Veterinary Laboratories Agency

VLA PARASITOLOGY GROUP

ANNUAL REVIEW 2004

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INTRODUCTION

This document has been prepared by members of the VLA Parasitology Group and is a summary of papers published in 2004 that are thought to be of most relevance to the work of the VLA. This document cannot be considered a complete review of the literature as it reflects the expertise of the group members at present. It is intended that this 'horizon scanning' document will be expanded in scope and produced on a yearly basis.

It is interesting to note the areas of parasitology that have provided the most published papers in 2004, namely anthelmintic and flukicide resistance, alternatives to endo and ectoparasite chemical control and zoonotic parasites. Other commonly diagnosed parasitological diseases e.g. bovine and ovine coccidiosis did not result in any notable papers in that year.

PARASITIC GASTRO-ENTERITIS (PGE)

PGE in sheep and goats

K.A. Abbott, M. Taylor and L.A. Stubbings wrote a technical manual for Veterinary surgeons and advisors on **sustainable worm control strategies for sheep in the UK.** This was published by SCOPS (sustainable control of parasites in sheep) in 2004. Available on www.nationalsheep.org.uk or www.defra.gov.uk (animal health and welfare>disease surveillance and control>other diseases.) Life cycles of important nematodes in sheep in the UK, anthelmintics available, anthelmintic resistance and guidelines to limit the anthelmintic resistance are all detailed.

Teladorsagia circumcinta.
An *in vitro* method has been developed at the Moredun Research Institute using abomasal tissue explants that enables studies to be carried out looking at the establishment of *T. circumcinta* larvae.
These studies have shown that:

- Larvae become established in the abomasal tissues very quickly in samples from naïve sheep (80% of the challenge dose within 3 hours) compared to 5% in samples from immune animals.
- The larvae tended to establish in the mid and pyloric explant areas of the abomasum, with fewer larvae associated with the fundic region explant.
- Continuous challenge with larvae is necessary for the prevention of establishment of infection to be maintained.
- Diet and intercurrent disease affect the prevention of establishment of larvae in immune animals. In this study, lambs on high protein diets had lower worm egg counts compared to those on low protein diets and, once treated with anthelmintic, abomasal tissue from these lambs allowed fewer larvae to be established in the mucosa compared to that from lambs on a low protein diet.

(Jackson, F. et al. Veterinary Parasitology 124 (2004) 73-89)

Haemonchus contortus
Studies on commercial sheep flocks in Sweden showed that *H. contortus* has evolved to survive the long cold winters entirely within the host as arrested fourth stage larvae. Almost 100% inhibition occurred as early as mid summer and numbers of inhibited larvae progressively increased throughout the season. The peri-parturient relaxation of immunity in ewes allowed the resumption of development and eggs then seeded the pasture. Therefore, in Sweden, one parasite generation per year occurs. This could be associated with clinical disease in ewes at lambing time. Also if environmental conditions were correct, this contamination could lead to clinical disease in lambs and ewes later in the season. In contrast *T. circumcinta* survived well over winter both within the host at L4 arrested stage and also on the pasture.
The authors also noted that *H. contortus* cycled through calves on these farms; therefore care is needed in alternate grazing cattle with sheep.
(N.B. One generation of *H. contortus* per year is also thought to occur in UK, but the inhibition of larvae may not be as early or as absolute as it occurred in this study)
(Waller, P.J. et al. Veterinary Parasitology 122 (2004) 207-220)

PGE in cattle

Nematodirus battus (*N.battus*)
An outbreak of *N.battus* infection in calves was described in Northern Ireland. It occurred in 4-6 month old, bucket-reared calves on a mixed beef and sheep farm. Important points are:

- Treatment with an injectable ivermectin did not produce a significant cure. (Macrocyclic lactones (MLs) for cattle do not claim efficacy against *N. battus*). A benzimidazole anthelmintic produced clinical recovery and no *N. battus* eggs were detected in faecal samples after treatment.
- The calves had been on pasture used for young calves in the last 8-10 years, which were the likely source for this outbreak. There had been little contact with sheep pastures.

(McCoy, M.A. et al. Veterinary Record 154 (2004) 370-371)

Effects of parasites on immunity
In vitro studies have shown that extracts of fourth stage ***Ostertagia ostertagi*** larvae inhibit bovine T lymphocyte responses (Gomez-Munoz, M.T. et al. Veterinary Parasitology 120 (2004) 199-214), consistent with other reports that parasites modulate host immune responses.

Research priorities into anthelmintic resistance in UK
A report on a Biotechnology and Biological Sciences Research Council (BBSRC) funded workshop on anthelmintic resistance was published. The aim of the workshop was to exchange information and plan collaboration between research workers in the area of anthelmintic and flukicide resistance. The following table was produced.

