over the winter period, up until the end of March 2022.

Moredun attended the end of project meeting with farmers, reporting on project results in Spring 2022 in collaboration with Kate Hovers and Dafydd Jones.

Project design

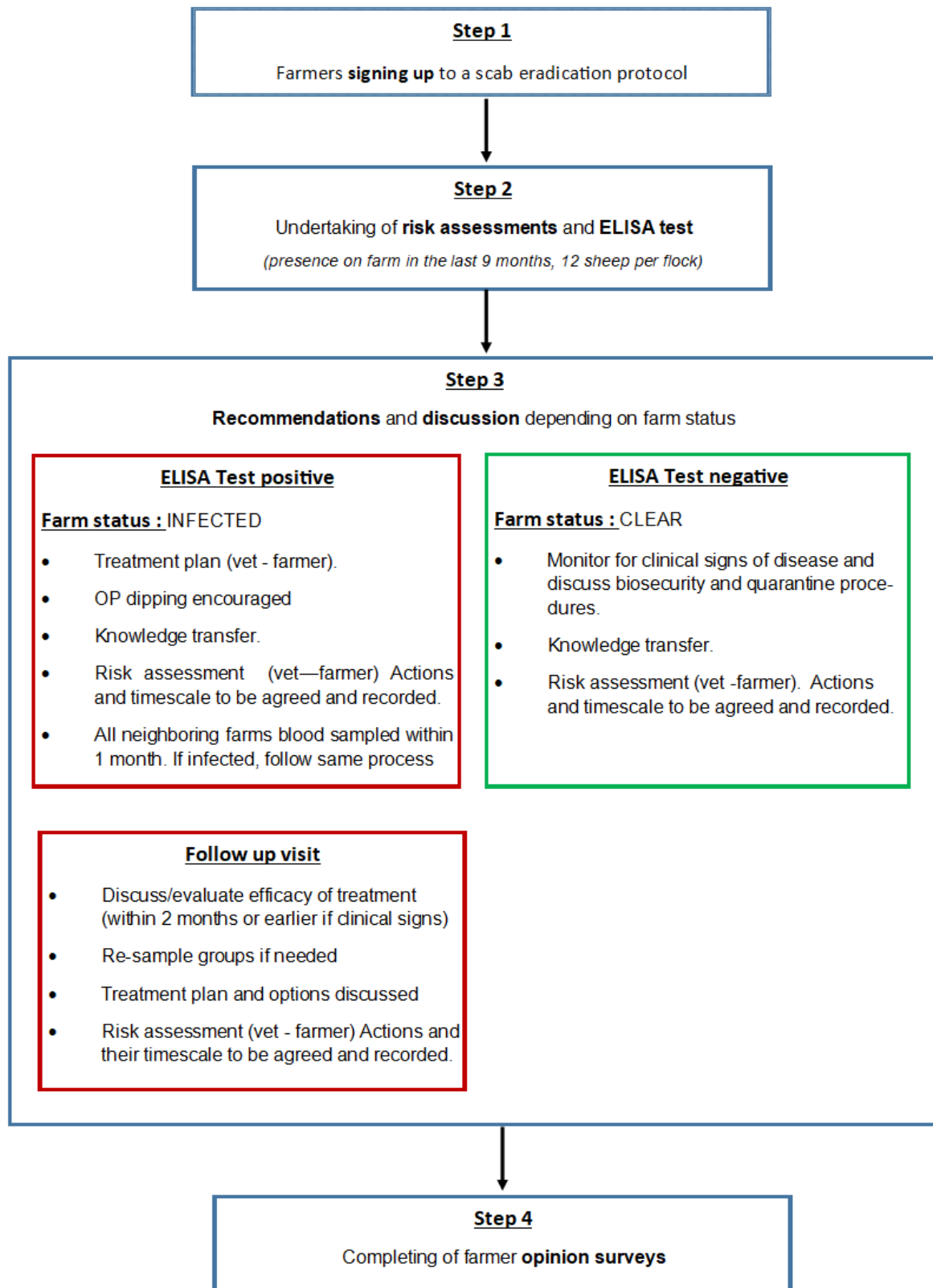


Figure 3: Project design

3 METHODOLOGY

3.1 Recruiting farmers

A total of thirty-nine farmers were contacted and invited to take part in the project, following consultation between the lead farmers, the vet and the broker about who needed to be contacted within the community.

All twenty-three farmers who agreed to take part were required to sign the scab eradication protocol (detail below) which outlined the principles of information sharing and consistent scab management.

Scab eradication protocol sign up.

- I want to take part in the proposed scab monitoring/eradication project.
- I agree to allow my vet to visit my premises as required and to sample the relevant sheep. I agree to help with this work by gathering the animals for sampling on the arranged dates.
- I agree to share the results with both my immediate neighbours (whether they are in the project or not) and with the rest of the group.
- I agree to implementing the bespoke treatment protocol designed in partnership with my vet should scab be confirmed in my flock.
- I understand that the scheme will not cover the treatment cost.

3.2 Sheep scab diagnosis

3.2.1 Risk assessments

The risk assessment was a standard template, used on all farms by the vet with the farmer, in a one-to-one meeting. It assessed biosecurity across the whole farm, focussing on the flock and scab transmission routes and management principles.

The form was designed specifically for the project in consultation with the Operating Group (OG) members, but was informed by those used by XLvets [‘Make your farm a fortress’](#), by the Biobest sample data collection form and built on work undertaken by [Moredun on Mull and Iona in 2013](#)³.

