Managing Internal Parasites in Organic Sheep Production Enterprises

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This report was originally submitted as a critical review paper for AGRO501: Organic Agriculture Principles and Practices while completing a Master of Agriculture at the University of New England in 2013. These principles are equally relevant for sheep producers who wish to take a holistic approach to animal health, reduce their reliance on inputs and build resilience into their production system.

Introduction to Organic Sheep Production

Organic agriculture is a holistic farming system which puts the emphasis on the interconnectedness among all living beings and between them and their environment. Organic farmers manage complex biological ecosystems with interventions in natures processes kept to a minimum. Food produced in organic farming systems is grown without the use of chemical fertilisers or pesticides. Organic farmers focus on preventative management strategies to ensure the health of their crops and livestock. Soil health is crucial in organic farming as it is directly linked to the health of plants and livestock.

Organic agriculture is based on four major principles (IFOAM, 2009):
Principle of Health: Organic agriculture should sustain and enhance the health of soil, plant, animal and human as one and indivisible.
Ecological Principle: Organic agriculture should be based on and work with living ecological systems and cycles, emulate them and help sustain them.
Principle of Fairness: Organic agriculture should be built upon relationships that ensure fairness with regard to the common environment and life opportunities.
Principle of Care: Organic agriculture should be managed in a precautionary and responsible manner to protect the health and wellbeing of current and future generations and the environment.

Organic agriculture was the traditional method of farming prior to the agricultural revolution in the 1840's. Organic agriculture has undergone a resurgence since the 1960's due to growing awareness of the damaging impacts of industrial agriculture on the environment and human health concerns. Growth predictions for organic agriculture of 10-15% for coming years (Monk et al, 2012) see the biggest challenge being developing domestic production to meet this growing demand. Australia has the largest area of certified organic land in the world (16.9million ha certified in 2011, with 253,392ha in pre-certification). In 2011 there were 2,117 certified organic farmers in Australia.

Organic lamb production represents a small percentage of total lamb production in Australia. Production of organic lamb was estimated at 100,000 – 120,000 lambs per year in 2008 (Burnett, 2008). According to the BFA Organic Market Report, 2012 (Monk et al, 2012) farm gate sales of organic lamb have increased by 64% since 2010. There is a consistent undersupply of organic lamb in Australia and processors do not expect supply to equal demand for some time. According to BFA statistics, 52% of the national organic sheep flock are located in NSW, 17.3% in Victoria and 16.9% in Queensland, mainly in western rangeland areas of these states (Burnett, 2008).

The organic wool sector in Australia is highly productive but has not developed a supply chain to provide consistent supply to end markets. The BFA Organic Market Report, 2012 claims sales of organic wool valued at $25,360,226 with most not being sold into organic markets due to the logistical and downstream processing challenges that exist.

Internal parasites are a significant burden for sheep producers, both organic and conventional in terms of economic cost of control, mortality and production losses (Kelly et al, 2010). Increasing resistance of internal parasites to chemical anti-helminthic drenches is causing conventional sheep producers to look for alternatives. For the organic sheep producer, preventative use of chemical anti-helminthic drenches is not an option so an integrated approach combining different methods is used to achieve the best control (Thamsborg et al, 1999). For organic sheep producers to have viable enterprises effective strategies for preventing internal parasites are essential.

This report reviews the options available for organic sheep producers to manage internal parasites. These strategies also assist conventional sheep producers to reduce their reliance on chemical drenches and help alleviate drench resistance problems in their flocks. The organic approach to internal parasites focuses firstly on prevention through nutrition, breeding and selection, grazing management and animal husbandry. Organic farmers can also utilise methods for monitoring internal parasites and alternative non-chemical treatments to treat worm infestations. Organic sheep farmers must take into account animal welfare considerations when making decisions regarding the best way to manage internal parasites in their flocks. Treatment using non certified substances can become necessary due to animal welfare considerations which will then have implications for meeting organic certification standards.

Prevention of Internal Parasites in Organic Sheep Enterprises

Organic sheep production requires a high standard of management, with the organic approach to internal parasite control focusing on prevention through diet, shelter, breeding and husbandry practices rather than treatment (Neeson, 2007). The philosophy is that healthy animals are in a better position to cope with parasites.

(a) Nutrition

Nutrition is the key to animal health in organic livestock enterprises, particularly in controlling internal parasites in sheep. Well-nourished animals cope better and overcome infection with parasites quicker than malnourished animals (Rahman & Seip, 2007).

According to Wells (2005), good nutrition plays a big part in how well the animal's immune system mounts the proper defences, and in the animals overall ability to tolerate the presence of worms. Healthy well-nourished sheep will be able to develop some resistance and resilience to worms and other parasites much better than animals who do not have access to quality feed.