An estimation of risk of anthelmintic resistance occurring in different host species in the UK, central and northern Europe.

	Sheep	Goats	Cattle	Horses	Pigs
Benzimidazoles	4	4	2	4	1
Levamisole/pyrantel	4	4	1	2	1
Macrocyclic lactones (MLs)	4	4	3	3	1
Triclabendazole	4	4	3	NA	NA

(1 low, 2 medium, 3 high, 4 very high, NA not licensed for use in that species)

Research priorities identified were

- Development of new tests for anthelmintic resistance (also research into the molecular basis of levamisole and ML resistance needed for this to take place)
- Farm management decision tools for worm control.
- Studies into drug resistance in *Fasciola hepatica*.

The continued need for good communication between farmers and their veterinary surgeons was stressed.
(Coles, G.C. et al. Veterinary Record 155 (2004) 253-254)

Anthelmintic resistance in sheep in UK

A paper reporting studies on two, **triple-resistant, field strains of *T.circumcinta*** were published. These were isolated from farms in Scotland. Moxidectin was the only product available that gave a highly effective treatment of these *T. circumcinta* strains. Combinations of different anthelmintic classes were also studied which improved efficacy, but improvements were greater against adult parasites than immature stages.
Some interesting observations from this paper were:

- Ill-thrift in lambs on these farms initiated the original studies.
- Combinations of different classes of anthelmintics generally gave greater efficacy than that of the individual classes, but despite this and the highly effective results with moxidectin in these trials, one of these farms no longer keeps sheep. (The persistent effect of moxidectin was lost, which is seen as a prelude to resistance, Sargison, N.D. Veterinary Record 156 (2005) 105-109)
- Monitoring the worm egg counts (WEC) after treatment showed that, for quarantine to be effective, sheep should be yarded for 48hours post quarantine treatment (egg counts then reduced to zero).

(Bartley, D.J. et al. Veterinary Parasitology 123 (2004) 189-199)

Results of a routine faecal egg count reduction test (FECRT) in a terminal sire flock in the UK that indicated **ivermectin resistance** were detailed in a letter to the Veterinary Record. The animals were weighed and dosed accurately with ivermectin but demonstrated only a 3% reduction in WEC. Egg counts were low (155 and 150epg) and there were no clinical signs of PGE, possibly due to the high plane of nutrition. The authors suggest that:

- This farm is not likely to be unique
- Ivermectin resistance would have been undetected on this farm without the routine faecal egg count reduction test, because there is no *in vitro* test available.
- There is potential for spread of ivermectin resistance to a number of farms through purchase of similar ram lambs, unless quarantine strategies were properly carried out.
- Monitoring for the presence of resistance is essential to prevent spread of this anthelmintic resistance.

(Sargison, N.D. et al. Veterinary Record 155 (2004) 343)

Anthelmintic resistance in sheep and cattle world-wide

A review of veterinary anthelmintics and the worldwide situation concerning anthelmintic resistance was published in 2004. Some interesting points from this were:

- The development of newer classes of anthelmintics unlikely, as macrocyclic lactones' (ML) broad spectrum of activity in susceptible parasites unlikely to be matched and resistance in cattle parasites not as major a problem as in sheep. (Cattle anthelmintics account for more than 55% of global market). Also, the high cost of licensing anything less than an exceptional product makes further products unlikely.
- Cyclodepsipeptides and paraherquamide compounds are possible new classes of anthelmintics and some work has been carried out since the discovery of the MLs,

but the authors are not aware of further plans to market these or any new classes of anthelmintics.
(McKellar, Q.A. and Jackson, F. Trends in Parasitology 20 (2004) 456-461)

Drug resistance in veterinary helminths was also reviewed in 2004 by two papers. (Wolstenholme, A.J. et al. Trends in Parasitology 20 (2004) 469-476 and Kaplan R.M. Trends in Parasitology, 20 (2004) 477-481).

- Multiple drug resistance to all three classes of anthelmintics in ***H. contortus*****,** ***T.circumcinta*** **and** ***Trichostrongylus colubriformis*** has been documented world-wide and threatens the viability of small ruminant industries in South America, South Africa, Malaysia and southern USA.
- **Moxidectin** resistance has been reported in Australia and New Zealand in small ruminants.
- **ML resistance in Cooperia spp. of cattle** is reported increasingly world wide and reports suggest that this may be relatively common in Brazil, Argentina and New Zealand (Resistance to benzimidazoles has also been reported)
- No active surveillance is carried out into cattle parasite resistance; most countries rely on detecting it when it becomes a clinical problem. This is likely to result in awareness only when resistance is present at a high level.