The risk assessment assessed the level of biosecurity undertaken and provided a simple action plan for each farm, outlining areas to prioritise to improve biosecurity. These options included the following good practice principles:

- Maintain fencing and check for gaps/shared rubbing areas
- Double fencing ideal but at least cover high-risk areas
- Communicate with neighbours and co-ordinate treatments
- Select new animals from known sources or health status
- Treat all incoming stock and quarantine for at least 7 days
- Clean any shared handling equipment/facilities prior to use.

³ <https://www.episcotland.org/resources/presentations-by-epic-members/moredun-roadshow-sheep-scab-testing-on-the-isles-of-mull-iona/>

3.2.2 Scab diagnosis: ELISA test

For the diagnosis of scab, the ELISA test was chosen as it can be more accurate than skin scraping and allows an earlier diagnosis. It can detect scab within two weeks of infection, thus before any visible lesions or clinical signs occur.

The ELISA test detects antibodies in the host sheep to a protein found in the sheep scab mite and not in other common parasites, such as lice. It can be used to detect evidence of exposure to scab mites and can pick up an infestation in the early stages.

The developer and initial supplier of the test -Biobest Laboratories- has evaluated the test and used it in a number of different flock types (lowland, upland, hill, with/without common grazing) to determine how it may best be applied. When used to test 12 sheep per flock, the test can provide a useful, accurate insight into flock scab status. Early and accurate diagnosis will allow farmers to quickly treat all animals, both those affected and other in-contact animals, helping to prevent further spread.

The cost of testing at project inception was £9.50 per individual sample (as of 2019, Biobest); £8.50 where two to eleven samples are submitted or £6.00 when 12 animals from a management group are tested. The latter sampling methodology was used during this project -i.e., 12 animals selected from each management group needing tested.

In the first part of the project, blood samples were sent to Biobest laboratories, based in Scotland. Latterly, the WVSC laboratory based in Aberystwyth provided the tests, which allowed the project to access local testing services, which was preferable to both vet and farmers. This project enabled the WVSC to assess their capability in processing these samples and improve their offering to the Welsh farming and veterinary sector.

3.2.3 Recommendations and risk assessments depending on farm status

The results from testing were cross-referenced by the vet with information about flock management and scab control activities from the risk assessment. The vet provided tailored advice to either improve scab control or cut out unnecessary use of OP dips or injectable ML treatments (i.e. treat based on known scab status, rather than treating prophylactically).

The reduction of unnecessary treatment was an important objective as injectable scab treatments are anthelmintics, which are also valuable treatment options for worm burdens in sheep. There is increasing parasitic worm resistance to these medicines in the UK, so broad spectrum use of anthelmintics accelerates the risk of resistance over time. There have also been recent reports of sheep scab mites with confirmed resistance to the MLs. These resistant mites have now been identified in all four UK nations and are likely to spread more widely across the UK flock.

3.2.4 Treatment recommendations

The farm-specific treatment plans were designed in partnership between the vet and farmer to take into account all relevant factors e.g., cost, facilities, time of year e.g., are the sheep heavily pregnant.

Through consultation with veterinarians, including Neil Paton (Royal Veterinary College), it was decided to follow the advice in promoting organophosphate (OP) plunge dipping as the most effective treatment for scab. However, ML injectable products were also offered if dipping was considered not appropriate by either vet or farmer.

The protocol signed by the farmers stipulated that if scab was found via the project funded blood sampling, then the farmer committed to sharing that information with their neighbours and treat their sheep for scab.

The farmers were fully aware that the treatment was to be funded by them (i.e. not covered as part of the EIP project budget). There was therefore a risk that cost implication would play a role in the choice of treatment, but this was discussed between farmer and vet as part of the treatment planning.

Ultimately, the use of OP dip as the treatment option was a decision for the farmer, but the participating vet strongly recommended OP dipping as this is known to be the most effective route to control.

3.2.5 Follow up visit

In the event of positive results for sheep scab and within two months of treatment, the vet carried out a follow-up visit to take further blood samples to evaluate the effectiveness of treatment. Depending on the results, further treatment or monitoring recommendations were made. Skin scraping was carried out on clinically affected sheep.

The full testing and farmer contact process outlined above is visualised at Figure 4 below.

