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Fasciola hepatica, epidemiology, intermediate hosts, GIS, fluke control and flukicide resistanc



Key external stakeholders:

Sheep and Cattle producers, livestock producers, helminthologists, veterinarians, agricultural advisors, pharmaceutical industry

Practical implications for stakeholders:

Fasciola hepatica is one of the most important helminth parasites of livestock in many countries and disease will result substantial loss in animal production. Evidence for resistance to any of these products has important implications for the future of fluke control. It has been over 50 years since the epidemiology of liver fluke has been examined comprehensively. With the emphasis on global warming and anecdotal evidence indicating the occurrence of fasciolosis earlier in the year a review of liver fluke epidemiology was overdue. This study:

- Completed temporal studies on *Fasciola hepatica* in *Galba truncatula* in the west of Ireland. Confirmed *R. peregra* potential to contribute to the transmission of *F. hepatica* in sheep and identified another possible intermediate host of *F. hepatica*; *Succinea* sp
- Confirmed *F. hepatica* infection in lambs by serology (parasite specific antibodies in serum) in July and by the presence of fluke eggs in faeces in September
- Provided evidence for resistance to triclabendazole (TBZ) in the fluke population

Main results:

- Molluscs other than *G. truncatula* i.e. *Radix peregra* and the *Succinea* sp were positive for *F. hepatica*
- *F. hepatica* infection in lambs was acquired as early as July
- TBZ resistance was observed in the fluke population on the Teagasc Hill farm.

Opportunity / Benefit:

The evidence of overwintered infection in snails plus other intermediate hosts besides *G. truncatula* highlight a greater scope for *F. hepatica* transmission than understood previously. The true extent of resistance to TBZ in Irish flocks remains to be established. Measures to prolong the efficacy of flukicides need to be adopted.

Collaborating Institutions:

UCD

Teagasc project team: Dr. Barbara Good (PI)
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1. Project background:

Liver fluke disease, fasciolosis cause major losses in livestock production. Control of liver fluke in sheep farming is heavily dependent on narrow spectrum anthelmintics. Evidence for resistance to any of anthelmintics (s) has important implications for the future of fluke control. With the emphasis on global warming and anecdotal evidence indicating the occurrence of fasciolosis earlier in the year, that it was over 50 years since the epidemiology of liver fluke pertaining to Ireland was examined comprehensively. a review of liver fluke epidemiology was timely.

2. Questions addressed by the project:

- What are the population dynamics and prevalence of *Fasciola hepatica* in *Galba truncatula* on Irish sheep farm?
- Is there evidence to suggest that *F.hepatica* infection in snails other than *G, truncatula*?
- Is there evidence to support the anecdotal information that *Fasciola hepatica* infection in lambs occurs earlier in the season?
- What is the prevalence and timing of *Fasciola hepatica* infection in lambs and ewes reared under two production systems?
- Is there evidence for anthelmintic resistance in fluke populations in Ireland?
- Fluke control practices on Irish sheep farms

3. The experimental studies:

- Temporal studies on *F.hepatica* in *G, truncatula* in the west of Ireland. The population dynamics and prevalence of *Fasciola hepatica* in *G, truncatula* were investigated on the Teagasc hill sheep farm in County Mayo over 2 years. Four habitats were identified on the farm and visited at fortnightly intervals to collect snails. Mean monthly rainfall and temperature on the farm were recorded
- Molecular detection of *F.hepatica* in snail species other than *G, truncatula* found on the Teagasc hill farm
- Investigated the transmission of liver fluke on the Teagasc hill farm *via R. peregra*.
- Fasciolosis in lambs reared under two production systems; low and hill grazing on the Teagasc hill sheep farm in Co. Mayo was evaluated on a monthly basis over two seasons.. A number of diagnostic procedures were used to detect *F. hepatica*; faecal egg count, serology and liver necropsy.
- The identification of potential *G.truncatula* habitats in the West of Ireland using geographic information system.
- Evaluated the efficacy of four commonly used flukicides; triclabendazole, closantel, oxcyloznide and nitroxynil on the Teagasc hill farm (known fluke history). Faecal samples were obtained from each animal on day of treatment, 7, 14, 21 and 56 days post-treatment. The numbers of *F. hepatica* eggs were determined and the efficacy of each anthelmintic was calculated in terms of the percentage reduction in egg count at each time point.
- A questionnaire relating to farm details, topography, grazing management and fluke control practices was designed and posted to 100 sheep producers from Kerry, Louth/Meath and Monaghan /Cavan nominated by Teagasc advisors

3. Main results:

Experiment 1

Snail abundance was associated with rainfall and temperature. Two parent generations per annum were observed late spring, late summer/early autumn. The F2 generations was capable of overwintering, predominantly as preadults, mature and reproduce in the following spring resulting in a peak abundance during this period.