A review of anthelmintic resistance in cattle was published. (Coles, G.C. Cattle Practice (2004) 12 177-179)

- The author has reported 2 cases **of ML resistance in *Cooperia oncophora*** in England.
- Faecal egg count reduction tests could be used to detect resistance, but the method has not been tested in this species (particularly with the use of pour-on anthelmintics).
- *In vitro* tests need to be validated for cattle.
- ***Cooperia oncophora*** is the dose limiting species for ivermectin i.e. the species that is more difficult to kill using ivermectin than others and determines the dosage licensed.
- The author suggests, in the UK, quarantine treatment with sequential administration of cattle with BZ and levamisole and holding off pasture for 48 hours (similar to SCOPS recommendations for sheep but different classes of anthelmintics advised).
- Treatment of young stock only (to maintain high numbers of parasites in refugia) and grazing them on fields used previously by adult animals.

Studies using reverse transcriptase PCR techniques have identified a possible marker for **ivermectin resistance in *Cooperia oncophora***. (Njue, A. I. and Prichard, R.K. Parasitology 129 (2004) 741-751).

<u>Anthelmintics in cattle</u>

A paper was published into the benefit of **eprinomectin** treatment in dairy cows and heifers in commercial herds in the UK. Treated cattle showed an increase in solids-corrected milk yield compared with untreated controls, which was significant 2 and 3 weeks post treatment. The response was greater in heifers than in cows. Live weight gain and condition score was also improved in both treated cows and heifers. (Forbes, A.B. et al. Veterinary Parasitology 125 (2004) 353-364)
A further study, in Canada, not surprisingly failed to show a similar benefit in herds that were totally confined or semi-confined during the summer and had no access to pasture (Sithole, F et al. Le Medecin Veterinaire du Quebec 34 (2004) abstract 078 (3123)).

The effects of licking behaviour in cattle on the transfer of drug after treatment with **pour-on formulations of doramectin, ivermectin and moxidectin** to untreated cattle were published. The treated and non-treated cattle were kept together in a paddock and systemic exposure to each drug was observed in 5 of the 6 untreated cattle. The authors stated that this raises concerns for drug efficacy and safety, emergence of drug resistance and the possibilities of unexpected high residues in treated/untreated animals. (Bousquet-Melou, A. et al. Int. Journal for Parasitology 34 (2004) 1299-1307).

A **review** of control of cattle parasites and anthelmintic products available was published by M. Taylor. (Veterinary Times 34 (2004) 13, 12-13.)

Alternative parasite control in sheep and goats

A review of worldwide research into alternatives to chemical parasite control was published in 2004.

- **Breeding for resistance** was thought to be the best option in the long term. Research taking place in many countries.
- **Vaccination**, particularly against *H. contortus*, is the subject of research in Scotland and Australia but recombinant vaccines have proved disappointing.
- Biological control using ***Duddingtonia flagrans*** (This is a fungus that, when fed to the animal germinates in the faeces and traps nematode larvae and prevents their migration onto pasture.) This has been found to be useful experimentally but some field studies have been disappointing. (A report on a successful field trial in Sweden in lambs is described by Waller, P.J et al. Veterinary Parasitology 126 (2004) 299-315).
- Application of **FAMACHA system** (a scoring system using a conjunctival colour chart, to determine necessity of treatment) in areas where *H. contortus* is endemic e.g. South Africa and southern USA (see Kaplan, R.M. et al. Veterinary Parasitology 123 (2004) 105-120).
- **Copper oxide wire particles** have been developed for control of *H. contortus* but there are potential toxicity problems. (Studies on use in USA in Burke et al. Veterinary Parasitology 123 (2004) 235-243).
- **Forages and feeds** containing condensed tannins and also other plants whose action is unknown but appear to reduce parasitism e.g. chicory and birds foot trefoil (see Marley, C. L et al. In, Organic farming: science and practice for profitable livestock and cropping. Proceedings of the BGS/AAB/COR Conference, Newport, Shropshire, UK, 20-22 April 2004 British Grassland Society (BGS) Reading, UK and also Paolini, V. et al. Parasitology 129 (2004) 69-79 for in- vitro studies of extracts of woody plants as anthelmintics with possible application for use in goats). Other herbal de-wormers are also being investigated.

It is likely that combinations of the above together with planned grazing management and restricted use of anthelmintics will have to be used in the future.
(Ed. Miller, J.E and Waller P.J Veterinary Parasitology 125 (2004) 59-68).