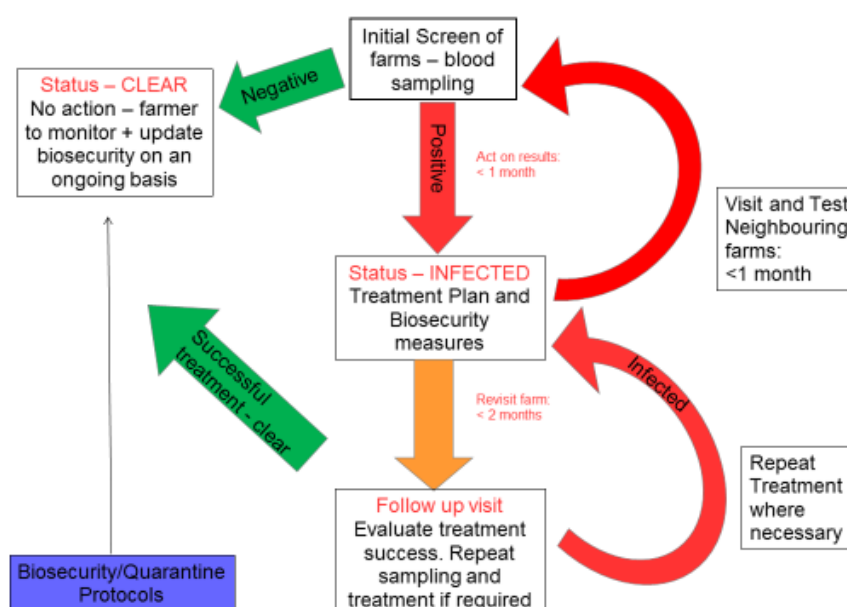


Figure 4: The project testing and farmer contact process chart

3.3 Opinion surveys

Towards the end of the project, farmers (participating and non-participating) were contacted to complete an opinion survey about the project. The topics included biosecurity, current sheep scab management, opinion about the project and their level of satisfaction.

The survey provided insights on how the management of sheep scab on the farms changed during the project and the perception of farmers of the effectiveness and challenges of cooperating between farms.

3.4 Modelling infection burden and risk in the flock

The ELISA tests provide useful insight into the scab status of a flock. The project was latterly able to access Moredun and Bristol University services to run the results through a modelling tool, to assist in assessing scab risk for each flock assessed.

The following provides some context to the modelling tool (detail from Stewart Burgess, The Moredun Research Institute).

Individual animals may test positive but there can be a degree of ambiguity if for example, the results reveal that one or two animals' results are close to the threshold between a positive and negative result. This often results in a need for further monitoring or a re-test, which can erode trust in the test by farmers using it. Moredun, in conjunction with Biomathematics & Statistics Scotland (BioSS) recently developed a new interpretative model to allow a finer level of interpretation of the results of a flock-level screening, providing a greater degree of confidence in recommendations made to vets and farmers.

The model is based on the use of Bayesian statistics and includes knowledge of the previous animal or group's disease status and the results from the ELISA flock screen (report). Previous animal history is used as the believed probability of an animal testing positive, and it depends on different parameters (flock history, use of common grazing etc.) -i.e., the type of information collected in this project at the biosecurity review.

For example, the believed probability of an animal testing positive is higher if the animal is from a group where other sheep have tested positive recently than if there is a long-lasting history of scab-free status. The outcome of the model is the probability of the animal testing positive given its ELISA test results and the overall probability of it testing positive. The result from the model helps to determine if the flock should be treated or not and this prior probability is currently set as >0.5 .

In the case of the current project, the outcomes of the standard ELISA tests and the model interpretation were compared to check if the results from both matched.⁴

3.5 Covid-19 restrictions during the project

During the Covid-19 outbreak, the Welsh Government restricted any non-essential visits to farms, which included EIP activity. Therefore, testing and project farm visits were not undertaken until Spring 2021. In reality, the project got fully underway again after the on-farm meeting with the group in August 2021 with the majority of tests taking place in Autumn through to the end of March 2022.

⁴ Stewart Burgess (Moredun Institute) – email correspondence.

4 RESULTS

4.1 Farmer participation

Farmer participation levels varied over the project period. A total of 39 eligible farms were invited to join at the start of the project.

In 2019, 23 farms participated.

In 2020, Covid made it difficult to keep the involvement of the farmers, with eight farmers withdrawing fully from the project over the Covid period.

Five farmers didn't wish to have further testing done after the first batch of tests in 2019 (the primary reason cited was that their 2019 results came back negative, and they did not feel further testing was necessary).

Thus, in 2020 only 10 farmers took an active part in further testing. This increased to 13 participants in the last year of the project, in 2021/22.

As regards farm characteristics across the group, the majority of the farms run a mix of enclosed and extensive hill grazing systems, mostly with purebred Welsh mountain or Welsh mountain cross breeds. A majority of the farms had upland or hill land (41% and 53% respectively), with only 12% farming lowland settings. Flock size ranged from 100 to 2,000 breeding ewes with an average of 759 ewes.

4.2 Sheep scab results

Sampling results are outlined below. As already indicated, due to Covid, testing and visits were limited during 2020 and 2021 so the results have been spilt into pre- and post-Covid periods, see below.

4.2.1 Pre-covid (2019)

Table 1: Test results in 2019

Number of positive and negative tests in 2019					
2019	1st Test (all farms)		Farms tested	Positive	Negative
	Spring/summer		21	7	14
	Autumn		2	2	0
	2nd Test (farms testing positive at 1 st test)		Farms tested	Positive	Negative
	Spring/Summer		3	2	1
	Autumn		5	4	1
	3rd Test (farms testing positive at 2 nd test)		Farms tested	Positive	Negative
	All year		5	2	3

In 2019, a total of 23 farms were tested and ten of these had suspected scab in the previous two years.

Nine of these 23 farms were positive at the first test but only eight farms agreed to have a second test done.

Only two of these eight had a negative result, the test was usually carried out within two months of the first test.

Five of the six positive (at 2nd test) farms had a third test and only two of them tested positive.

All positive farms during the testing regime implemented treatment and management adjustments, with the above results indicating that these were effective in the majority of cases.

Table 2: Test results in 2020

Number of positive and negative tests in 2020				
2020	1st Test (all farms)	Farms tested	Positive	Negative
	Autumn	10	5	5
	2nd Test (farms testing positive at 1 st test)	Farms tested	Positive	Negative
	Autumn	2	1	1

In 2020, half of the 10 farms were diagnosed with scab. Only two farms had a second test done and one of these tested positive again.