Experiment 2 & 3

Two snail species were examined, one which was found in a similar habitat to *G. truncatula* i.e. *Succinea*, while the other snail species (*R. peregra*) was recovered in a drainage ditch located in the acidic upland hill area. *F. hepatica* DNA was identified in 74% of *Succinea* sp collected in May and 10.3 %, 60.4% and 61.2% of *R. peregra* collected in March April and May respectively. Lambs challenged with infected herbage from the drainage ditch confirmed *R.peregra*'s role in the transmission of liver fluke in upland acidic areas where *G.truncatula* was absent.

Experiment 4

Fluke eggs were first detected in lambs in September for both years. The proportion of lambs positive for *F.hepatica* by FEC was greater in the first grazing season. Compared to the hill flock, a greater proportion of lambs from the lowland flock were positive for *F.hepatica* by both FEC and serology. The pattern of *F. hepatica* in lambs suggested that lambs were mounting an immune response to challenge in July.

Experiment 5

A geographic information system (GIS) was constructed using remote sensing and landscape feature data to identify environmental variable that influence the distribution of *G. truncatula* in counties Mayo and Galway. Eight farms were examined for *G. truncatula* habitats. Mapping of *G. truncatula* habitats revealed several characteristics indicative of the presence of this mollusc, including greenness (> - 20, according to the tasselled cap formula), elevation (below 70 m above sea level) and soil type (shallow poorly drained mineral soils and lithosolic-podzolic type soils

Experiment 6

The results for closantel, oxcloznide and nitroxynil indicated that these were effective; faecal egg counts were reduced by 100% by day 14 post infection. The results for triclabendazole yielded lower efficacy levels with faecal egg count reductions of between 46% and 66% based on arithmetic means over the period 7 to 56 days post treatment.

Experiment 7

Completed questionnaires were returned by 39 producers. There was a history of fasciolosis on approx. 50% of farms. The majority of producers (>94%) treated their sheep for fluke and followed a set programme. Hill producers treated their livestock significantly more frequently than the lowland farms. Evidence for fluke infection in their own livestock at the factory was important in informing dosing decisions. Past experience of the product and veterinary advice were the most influential factors when choosing a flukicide product. Farms without a history of fluke (79%) were more likely to treat purchased stock compared to farms with a history of fluke (40%).

4. Opportunity/Benefit:

Results from study demonstrated that lambs can become infected as early as July; further work is needed to clarify as to how this affects performance. The detection of *F. hepatica* DNA in snails other than *G. truncatula* highlights the importance of considering other snails in the transmission of *F. hepatica*. Moreover, the use of simple PCR based diagnostic assay for *F.hepatica* was more accurate in detecting *F.hepatica* than dissection methods. As triclabendazole is the only product effective against all stages of fluke, resistance to TBZ in fluke populations as shown in this study will pose a serious dilemma to the producer where there is a history of fluke on the farm. It is important that strategies to prolong the efficacy of TBZ on farms are adopted. Recommendations include that TBZ is only considered at times when the risk of acute challenge is greatest, knowledge of the resistance status of the fluke on their farm and the application of appropriate bio-security protocols of purchased livestock.

5. Dissemination:**International conference**

Presented at many international conferences including 22nd International Conference of the World Association for the Advancement of Veterinary Parasitology, Calgary, Canada (2009), *International Symposium on Geospatial Health*, 5–7 December 2008. New Orleans, U.S.A. (2008), British Association of Veterinary Parasitology, Irish Society for Parasitology Joint Meeting, University of Bristol (2008), 21st International Conference of the World Association for the Advancement of Veterinary Parasitology, Gent, Belgium (2007) and Association for Teaching and Research Work, Annual Conference, Scarborough, U.K (2006)

National Conferences

Presented at the National Sheep Conference (2013), Agricultural Research Forum (2008, 2009) Irish Society

for Parasitology Annual Meeting (2008,) Association for Veterinary Teaching and Research Network (2008), British Society for Parasitology Spring and Malaria Meeting,, Queens University, Belfast (2007) *Proceedings of a Workshop on Decision Support Systems for Irish Agriculture - Making Science Work on the Farm*. Johnston Castle, Co. Wexford, Ireland (2007).

Open days

Presented at Farm Fest ,Science Village 2008, Sheep 2010 and Lab open days during Science Week, in-service training seminars for Teagasc advisors and farmers meetings

Main publications:

Relf, V., Good, B., Hanrahan, J.P., McCarthy, E., Forbes, A.B. and De Waal, T. (2011). 'Temporal studies on *Fasciola hepatica* in *Galba truncatula* in the west of Ireland'. *Veterinary Parasitology* 175:287-292

Relf, V., Good, B., McCarthy, E. and de Waal, T. (2009). 'Evidence of *Fasciola hepatica* infection in *Radix peregra* and a mollusc of the family Succineidae in Ireland'. *Veterinary Parasitology* 163, (2009), pp 152-155

Mooney, L, Good, B., Hanrahan, J.P., Mulcahy, G., DeWaal, T. (2009) 'The comparative efficacy of four anthelmintics against a natural acquired *Fasciola hepatica* infection in hill sheep flock in the west of Ireland'. *Veterinary Parasitology* 164:201-205

Popular publications:

Teagasc Research Reports(2007-2009)

6. **Compiled by:** Dr. Barbara Good