See also **review of parasite control in 'green' ruminant systems** (Waller P.J. and Thamsborg, S.M. Trends in Parasitology 20 (2004) 493-497).

A general review into **veterinary parasitic vaccines**, which includes a summary of vaccines available in poultry and dogs as well as ruminants was also published in 2004 (Vercruysse, J. et al. Trends in Parasitology 20 (2004) 488-492).

TESTING DEVELOPMENTS IN DIAGNOSIS OF ENDOPARASITIC DISEASE

The results of evaluating an indirect micro titre based **ELISA**, based on whole worm ***Ostertagia ostertagi*** antigen developed for use on serum or milk samples in commercial **cattle** were presented at the 23rd World Buiatrics Congress 2004 by workers in Canada.

- There was a low correlation between OD values and faecal egg counts.
- Herd management practices that would be expected to result in higher parasite burdens, consistently produced higher OD values.
- Higher milk yields were associated with lower OD values.
- Cows with high OD values in late lactation had greater responses in milk production and reproductive performance to anthelmintic treatment, when compared to animals with low OD values.

The authors conclude that the ELSA is a useful tool in evaluating parasite burdens in adult dairy cattle.
(Dohoo I. et al. Le Medecin Veterinaire du Quebec 34 (2004) abstract 074 (2946) and abstract 400 (1933)).

Studies were carried out to measure variation in **faecal nematode egg count** or serum **anti-nematode antibody** concentration in Friesian **cattle**, and correlations between these traits and subsequent milk yield. It was concluded that faecal egg counts were repeatable in calves (compared to heifers) and those calves with a higher antibody response to ***Cooperia oncophora*** or ***Ostertagia*** L3 antigens tended to show slightly higher first-lactation yields. (Morris, C. A. et al. New Zealand Journal of Agricultural Research 47 (2004) 267-274).

The development and evaluation of a **copro-antigen capture ELISA** to detect ***T.circumcinta*** infection in **sheep** was described. By heat treatment of faeces, sensitivity of 85.7% and specificity of 87.5% were achieved when compared to sheep infected with *H. contortus*. However cross reactivity with other common ovine gastro-intestinal parasites was not tested. OD values obtained showed good correlation with adult worm burdens of *T. circumcinta* except when low numbers were present when there was overlap with worm free animals. It is hoped development of this may allow cheap, automated detection of infected animals in the future.
(Johnson, D. A. et al. Parasitology 129 (2004) 115-126).

A **PCR based assay** to simultaneously identify eggs and cultured larvae of different species in faeces of **sheep** was described. Nine species were identified. (*Haemonchus contortus* was not included.) A modification for quantification using real-time PCR was thought possible. The application to high through- put screening systems was discussed. (Wimmer, B. et al. Int. J for Parasitology 34 (2004) 625-631).

FASCIOLA HEPATICA

Triclabendazole Resistance

A research team at the Queens University Belfast led by Ian Fairweather published two papers. One concerned the response of two different strains of *Fasciola hepatica* to exposure to metabolites of triclabendazole (TCBZ). One strain was susceptible to TCBZ, the other showed resistance in flukes of two to four weeks of age. Some of these metabolites of TCBZ have flukicide activity. Changes in ultra structure of the parasite were described for the two strains. The other paper concerned metabolism of triclabendazole within sensitive and resistant strains of *Fasciola hepatica*. Metabolism of the active form of the fasciolicide to an inert form is currently suspected of being the mechanism for resistance.
(Walker S. M. et al. Parasitology research 94 (2004) 427-438 and Robinson Mark W. et al. Parasitology research 92 (2004) 205-210).

Treatment of fasciolosis

A paper was published that included field trials with a **new fasciolicide** based on the benzimidazole molecule. The efficacy of 5-chloro-2-methylthio-6- (1-naphthyloxy)- 1H-benzimidazole, called "alpha", was tested in calves infected with *F. hepatica*.
(Vera Montenegro, Y. et al. Parasitology Research 92 (2004) 211-214).

There was also a **review** of treatment of trematodes in general**.**
(Keiser Jennifer and Utzinger Jurg, Expert opinion on pharmacotherapy 5 (2004) 1711-1726).

Molecular Biology

Much work in this area is relevant to immuno prophylaxis. One research team, including workers in Australia and Dublin, have been looking at various **immunogenic markers** to develop a vaccine. One paper concerned glycosidase activity in secretory products of *F. hepatica;* these are used for tissue destruction during migration of the parasite. (Irwin, J. A. et al. Parasitology 129 (2004) 465-472).

Other papers have looked at the **genetics** of the parasite, and which genes code for immuno dominant antigens. (Mohamed Mona M et al. Journal of the Egyptian Society of Parasitology Dec 2004).