4.2.2 Post-Covid (Autumn 2021 to Spring 2022)

Covid farm visit restrictions were lifted in April 2021 with tests carried out between April 2021 and March 2022. Thirteen farms were tested with seven of them positive. Five of the positive farms had at least one further test carried out, with the majority of them still testing positive at this second test, indicating that for these farms, scab treatment and management was proving a challenge for them to implement effectively during the time period.

The project relied on farmers voluntarily putting themselves forward for testing -the farmers tended to not actively request testing and the project relied heavily on the liaison support provided by ADAS in the period August 2021 to March 2022 to get farmers to participate.

As a result, the thirteen farmers involved in the post COVID testing programme were ones that were more accessible, wanting to participate and made the time for the vet to come and test management groups, understanding the benefit of sampling information for flock health decisions. Sample results from this 2021/22 testing programme form the basis of future scab management protocols for these thirteen farms, moving forward post-project.

Table 3: Test results in 2021/2022

Number of positive and negative tests from Autumn 2021 to Spring 2022				
2021-22	1st Test (all farms)	Farms tested	Positive	Negative
	2021	6	4	2
	2022	7	3	4
	2nd Test (farms testing positive at 1 st test)	Farms tested	Positive	Negative
	2021	2	1	1
	2022	3	3	0
	3rd Test (farms testing positive at 2 nd test)	Farms tested	Positive	Negative
	2021/2022	3	1	2

4.3 Modelling infection burden and risk in the flock

The modelling from Moredun provided four possible outcomes:

- No action required – original (tests in tables above) and model interpretation negative
- Agree - original and model interpretation positive
- Reflection – original interpretation positive and model interpretation negative
- Error – original interpretation negative and model interpretation positive

The modelling work was done towards the end of the project, so its ability to influence management decisions during the lifetime of the project was limited. The information was made available to both vets and farmers to inform longer term decisions regarding scab management.

Table 4: Modelling results

	Agree / No action required	Reflection	Error
2019	80.4%	17.4%	2.2%
2020	92.9%	7.1%	0%
2022	92.5%	7.5%	0%

Overall, the model results and the actions taken based on the blood sampling only matched well.

The model would have improved the recommendations for the tests with the “reflection” outcome (13 results over three years). For those tests, the recommendations given could have focused more on monitoring rather than treating animals, on an on-farm basis. This would have helped further reduce unnecessary treatments.

However, the model only reports on blood test results and does not consider the appearance of clinical signs (unless stated in the data) and also does not reflect any contiguity between properties or other risk factors, which could have influenced the advice given on the ground.

In addition, the model is probably better at highlighting a positive outcome, as it provides a visual presentation of the results. If results are purely presented numerically in a spreadsheet a single positive value may be missed, especially where multiple groups are included in a single report.

