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Worms in smallholder livestock systems: Technologies and practices that make a difference

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ABSTRACT

Australian scientists, in partnership with Asian, African and Pacific nations have longstanding interests in applied research on helminth parasite control. Many technologies and practices have been successfully developed to control the parasite problems of smallholder and emerging farmers. This wide range extends from simple herbal remedies to complex, integrated use of chemicals, feeding and breeding. In many cases widespread adoption has been limited by lack of technical support, poor access to input markets and lack of incentives for poorer farmers to seek out and pay for innovations. A further new approach may be required that encompasses the wider production and market environment.

The biological, social and economic context of each 'emerging farming system' is different and the matching of technologies to each system requires sound understanding of farmer needs and requirements. Thus, it is essential that farmers, extension workers, and scientists jointly decide what technologies to try, what results mean and, if successful, how to sustain their use.

In one Asian example a range of technologies were considered for pig, large ruminant and goat production and parasite control through a participatory process which was also used to agree on what determines sustainability beyond testing. The criteria use to screen technologies and practices were (a) continued availability of inputs including dewormers, (b) dependence on related innovations (e.g. weaning or fencing) and (c) degree of community organisation required (e.g. control of breeding or communal grazing). On this basis deworming with chemicals, especially for *Toxacara* infection in cattle and buffalo calves following on from supplementary feeding with forages were the most feasible entry points. Further interventions were dependent on changes to the production system, including the introduction of weaning and controlled breeding. Further, the incentives for these production changes could not exist without improved market access and market signals for improved weight and condition. Examples such as this point to the need for stronger multidisciplinary and participatory approaches to parasite control.

1. Introduction

Helminth parasite continue to be one of the greatest constraints on the productivity of livestock in both the developed and developing world and new technologies are continually being conceived, developed and tested to overcome their effects and prevent animals from becoming

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infected (Sani et al., 2004). New chemicals and new delivery methods for these chemicals, epidemiologically based management practices, nutritional and genetic modification and vaccination are at various stages on the research continuum from discovery to field testing and, where appropriate, registration. In this paper we would like to draw attention to an often neglected part of the research to development spectrum that follows on from successful technology development. Those 'missing links' are sustainable mechanisms for the delivery of technologies and their appropriate use by farmers and other users. We will focus on livestock production in developing countries where the principles of animal health delivery may be the same as in more advanced commercially-oriented systems with fully developed veterinary and animal health input services, but where the practices are very different, very diverse and may themselves require novel approaches. Main points will be illustrated by examples from Laos where recent research and development efforts have highlighted the need for the integration of technology development into a pathway that leads to realistic development outcomes.

A major challenge to the field of 'novel approaches' or 'sustainable and integrated' parasite control is that several of these approaches are not distinct as animal health inputs. These include improved feeding, breeding, general husbandry and grazing management; in contrast to vaccination and chemical dewormers which would be delivered through more conventional systems of registration and a commercial supply chain. Thus the problem of parasite control to overcome the large impact that helminths have on livestock production cannot be separated from the larger problem of improving system productivity. Further, as livestock are completely integrated into the overall farming and livelihood systems of many developing countries (World Bank, 2010; McDermott et al., 2010) innovation in livestock systems cannot be isolated from other economic and social developments.

2. Available technologies and novel approaches to worm control

Much research in this area has been conducted in developed countries from which extrapolation of results has been attempted in a variety of developing countries. In both Africa and Asia there has been substantial research on breeding and on ethnoveterinary approaches as there are significant advantages in conducting experiments *in situ* where both animals are plants exist in viable production systems. These brief descriptions summarise the state of play for each of the approaches being investigated.

2.1. Chemical dewormers

Chemical deworming remains a mainstay of helminth control in commercial livestock systems and, although it has application of the treatment of sick animals, is almost always implemented as a preventive control strategy with other management elements, to prevent build up of dangerous or production-lowering levels of parasites in both host and environment. The drivers for much recent research on alternatives to chemical deworming have been the appearance of resistance, often multiple resistance, and the lack of optimism that new chemical families would be brought to market by the large pharmaceutical companies (e.g. Jackson et al., 2009). However, a new family of dewormer suitable for helminths in ruminants, monepantel, has recently been brought to market (Sager et al., 2010). Cost and how it is employed in control programs will determine if, and when, resistance to this newcomer develops. In general terms, if dewormers are used sparsely and in combination with other management approaches it is less likely that resistance will develop quickly. In the developing world resistance has been found extensively (e.g. Waller et al., 1996; Chandrawathani et al., 1999; Ancheta et al., 2004) but the main restriction on the use of dewormers remains their lack of availability, their high cost and the lack of knowledge among farmers and extension workers to apply them (Sani et al., 2004).

2.2. Grazing management

Knowledge of the epidemiology of nematodes of grazing small ruminants, especially *Haemonchus contortus* led to the spectacular success of Rapid Rotational Grazing Systems in experimental on-farm conditions in the Pacific (Barger et al., 1994) but there has been little subsequent adoption of such systems in any part of the world. Nonetheless these same principles have been employed to conceive and develop practical measures to retain free-living parasite larvae in *refugia* as a strategy to delay the onset of anthelmintic resistance. The tensions involved in this approach have been well-described (e.g. Besier et al. this volume) not only in maintaining effective parasite control but also in developing extension messages which are simple enough to encourage farmers to adopt what were previously advised as ineffective control measures. This highlights the interaction between the technology and the human factors of livestock husbandry once described a 'tailoring individual scientific results into the mosaic of demands' of practical farm management (Willadsen, 2006).

2.3. Feed – nutrients

The evidence that animals which are well-fed in terms for both protein and energy are more resistant to helminth infections is overwhelming and while debate continues about the relative benefits of different feeds and the importance of dietary components, there is scientific consensus that an increased plane of nutrition is a protective mechanism to lower infection levels and mitigate their effects (Knox et al., 2006). Application of this principle is not only influenced by the need for parasite control but by the relative costs of feed and the benefits obtained from the sale of heavier and better-conditioned stock.

2.4. Feed – antinutrients

Tannins have attracted attention as sources of improved nutrition in ruminants, by binding proteins that by-pass the rumen, and as compounds with direct effects on both free-living and parasitic helminth stages (Houdijk et al., this volume; Kahn and Diaz-Hernandez, 2000 and this volume).