Epidemiology

A paper was published that looked at the **distribution of cercariae on plants** in an *in vitro* experiment where snails were infected both with *Fasciola hepatica* and another trematode parasite *Paramphistomum daubneyi*. (Dreyfuss, G. et al. Parasitology research 94 (2004) 70-73).

Another paper determined **seroprevalence** of *F. hepatica* in cattle herds in northern Portugal. Blood and faeces samples were taken from adult cattle in seven herds. and blood samples from other animals sampled for eradication of other statutory diseases were also used. (Conceicao, M. A. P. et al. Veterinary Parasitology 123 (2004) 93-103).

Diagnostics

One interesting paper in this area concerned detection of **coproantigens to excretory secretory proteins in faeces of cattle and sheep**. This may be an early means of demonstrating *Fasciola hepatica* infection by detection of these antigens in faeces. These antigens are specific to *F. hepatica*, and are not produced by any other nematode parasites during co-infection.
(Mezo Mercedes et al. Journal of Parasitology 90 (2004) 845-852).

Review Articles

There was one notable review article produced last year concerning human fasciolosis, reporting on disease in various developing countries, diagnosis, and the symptoms encountered.
(Saba, R. et al. European Society of Clinical Microbiology and Infectious Diseases 10 (2004) 385-387).

M. Taylor published a general review of liver fluke disease in Veterinary Times. (Veterinary Times 34 (2004) 37, 28-30.)

CRYPTOSPORIDIOSIS

Animal Disease

Cryptosporidium andersoni was identified in the faeces of an adult dairy cow submitted to VLA Carmarthen in 2004.This is the first reported isolation of *C. andersoni* from an adult bovine in the UK. The pathogenicity of this species in cattle is not yet fully elucidated. There is no recognised zoonotic risk with this species. Identification to species level was carried out by the National Public Health Service laboratory in Swansea, and is an example of the fruitful collaboration between VLA and other Agencies.

Cryptosporidium suis
A paper demonstrated *C. suis* to be genetically distinct from all known species and genotypes of *Cryptosporidium.* (Ryan, U.M. et al Journal of Parasitology 90 (2004) 769-773).

Diagnosis

The evaluation of 2 **rapid assays** for detecting *Cryptosporidium parvum* in calf faeces was published. These are intended to be used calf-side and results suggest they are both sensitive and specific. (Muccio, Janna L. et al. JAVMA 225 (2004) 1090-1092).

Treatment

Protection of calves against cryptosporidiosis by oral inoculation with **gamma-irradiated *Cryptosporidium parvum* oocysts** was investigated**.** The findings of this paper suggest that protection may be possible by preventing the parasite from developing to the oocyst stage but not affecting the capacity of the oocyst to induce a protective response. (Jenkins, M. et al. Journal of Parasitology 90 (2004) 1178-1180).

A paper outlining the possibilities for new targets for drugs and vaccine development and their validation for *Cryptosporidium* based on genomics and transgenics was published. (Striepen, B. and Kissinger, J.C. Trends in Parasitology 20 (2004) 355-358).

A **model,** both simple and inexpensive, for testing anticryptosporidial drugs and studying host-parasite interactions using the growth of *C. parvum* in rabbit chondrocytes (VELI\0 cells was described. (Lacharme, L. et al. Microbes and Infection 6 (2004) 566-571).

Zoonotic Aspects

Chalmers and others (Veterinary Record 156 (2004) 49) report on the identification of
***C. parvum* genotype 2** in domestic horses. Contact with horses or their faeces could constitute a zoonotic risk. Previous work has not investigated the genotype of *Cryptosporidium* involved in horses.

Laboratory application of molecular techniques to taxonomy and epidemiology is helping to characterize new and existing species and thereby differentiate field isolates of *Cryptosporidium* and determine the possible sources of the parasites. Continued application of these techniques will further aid the identification of new species and subspecies, facilitating the identification of sources of water-borne cryptosporidiosis in humans (Fayer, R. Veterinary Parasitology 126 (2004) 37-56).

Newly designed filtration equipment and improvements in disinfection methods are underway in the water industry. Application of these technologies including the use of ultraviolet light, ozone and possibly other disinfection schemes will improve water quality and safety (Betancourt, W.Q and Rose, J.B. Vet Parasitology 126 (2004) 219-234).

Reviews

"A review of the biology and epidemiology of cryptosporidiosis in humans and animals" in Ramirez, N.E, et al. Microbes and Infection 6 (2004) 773-785.

"Update on Cryptosporidium and Giardia infections in cattle" in Olsen, M.E et al. Trends in Parasitology 20 (2004) 185-192.