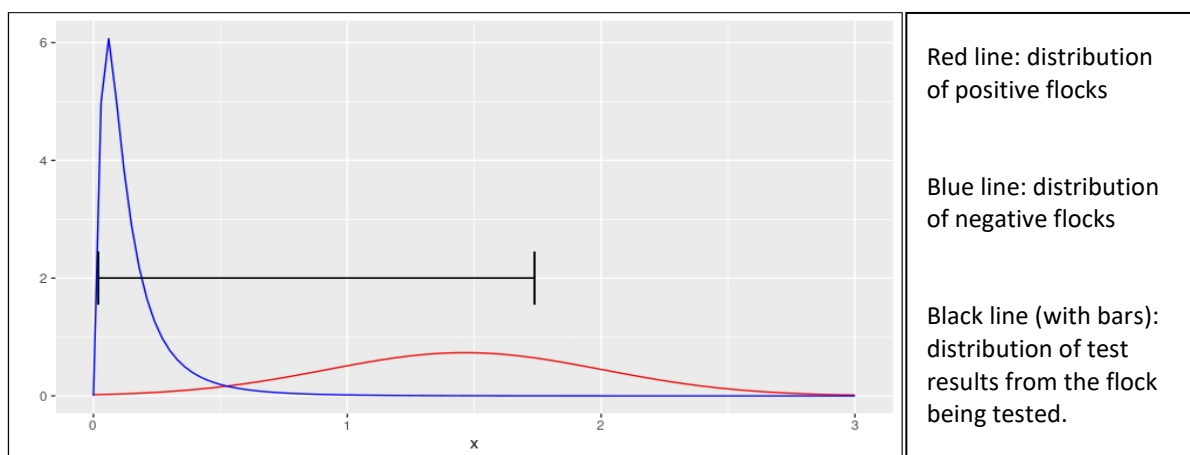


Figure 5: Single positive model interpretation

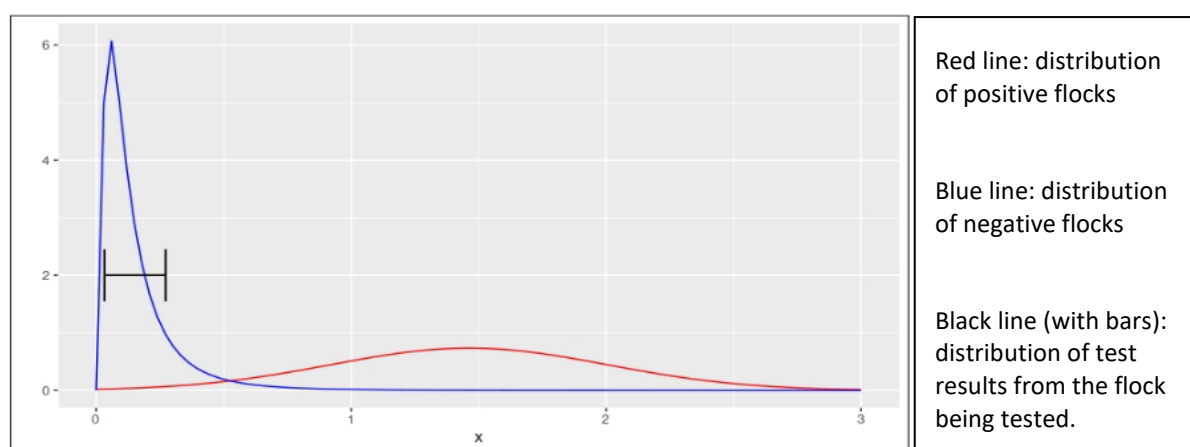


Figure 6: Single negative model interpretation

4.4 Farmer behaviour

The following information was gathered either during the initial risk assessment which was completed when farmers joined or in the final questionnaire (n=9), completed at the end of the project. Although the farmers completed the questionnaires, they were not always able to provide answers to all questions. Thus, some of the questions are based on a lower number of answers.

The initial risk assessment assessed biosecurity across the farm and focused on the flock and scab transmission routes and management principles. The final questionnaire covered topics such as biosecurity, previous and current sheep scab management, opinion about the project and their level of satisfaction.

4.4.1 Scab diagnosis and treatment

Sheep scab diagnosis and treatment is essential for controlling sheep scab on the farm. Before the project, only two farmers out of nine (farmers that completed the final feedback questionnaire) used skin scraping to diagnose sheep scab while all of them looked for clinical signs. Only one out of nine used routine treatments. The trust in tests depended mainly on previous experience. At the end of the project, all surveyed farmers (n=9) seemed to agree that both the ELISA and skin scraping tests are useful although the ELISA test detects scab earlier but is less convenient. Across all surveyed, sheep brought in from outside the farm are usually not tested before being mixed with the flock.

Based on the first risk assessment completed with each farmer at the start, 14 farmers had treated their flock against scab within the last 12 months. Nine of them had used OP Dip (Gold fleece) and five used injectables (Zermex or Dectomax).

According to the nine farmers that completed the end of project survey, only four of them used routine preventive treatments before the project started: mainly using OP Dip via plunge dipping.

Four reported that they changed their control strategy over the life of the project by starting to use DIP (three) or injectables (one).

Two farmers changed the treatment period and three farmers have been isolating and/or treating incoming sheep more often.

However, respondents indicated that they usually treated the whole flock, not only the affected group.

One farmer reported that he couldn't do any preventive treatments, requiring proof of infection before administering medicine, due to restrictions associated with the organic certification rules.

4.4.2 Biosecurity

Common grazing, new incoming sheep, using contractors and sharing facilities or equipment with other farmers are increased risk factors for sheep scab. Regarding biosecurity on farms, before the project only one farm was double fenced and two farms used common grazing. Nearly half of the participants used contract shearers (47%) while fewer used contract dippers (18%), sharing gathering facilities (18%) or livestock trailers (12%).

According to the final questionnaire (n=9), two farmers had installed double fencing and a third farmer was planning to do the same. Farmers reported having reduced the use of contractors or sharing of gathering facilities and livestock trailers. It was also reported that three farmers now increased the treatment or isolation of incoming sheep on the farm (usually rams) compared to three years ago.

One farmer reported that working with his neighbour and coordinating treatments following positive ELISA test results helped scab control on both farms, and that this project had helped reiterate the value of this method of working.

4.5 Challenges faced by farmers and vets

The local vet reported that the main challenge was project uptake with half the farmers in the area not wanting to participate at the start. Covid was an extra challenge which caused a loss of momentum.

According to farmers and the vet, there will be future challenges regarding sheep scab in the area. The main barrier stated was the difficulty for farmers to be open about the scab status of their farms and to work together. The feedback confirmed that although some farmers are willing to communicate with their neighbours, it can be harder for others. Unfortunately, if one flock is positive for sheep scab and it isn't treated effectively, it makes controlling sheep scab on neighbouring farms more difficult.

4.6 Participant feedback

4.6.1 Farmer feedback

Out of 20 farmers contacted, nine participants and two non-participant farmers agreed to complete the feedback survey at the end of the project.

Overall, farmers were moderately to very satisfied with the project. Farmers recognised the usefulness of the project in sharing knowledge about sheep scab and ways to diagnose, treat and control it.

However, participating farmers wished that more of the farmers had participated to improve the effectiveness of on-farm treatments and sheep scab control in the area.

4.6.2 Vet feedback

The local vet was satisfied with his participation levels in the project and believed that it increased awareness of the issue of scab and management options amongst participating farmers.

