DISCONTOOLS

Nematodes
Summary

Introduction

1. This note provides a brief summary of the Disease and Product analysis prepared by a DISCONTOOLS group of experts on Nematodes. They reviewed the current knowledge on the disease, considered the existing disease control tools, identified current gaps in the availability and quality of the control tools and finally determined the research necessary to develop new or improved tools. Full details are available on the web site at http://www.discontools.eu/ and can be downloaded by selecting Disease Database, then the specific disease and highlighting the variables of interest. This is completed by selecting "create a report" which can then be downloaded as either a PDF or Excel spread sheet.

Disease profile

2. There are a large number of genera and species but only nematodes of the gastrointestinal tract (GI) of ruminants and pigs are considered. Some GI nematode species are more pathogenic than others but within nematode species, no documented differences in pathogenicity have been identified between strains or regional isolates.
3. GI nematode infections are an important constraint to efficient livestock production worldwide and negatively affect livestock welfare and production (both meat and dairy). The effect of ruminant nematodes is mainly in growing animals where subclinical infections can lead to reduced weight gains by 10 to 30%. In adult animals infections can result in milk yield losses of 5 to 10% in cattle and up to 40% in small ruminants. Other losses include lower conception rates, poor carcass quality, reduced wool yields. The impact of pig nematodes is largely unknown although some older studies report on marked reduced reproductive performance and weight gain, but several other studies have failed to show an impact. Liver condemnations may be up to 20 % in certain countries.

Risk

4. In ruminants, parasitic gastroenteritis mainly occurs during the grazing period and will vary according to latitude. Management conditions (e.g. access to pastures, turn-out and housing periods) will determine infection levels. Selective control agents may suppress certain nematode species and allow others to flourish. Changing climate is likely to exacerbate parasitoses by increasing the level and duration of pasture infectivity.
5. Drug-resistant nematodes are a well-known problem in sheep and are emerging in cattle. Anthelmintic resistance (AR) is one of the main threats to sustainable parasite control in the future. The issue of AR is also of public health concern, particularly in view of the large-scale application of anthelminthic drugs to at-risk populations in developing countries. There is also a need to assess the impact of *Ascaris suum* infections in humans

Diagnostics

6. In ruminants, coprological (microscopical) methods are used for all GI nematodes and all hosts to identify and quantify eggs. The methods can be combined with coproculture to identify L3 stage larvae. Serological methods involve measuring serum pepsinogen levels to assess the degree of damage/extent of exposure to abomasal nematode infections. Antibody levels against crude extract of *Ostertagia ostertagi* in bulk-tank milk or serum are used to assess nematode exposure in adult cows. Morbidity markers have been described in sheep. Pig nematodes are mainly diagnosed by faecal examination for eggs and occasional reports from abattoir of milk spots in the liver, only indicative of recent *Ascaris suum* exposure. Since recently, also a serological test to detect *A. suum* infection in finishing pigs is available, which has higher sensitivity compared to faecal examination.
7. The conventional diagnosis of nematode infections is laborious and expensive, and often not informative in providing a decision on whether to treat or not. A key problem is to identify those animals requiring treatment in order to avoid unnecessary use of anthelmintics. Non-invasive and automated sampling methods and assays (e.g. milk, meat-juice, body condition scoring) are required. Further development of existing tests to make them suitable for high-throughput

Comment [JC1]: Something about molecular diagnostics and Luminex?

platforms and the development of pen-side tests for user friendly (low input) on-farm monitoring and rapid detection of parasitic infections would be beneficial. Other requirements include novel tests for the early detection of anthelmintic resistance and the interpretation of results, identification of the specific proteins or sequences for species differentiation and the novel genetic markers associated with host resistance/resilience.

Vaccines

8. A commercial vaccine against *Haemonchus contortus* has been launched in Australia and reduces worm numbers and worm egg output by > 90%. Prototype vaccines against *Ostertagia ostertagi* reduce worm egg output by 60% during a two month challenge period. The main shortcomings include a lack of cross-protection against other important nematodes and possible need for repeated administrations. The required efficacy has been defined for some species by experimental infection and/or by modelling but there is a requirement to define efficacy in the field, probably at the level required to reduce or eliminate the economic impact of the disease. Vaccines for all the important gastrointestinal nematodes – in some cases (*Haemonchus, Ostertagia*) might have a market place as mono-valent vaccines but the ambition should be polyvalent vaccines. Effective recombinant vaccines to allow mass production are required.

Comment [JC2]: Something about Cooperia?

Pharmaceuticals

9. Control of GI nematodes in Europe relies largely on anthelmintics. All anthelmintics used in livestock are very effective at reducing susceptible worm burdens. Possible drawbacks to the use of anthelmintics may include: (a) the increasing incidence of AR; (b) reduced development of natural immunity against nematodes; and (c) consumer concerns regarding drug residues in food products and in the environment. Instead of blanket treatments future treatment strategies could benefit from selective treatment of only those animal requiring treatment. This means optimising anthelmintic usage to both control nematodes and maintain efficacy.

10. The dependence on anthelmintics is not without risk as the spread of anthelmintic resistance is an emerging problem. The prevalence of AR varies geographically, depending on the livestock species involved and the drugs used. Benzimidazole-resistant and macrocyclic lactones-resistant nematodes are widely reported in sheep/goats of several temperate European countries. Resistance to levamisole is present in sheep and goat parasites, though at a lower level. In cattle AR has been reported, however, until now it is mainly limited to macrocyclic lactone resistance to *Cooperia* spp. In pigs AR has been demonstrated for *Oesophagostomum* spp. in Denmark and Germany (pyrantel, levamisole, benzimidazoles), and may be an overlooked problem.

Knowledge

11. There are many significant areas of uncertainty in the understanding and knowledge about nematode infections especially in relation to genetics, pathogenesis, immunology, vaccinology, epidemiology and control. Research is needed to fill these gaps in knowledge as many of these are closely linked to the research requirements to develop more effective tools for the control of the disease. Full details of the gaps are shown in the Disease and Product Analysis for Nematodes on the DISCONTOOLS web site.

Conclusions

12. According to FAO, the demand for food is expected to continue to grow as a result both of population growth and rising incomes. Both milk and meat production from cattle and pigs are the most important sectors in animal farming in the EU. Nematode infections cause among the highest productivity and economical losses in livestock. Combatting these infections is indispensable to increase efficiency of production.

13. Improved communication and implementation of holistic control strategies using improved diagnostics, host genetics, nutrition and pasture management are needed to reduce the reliance upon anthelmintics. This would be linked to the introduction of additional control measures, e.g. vaccines, bio-active forages, nutraceuticals, ovicidals.