ECTOPARASITES OF CATTLE

Colebrook and Wall undertook a review of the current status of livestock ectoparasites. (Veterinary Parasitology 120 (2004) 251-274). This looked at various European studies reporting prevalence of the various ectoparasites in domestic animals. It gives a comprehensive overview of the various studies and the reported results. It notes that the studies involved vary greatly and so comparisons between areas would be difficult with research directed by local factors and undertaken in various ways. There is no standard protocol or funding group able to allow collation of such studies.

A **review of ectoparasite treatment** was given and acts as an up-to-date summary of available products and the parasites. Taylor, M. (2004) Veterinary Times 34 (2004) 19,10-11.

Lice

Otter, A. et al (Veterinary Record 153 (2004) 176-179) have implicated *Linognathus vituli* (*L.vituli*) as a **cause of anaemia** in young calves. Research prior to this found no detrimental effect on PCV of cattle infested with this species. However, this paper was reporting findings from clinical field cases in calves with high levels of infestation.

Cleale et al. (Veterinary Parasitology 120 (2004) 215-227) looked at the effects of **long acting injectable products** containing moxidectin on lice infested cattle. They concluded that the formulations provided significant protection against reinfestation with *L.vituli* and *Solenoptes capillatus* (*S.capillatus*) (>95% efficacy) for 133 days. However, as with other researchers, the formulations were not significantly effective against chewing lice as this species feeds on skin debris not blood. Pour on macrocyclic lactones have indications for treatment of these lice.

Ticks

The distribution of tick species varies due to the suitability of the environment, but with changes in climate, geographical distribution may be subject to change and with it an increase in tick borne disease. *Ixodes ricinus* is a vector for the flaviviruses associated with tickborne encephalitis (TBE), which is endemic in central and Eastern Europe. The increase in human cases in the Czech Republic has been related to changes in the geographical distribution of the tick vector (Beran, J. Eurosurveillance Weekly 8 (2004) 8-13).

A review document was produced by Foil and others (Veterinary Parasitology 125 (2004) 163-181) to collate data on prevalence and influencing factors of **acaricide resistance and tick-borne diseases**. This paper did not cover UK agriculture. However it reported

- Multiple acaricide resistance in *Boophilus microplus* ticks in Mexico.
- Two different mechanisms conferring pyrethroid resistance.
- In Mexico, in endemic tick areas young cattle may be infected with babesiosis without clinical signs. There is a balance between infestation and immunity and if immunity is low due to lack of exposure then outbreaks may occur more readily than in areas with stable tick populations.

Flies

Azzolini, et al. (Experimental Parasitology 106 (2004) 103-109) described characterisation and cloning of the serine proteinase inhibitor from *Hydrotaea irritans*. Although this appears to be almost blue-sky research, it is an evolving area as researchers look to follow the success of previous work done on ticks to provide **immunological methods of ectoparasite control**. Serine proteinases are thought important in insect immunity, perhaps participating in the invertebrate defence response. Presumably if important insect material can be sequenced and cloned then immunologists can attempt to provide methods of control.

Other non-traditional methods of control, which were covered by 2004 literature, included the potential use of **volatile semiochemicals** to control fly burdens. These chemicals mediate interactions between organisms with pheromones a sub classification, which is a more familiar and understandable term. Sex pheromones have been used to bait and trap insects, but this recent research has highlighted the possible role of chemical factors emitted by the host. Jensen et al. (Med Vet Entomol 18 (2004) 275-280) found that fly numbers within a herd could be manipulated using fly susceptible/resistant animals with volatile semiochemicals the reason for the individual susceptibility. Birkett et al. (Med Vet Entomol 18 (2004) 313-322) used volatile emissions from heifers, which reduced the fly loads when applied to other groups.

ECTOPARASITES OF SHEEP

Sheep Scab

Clinical observation has indicated that *Psoroptes ovis* (*P.ovis*) mites provoke cutaneous inflammation within hours of experimental infestation, but this paper describes the **nature of this reaction**. Lesion severity was particularly pronounced from 42 to 63 days after infestation, but significant resolution had occurred by 84 days. Pathological changes at the advancing margin of the lesion were more severe than at the initial site of infestation, and the numbers of mites present reflected this. This data suggest that *P. ovis* elicits an early innate cutaneous response that is subsequently augmented by the development of an adaptive immune response, the intensity of which corresponds to the local population density of mites. (van den Broek, A. H. M. et al. Journal of Comparative Pathology 131 (2004) 318-329).