He noticed changes in scab management on some farms as a result of the project. These changes included:

- increased dipping -both as a result of positive test results, but also on a precautionary basis (not based on results) based on farmer concerns regarding exposure
- testing specific management groups
- testing specific sheep after purchase and before introducing them into the flock
- testing sheep coming back from seasonal grazing, before introducing them into the main flock
- trialling testing of rams pre and post tupping to assess tupping group scab status.
- a move from ML injectables to dipping for some, with a clear reduction/eradication of scab in the flock

Several farmers used the testing to check their perceived scab free status. Once this was confirmed with a one-off set of sampling, getting further engagement for regular sampling was challenging. For those with positive scab results, continuing engagement was much easier, but even then, once continuing testing indicated scab was no longer present, further engagement of some farmers was a challenge. A minority of participants valued on-going testing, irrespective of their previous testing results.

Regarding long term farmer behaviour, the vet is not convinced farmers will continue routine test without external funding and facilitation (or without more stringent regulation/supply chain demands).

A general feedback theme was that without external support farmers were not inclined to take a proactive approach to managing scab as a group. Individuals within the group were very proactive, but a collective management approach was very hard to instil effectively.

Prior to the project the vet did not use blood sampling routinely to establish scab status on-farm. The project provided knowledge to the vet on the different diagnosis methods, communication and administration work for such project. In the future, the vet will be using more blood testing in

combination with skin scraping to monitor the situation as this approach provides reassurance in the recommendations given.

Farmers who didn't take part in the project indicated that this was primarily due to the low participation of other farmers and that they didn't think it was worth participating in the project if other farmers in the area won't do anything about reducing scab on their farm.

4.6.3 Participating laboratory feedback

The location of the project and the involvement of an Aberystwyth based vet, and a specialist independent associated with the WVSC helped the WVSC look to offer the ELISA laboratory analysis service to its customers, which was not available at the outset of the project. The WVSC was able to use the demand for ELISA analysis from this project to establish and proof this offer from its laboratory. Therefore, the project helped improve the laboratory testing services available to farmers in Wales, increasing the range of support for Welsh sheep farmers and veterinarians.

5 CONCLUSION AND LEARNINGS

5.1 For the participating farmers

Overall, farmers were generally satisfied with the project. The project:

- increased the level of knowledge regarding scab status within the Ceulanamaesmawr parish
- improved communication and liaison between the farmers, and between farmers and the vet on the topic of scab management
- allowed farmers and vet to trial the use of blood sampling as a means of ascertaining scab status within flocks.

The project certainly resulted in an increase in the management of scab levels. It is not possible to say whether the project reduced scab incidence across the parish, due to the voluntary nature of participation and the limited time period and budget available to the project.

The project provided farmers with increased understanding of flock specific infection routes, diagnosis methods as well as treatment options and the importance of monitoring for infection, even when there were no clinical signs.

It showed how useful the ELISA test is in detecting early outbreaks of scab and before clinical signs are present.

The project demonstrated good outcomes for the participating farmers, some of whom modified their strategy against scab according to the recommendations given. An example is that more farmers are now choosing to dip in the area, and are basing this treatment on monitoring, either via wool samples and/or via blood testing.

It is unclear however whether farmers will continue regular testing due to the cost associated with the requirement for a vet to undertake the blood sampling and the cost of analysis.

It was clear that the take up of blood testing to assess scab prevalence with or without clinical signs was only achieved due to the financial support available, and even then, uptake was not consistent across the farmer group.

However, some participants have continued to test for scab using blood tests after the project end. This is as a result of both the farmer and the vet being more aware of the value of blood testing to assist in flock health management and having had experience through the project of this diagnosis option.

Project impact was negatively affected by the challenges associated with relatively low levels of active farmer participation across the lifetime of the project. Understandably, COVID exacerbated this, with the number of participants dropping in 2020 before slightly increasing in 2021/2022.

Whilst farmer numbers were not as high as originally hoped, it is true to say that the farmers with the majority of the sheep in the parish participated. Whilst this does not mean that all sheep in the parish infected with scab were assessed as part of the project, the majority of the 'parish flock' participated in the project at some point during the 3-year period, with management groups from the majority of the key farmers in the area (in terms of flock size) participating.

Sheep scab will continue to present future challenges, and this project results evidence this.

There are still barriers to overcome before effective control of sheep scab is achieved in a specific geographical area, the main barriers being a lack of communication and trust between farmers regarding farm scab status and subsequent treatment.

Ensuring complete coverage, with all contiguous holdings participating was difficult to achieve. Even when farmers were part of the project, getting them to participate in regular blood sampling to monitor status when there were no clinical signs of scab was challenging.

Funding the veterinary time and blood sampling helped with the uptake of these services, but for several target farmers (participants and non-participants) this funding incentive was still not sufficient to get them to actually take part, or take part consistently.

5.2 For the wider industry

The project provided learning and piloting opportunities for the wider industry.

Local veterinary expertise was further developed, with an increased use of blood sampling to assess scab status, irrespective of clinical signs. Vets, farmers and the local animal health laboratory were able to work together to provide better quality scab status/management advice services for the North Ceredigion area and are now in a position to continue to do so longer-term.

As a result of the project, the WVSC laboratory in Aberystwyth had the opportunity to develop the ELISA test offer in-house. They were not able to do this previously as the laboratory did not hold a home office licence to bleed animals for test-developing purposes. As a result, WVSC is the only laboratory in Wales offering the ELISA blood test and only the second commercial laboratory in the UK. It has also expanded the laboratory's services and put it in a position to offer testing for the future *All Wales Scab eradication programme* and will hopefully help with farmer engagement and increased farmer awareness of the services offered by the laboratory. The project has therefore assisted in this work and associated funding/income to be kept within Wales.