In an attempt to enrich for potentially protective *P.ovis* antigens, three separate **vaccine trials** were conducted in which groups of sheep were immunised three times with various fractions of a soluble extract of *P. ovis* mites using QuilA as adjuvant. These groups, as well as adjuvant only controls, were challenged with *P. ovis*, and measuring lesion areas and conducting mite counts 4 and 6 weeks later assessed protective immunity. All fractions stimulated high titre serum antibodies. The best fraction slowed lesion growth to less than a third by 6 weeks after challenge and reduced mite numbers by more than 13 times compared to control sheep vaccinated with QuilA only. However, as judged by polyacrylamide gels, the polypeptide profile of this fraction was still complex, indicating that further work is required to identify the protective components. (Smith, W. D. and Pettit, D. M. Parasite Immunology 26 (2004) 307-314).

Biological Control

The growth rates of different isolates of the **entomopathogenic fungus** *Metarhizium anisopliae* (*M anisopliae*) were compared and the pathogenicity of these isolates against *Psoroptes* mites derived from the ears of rabbits (*Psoroptes ovis* Hering, syn *P cuniculi*) were evaluated. The effect of different temperatures (28°C to 40°C) and different formulations (Tween 80 or silicone oil) were compared. It was suggested that high-temperature adapted isolates of *M. anisopliae* formulated in silicone oil offer good candidates as control agents under the conditions found at the sheep skin surface. (Brooks, Alexandra. J. et al. Pest Management Science 60 (2004) 1043-1049).

Sheep Scab Mite Behaviour

To help understand the behaviour, which facilitates transmission via the environment, the responses of *P. ovis* derived from rabbits (syn. *Psoroptes cuniculi*) to temperature and light were examined in the laboratory. The results indicate that the movement of these mites is strongly directed towards areas of high temperature but away from higher light intensity. These behaviours might be expected to maintain the position of the mites on a host animal and help them locate the skin surface of a new host when displaced into the environment.
(Pegler, K. R. and Wall, R. Experimental & Applied Acarology 33 (2004) 69-79).

Sheep Scab Chemical Control

Two emulsifiable concentrate formulations of **deltamethrin,** differing on the basis of the vehicle (methyl glycol acetate [AMG] or 2-propylene glycol 1-methyl ether acetate [AMP]) were evaluated for their efficacy against sheep scab. Groups of sheep were dipped twice 10 days apart in either formulation. Live mites were not detected in scrapings after 7 days (AMP Group) or after 14 days (AMG Group). (Cadiergues, Marie-Christine. et al. American Journal of Veterinary Research. 65 (2004) 151-154).

Psoroptes Macrocyclic Lactone (ML) Resistance Bioassays

Results of the development of an efficient ***in-vitro*** **bioassay** for assessing the efficacy of MLs against the ear mite of carnivores, *Otodectes cyanotis*, suggest that the same assay could be successfully adapted to assay for resistance to MLs in the related mite, *Psoroptes ovis*.
(Brimer, L. et al. Experimental & Applied Acarology 33 (2004) 81 – 91).

Chewing Lice (*Bovicola ovis*)

A study was carried out to assess the **prevalence of infestations of lice** (*Bovicola ovis*) in sheep flocks and to survey control practices for lice in **South Australia** (SA). The apparent prevalence of flocks infested with lice in SA was 21%, with 13% infested in high rainfall areas, 21% in the cereal-sheep zone and 25% in the pastoral zone. Flock owners were questioned about the treatments they used for lice. Rural newspapers and magazines were by far the most commonly noted source of information for the control of lice on sheep.
(James, P J and Riley M J Australian Veterinary Journal. 82 (2004) 563-568).

Blowfly Strike

Trapping

Numbers of *Lucilia cuprina* (Australian sheep blowfly), *Chrysomya* spp., and *Calliphora* spp. blowflies caught on sticky traps baited with various synthetic **attractants** or a standard liver/sodium sulfide attractant in western Queensland were recorded. Numbers of each genus collected were influenced by the composition of the chemical attractants. The synthetic attractants were more effective and selective for *L. cuprina* than the standard liver/sodium sulfide attractant, and they can be packaged in controlled-release dispensers to generate constant, prolonged release of the attractant. (Urech, R. et al. Journal of Chemical Ecology 30 (2004) 851-866).

Biological Control

The fungus *Metarhizium anisopliae* is a natural component of soil flora world-wide and is a causal agent of the green muscardine diseases of insects. The use of this pathogen as a potential **biocontrol** agent against adult females of the blowfly, *Lucilia sericata* was considered. Exposure of flies to suspensions of fungal spores by immersion, topical application or tarsal contact with treated surfaces all resulted in high levels of fatal infection. The implications of the results for the potential use of *M anisopliae* in the biocontrol of blowflies are discussed. (Wright, C. et al. Pest Management Science 60 (2004) 639-644).