Liaison with Neil Paton and the National Sheep Association (via Kate Hovers, support vet and also NSA chair) resulted in this project helping inform the development of the pan Wales scab management proposal. Collaborative working and information sharing was key, benefiting both the design and implementation of both the EIP project, and the pan-Wales proposal.

5.3 Recommendations for future projects

The project provided key learnings regarding the organisation of such initiatives in Wales.

- Good project design and organisation are essential to the success of this type of project.
- Sufficient administrative resource is required to support the project; for example, to contact and chase farmers to maximise engagement to achieve the project aims.
- Another key learning outcome was the communication required to persuade farmers to take part. Some level of neighbour-to-neighbour peer pressure occurred in this project, but more is required if projects such as this are to achieve their objectives.
- A higher level of veterinary support would be useful -the veterinary expertise is what these health projects rely on, both technically and to provide the project credibility with the target audience. The involvement of a range of veterinary expertise, in part to support each other (as their resources are very stretched), adds value and reduces project risk. The involvement of Kate Hovers and Moredun during this project was a real benefit as regards ensuring momentum and providing a pool of expertise. Having this available at the project outset would have helped drive even better value from the initiative.
- If sector agencies are wanting farmers to actively participate in the on-going monitoring of scab status via blood testing, then this needs to be financially incentivised. Uptake of this would be increased if the cost of treatment costs was also subsidised.

It is easy to reflect on the things that were not achieved during this EIP project, when in fact the benefits at both a farmer level and for the wider veterinary support level are clear.

Scab eradication, or more realistically, scab monitoring and management is feasible and can be more easily achieved with collaboration and communication between farmers about flock management, coordinating sampling and treatment with each other, and being vigilant about sheep movements within and between holdings.

The project has helped further understand both the opportunities and challenges associated with scab management, from a farmer and supporting farm vet perspective.

APPENDIX: LITERATURE REVIEW – CONTROL AND TREATMENT OF SHEEP SCAB

The following literature review was undertaken by IBERS (Aberystwyth University) at the outset of the project at expression of interest stage, to inform the subsequent application for EIP funding. The text below is the literature review detail as provided by IBERS to Menter a Busnes at the project expression of interest stage.

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A search of the scientific literature on the control and treatment of sheep scab demonstrates that this disease is of high importance throughout the UK as it leads to production and economic losses and also represents a significant animal welfare issue. Changes in legislation have led to an increase in outbreaks in subsequent years, however, there has been some success with community driven regional control programmes. There are new methods of control on the horizon, but these will not be available in the near future, therefore management strategies are likely to be the only way forward at present. Inadequate diagnosis of infection appears to be a major driving factor in the incidence of sheep scab, but the advent of a new ELISA test developed by Moredun, aims to improve on farm diagnosis. Compulsory control programmes have been used to great effect in the past, but today changes within the sheep industry such as a general increase in flock size, increased movement of sheep and concerns over residues in meat for human consumption, make the compulsory control of sheep scab more challenging.

Introduction

Sheep scab is caused by the non-burrowing mite *Psoroptes ovis*, which spends its entire lifecycle on the sheep. *Psoroptes ovis* infection is highly contagious and can cause significant health and welfare problems within flocks. Mites are capable of surviving off the sheep for between 16-19 days, therefore infection can also arise from contaminated sources such as fence posts, trees, areas of housing and handlers clothing. Therefore, the transmission of infection is an important consideration. The presence of the mites on the skin causes an allergic reaction resulting in intense pruritus (itching), loss of wool, skin lesions and abrasions which can be made worse by opportunistic bacteria. Symptoms may not appear for several weeks, allowing the infection to spread amongst flocks before treatment is administered. However, the severity of infection largely depends on the individual sheep and some breeds of sheep may be more susceptible than others. Therefore, visible symptoms may vary between and amongst flocks. Obtaining a correct diagnosis is paramount, as a waste of time and money can be spent on inaccurate diagnoses along with further damage to flock health by administering unnecessary or ineffective treatments. Symptoms of sheep scab are similar to that of lice infestations, therefore diagnosis based solely on observations is insufficient. Currently the most effective method of diagnosis is made by skin scraping examination to determine the presence of mites. Although, a blood test has also been developed by Moredun, which enables a more accurate diagnosis of infection (Burgess *et al.*, 2012). Once infection within a flock is established, it is necessary to treat the entire flock and not just those individuals with signs of infection. Current treatment can be administered in injectable format using Macrocytic lactones (MLs) or by an organophosphate plunge dip. However, since MLs are also used in the treatment of roundworms, the prevention of further drug resistance must be considered.

Community approaches to control sheep scab and broaching the stigma of disease

The incidence of sheep scab was kept under relative control before the deregulation of the disease in 1992, consequently the escalation of cases has continued over subsequent years. A regulation in force in England and Wales (Sheep Scab Order, 1997) gives the authorities control of the disease if owners do not take appropriate action. With greater awareness of sheep scab and the willingness of farmers to work together, the control of infection has improved in some areas of the UK (Dunn, 2015). For

example, in Northumberland, a coordinated effort strategy was developed for sheep scab eradication. All farmers worked together to treat all of the sheep after a veterinary diagnosis was made. A chairman was elected to ensure the smooth running of the operation amongst farms and to instigate knowledge transfer. By undertaking this approach, a potential endemic was reduced to occasional outbreaks of the disease (Henry, 2016).