The Australian sheep blowfly *Lucilia cuprina* is the most important pest species involved in cutaneous myiasis (flystrike) of sheep in Australia and New Zealand. In New Zealand *L. cuprina* is primarily controlled through the application of insecticides. However, there is an increased interest in biological methods of control of this species. The authors propose to develop a genetically modified strain of *L. cuprina* that would be ideal for a male-only sterile release programme. They have also developed in *Drosophila melanogaster* a 2-component genetic system for controlling female viability. (Scott Maxwell, J. et al. Insect Biochemistry and Molecular Biology 34 (2004) 185-192).

Environmental issues

Synthetic pyrethroid (SP) plunge dip formulations are deemed to be less toxic to human health than organophosphate (OP) formulations, although they are approximately 100 times more toxic to the aquatic environment. The UK Government has recently reviewed agricultural practices relating to the disposal of used sheep dip, because the constituent insecticides are frequently detected in UK watercourses and the presence of these compounds is a severe hazard to the aquatic environment. Three insecticides were selected for experimental investigation: diazinon, propetamphos (OPs) and high cis-cypermethrin (SP), This paper suggested that SP insecticides such as high cis-cypermethrin will not migrate in the soil profile due to their virtual immobility and strong soil retention, and thus waste sheep dip disposal to agricultural land should not pose a risk to aquatic life if applied with appropriate controls.
(Cooke, C. et al Science of the Total Environment. 329 (2004) 197-213).

ECTOPARASITES OF PIGS

Sarcoptic mange

A **review** of sarcoptic mange by Set Bornstein (National Veterinary Institute, Uppsala) showed that it is still a common disease world-wide. It has a negative effect on the growth rate and feed conversion efficiency in growing pigs and on sow productivity. Control and eradication of the infection leads to healthier animals and costs of treatment are recovered within a few months. By employing modern endectocides (macrocyclic lactones) with their long-acting properties, the environment of infected pigs need not be addressed. Thus eradication programmes are much easier to perform, since disinfection of the environment with acaricides is not necessary. In addition, available acaricidal products such as injectables, pour-ons and in-feed formulations are effective, and particularly the latter two, easier to apply than the previous generation of acaricides. Several novel diagnostic tools including antibody indirect ELISAs are available, making diagnosis more reliable, simpler and cheaper to perform, thus giving pig breeders effective tools to monitor whether or not their herds are free from *Sarcoptes scabiei* infections. (Bornstein, S. Pig News and Information 25 (2004) 11N - 24N).

Prevalence in the UK

A survey in the UK of over 13,000 fatteners by Merial Animal Health suggested a surprisingly high level of porcine sarcoptic mange in otherwise healthy, good quality pigs. The survey involved examination of a minimum of 50 pigs/farm, scoring mange lesions on a scale of 0 to 3. A score of 3 indicating a 99% chance the lesion was a result of sarcoptic mange. 730 pigs, 5.6% of pigs examined, were judged to be score 3. (Anon. Farmers Weekly (2004) November 12th – 18th).

Immunodiagnosis

Studies were carried out in Austria to compare four different **ELISA test kits** against each other and against conventional skin scraping for the diagnosis of *Sarcoptes scabiei* var. *suis* infestations. The SARCOPTES-ELISA 2001 was shown to detect the most positive results (88.58%), followed by the ELISA of the National Veterinary Institute, Uppsala (70%), the Acar-Test P-ELISA (52.86%) and the CHEKIT Sarcoptest (30%). Conventional skin scraping was more effective than the latter, diagnosing 48.57% of infestations. In a second study, eight litters from infected sows were examined on weeks 1 to12 after birth using the CHEKIT Sarcoptest and the SARCOPTES-ELISA 2001. The presence of maternal antibodies was highest after the first week in both ELISAs and could be detected until weeks 5-9. Antibodies increased as a result of an active immune response between weeks 8 and 9 in the SARCOPTES-ELISA 2001 and between weeks 10 and 11 for the CHEKIT Sarcoptest.
(Lowenstein, M. et al. Parasitology Research 94 (2004) 24-30).

Sarcoptic Mange In vitro Resistance Bioassays

The current in vitro migration assay for acaricidal effect of macrocyclic lactones utilising *Sarcoptes scabiei* var. *suis* is fully quantitative but quite time-consuming. The assay can now be modified to become faster and simpler to obtain accurate results within 6h, as opposed to 24h. (Brimer, L. et al. Experimental & Applied Acarology 33 (2004) 81 – 91).