In Scotland, the sheep scab order (2010) requires that “a person who has possession of, or is in charge of, any sheep or carcase which the person knows, or suspects has sheep scab must as soon as possible notify the Divisional Veterinary Manager of that knowledge or suspicion”. Since this order, the Moredun Research Institute conducted a study to identify the presence of low or absent levels of sheep scab on the Isles of Mull and Iona using an ELISA blood test (Busin *et al.*, 2015). Outbreaks were isolated and controlled as part of a local eradication campaign. Other regional control programmes have been shown to be effective, however there are potential issues such as complexity, safety concerns, stray or feral sheep, organic farms and biosecurity (Sargison *et al.*, 2006). Eradication of sheep scab from New Zealand was possible at the end of the nineteenth century by the use of dips in a farmer-led programme, which could be a possibility in the UK if a national sheep control programme was re-established (Sargison *et al.*, 2006). Armstrong and Davies (2007), highlight the need for a coordinated control programme across Wales with a demand for control programmes from both producers and vets.

Information about disease states within regions across the country are obtained by the use of questionnaires. However, gaining accurate results may be difficult due to low response rates, or the sensitivity of the questions. The randomised response technique was used by Cross *et al.*, (2010), in order to improve response rates and reduce evasive responses to estimate sheep scab prevalence in Wales. This was used to assure response anonymity and increase the levels of honest reporting (Cross *et al.*, 2010). Sheep scab in Wales was shown to be highly localised in some areas, suggesting management or environmental risk factors which make the farms more susceptible to infection. Common grazing areas have also been determined to be at higher risk of infection, where sheep from neighbouring farms were in contact (Rose and Wall, 2012). This was mirrored in a study conducted by Wall *et al.*, (2017), where outbreaks of sheep scab in Wales during 2015 were investigated through a survey. They also highlight that the distribution of outbreaks of scab in the last 10 years shows Powys and coastal areas of Northern Ceredigion and southern Gwynedd to be worst affected, with a cohort of farmers experiencing outbreaks continuously and 71% of farmers with no scab within the last 10 years. Wall *et al.*, (2017), concluded that control and management efforts can therefore be focussed on a small group of farms to be more cost effective. They also emphasised the need to identify areas for potential outbreaks in order to undertake localised scab interventions.

New approaches to control sheep scab

Research conducted by Nixon *et al.*, (2017), utilises a mathematical game theory approach to determine cost-benefit strategies of sheep scab treatment. Following this approach, they suggested that since Wales has a reported above average prevalence of sheep scab, a combination of dipping and injection with a long-acting ML would be the most effective strategy of control. From the model produced, estimated costs associated with sheep scab control and treatment provide the means to aid in management decisions by farmers.

A study by Hall *et al.*, (2015), considered the potential for the disruption of *P. ovis* mite survival by investigating the associated bacteria as a novel means of parasitic control. Hence, affecting the symbiotic relationship between bacteria and mites would effectively control mite abundance. Many bacterial species hosted within the mite act synergistically and the administration of antibiotics was shown to have an effect on total bacterial abundance and mean mite survival. Although the use of antibiotics is not a realistic long-term treatment for mite infection due to resistance concerns, this study did detect for the first time a potential candidate endosymbiont bacterium, which could be a future target for control.

Another alternative method for control has been the utilisation of fungal hyphae (Lekimme *et al.*, 2008), where the investigation of entomopathogenic fungal isolates was conducted to determine the *in vitro* pathogenicity against *P. ovis*. Results showed two potential isolates to be considered for future control methods. Alongside these *in vitro* tests, an *in vivo* investigation has also been conducted determining the pathogenicity of two fungal pathogens when applied to sheep skin in controlled experiments on live hosts. This also showed promising results for future control strategies (Abolins *et al.*, 2007).

Burgess *et al.*, (2016) demonstrated that vaccination of sheep against *P. ovis* has potential to reduce infection levels. Efficacy levels are shown for a recombinant subunit vaccine based on a cocktail of seven *P. ovis* antigens. The vaccine resulted in a 57% reduction in lesion sizes and a 56% reduction in mite numbers during repeated trials. This represented the greatest reduction in lesion size to date with a recombinant vaccine. This work provides further evidence of the potential future production of a commercially viable vaccine against sheep scab. However, the authors state that this should not be considered as a single control measure, but as an addition to other available tools for a combined control approach. This is important to ensure efficacy of treatment, sustainability, environmental protection and be cost effective.

Possible Outcomes

The incidence of sheep scab across Wales appears to be widespread and from the literature the reintroduction of compulsory treatment may be a necessity in the long term. Sargison *et al* (2006, 2007) for example supports this, stating that identifying every farmer in the region and the development of disease resistance will be barriers to implementing control. Rose *et al.*, (2009) attributes the lack of successful control of the disease to the absence of mandatory procedures to report and treat the disease. Clearly it has been demonstrated that at present, farm practice management should be the best way forward for sheep scab control and the need for a holistic control programme is recognised. This is especially important when considering common grazing areas where different flocks come into contact with each other. There is much information available for farmers with advice for diagnosing, treating and controlling sheep scab, however, there seems to be potential if farmers are willing to work together to reduce the incidence of outbreaks on a regional scale. There are obviously several obstacles to overcome as highlighted in this report, but an increase in education and more resources that are now available suggests that any stigma associated with the disease could be reduced by demonstrating the adoption of best practices. However, if sheep scab is to be eradicated it needs to be considered on a UK wide basis.

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