Good nutrition in organic sheep enterprises starts with a fertile soil. Organic soil fertility is built through management practices (crop rotations, incorporation of organic matter, cultivation to aerate soil, deep rooting species) which build up soil humus and biological activity. In organic livestock systems crop rotation and a variety of plant species in the pasture create a diverse diet which is a key in providing livestock with balanced nutrition.

Ensuring a diet high in protein plays a key role in improving the ability of sheep to cope with parasitic infection. Protein is needed for growth processes as well as immune responses. An animal has only a certain amount of nutritional resources available to allocate amongst the different bodily functions. If the protein supply does not cover these necessary requirements then certain functions are prioritised to the disadvantage of immunity (Coop & Holmes, 1996; Bishop & Stears, 2003).

Grazing certain leguminous forages and herbs which can act as botanical de-wormers can reduce parasitism in sheep. Thamsborg et al (1999) found that leguminous plants with a high content of condensed tannins improved the performance of parasitised lambs. Worm burdens in lambs were reduced by up to 50% by feeding sulla (Hedysarum coronarium) or great trefoil (Lotus pedunculatus). The condensed tannins in these plants are believed to protect plant protein against ruminal degradation, increasing the protein availability in the small intestine and improving the animal's protein supply.

Grazing pastures containing chicory can also reduce the effects of parasitism in sheep. Chicory is highly nutritious forage due to its high soluble carbohydrates and trace minerals content which improve the growth rate of animals and enable the host to better withstand parasite infection. Lactating ewes and lambs grazing pastures containing chicory were found to have significantly lower faecal egg counts, improved live weight gains and pasture contamination with larvae was reduced on chicory pasture swards (Athanasiadou et al, 2007; Scales et al, 1994, Tzamaloukas et al, 2005).

Pastures containing herbs such as chicory, plantain, yarrow and caraway increases diet diversity and improves sheep nutrition assisting to build immunity to worms. Deep rooted native species can recycle and make available nutrients that otherwise may be unavailable deep in the soil profile. Legumes like Lucerne can supply organic nitrogen to the grass component of the pastures and help recycle nutrients (Neeson, 2008).

Vitamins A, D and B complex are the most important vitamins required by animals to develop resistance to internal parasites, according to Duval (1997). Cobalt is also essential as animals require cobalt to synthesize vitamin B12. Iron supplements are useful when sheep are infected by worms which drain blood like Haemonchus contortus. Patra (2007) recommend supplementing with minerals such as zinc, copper, molybdenum and phosphorus and vitamins A, E and B12 to build resistance, resilience and expression of

immunity against nematode infections. It is important to note that the National Standard for Organic and Bio-dynamic Produce (Organic Industry Export Consultative Committee, 2009) states that feed supplements of agricultural origin must be of certified organic origin. Feed supplements of non-agricultural origin can include minerals, trace elements, vitamins or pro-vitamins only from natural sources.

(b) Breeding & Selection:

Breeding and selection for resistance to internal parasites is an important management tool for organic farmers. Conventional livestock producers put the genetic emphasis on high production. Organic farmers select for a wider range of qualities which include pest, parasite and disease tolerance and mothering ability. Organic farmers breed for lifetime yield, aiming to increase animal's productive life rather than the early productivity goals of conventional systems. Developing longevity in a flock is often associated with resistance to disease. The farmer gains the opportunity to know animals well which means they handle easily and a good knowledge of disease history is obtained. The flock also establishes stable social order and a stable health status (Neeson, 2008).

Research into breeding sheep for host resistance to internal parasites began in Australia in the 1970's in response to widespread anti-helminthic resistance in worms and the recognition that there are large differences between individual sheep in their ability to withstand worms. Conventional breeding of lines of sheep selected for productive traits (increased fleece weight, lamb growth rates or general productivity) has been found to result in lines of sheep with higher faecal egg counts (FEC) than randomly bred animals (Greer, 2008). Worm resistance in sheep was found to be heritable and a three year CSIRO project, entitled Nemesis bred merino sheep to resist infection by parasitic worms with little or no chemical treatment (Eady et al, 1997). Genetic selection is now widely used to increase resistance to internal parasites. Using rams with better than average worm resistance, as indicated by more negative Worm Egg count Australian Sheep Breeding Values (WEC ASBV's) has been shown to be the best way to increase the genetic resistance of a sheep flock to worms (Wormboss, 2013).

Research by Wells (2005) found 80% of parasite problems occurred in 20% of a particular flock. Implementation of a culling program for animals based on parasite status will improve overall herd health and decrease pasture contamination. Records of animals with high FEC's should be kept and if an animal does need to be drenched consider culling that animal and any offspring or siblings.

(c) Grazing Management:

Grazing management plays an important role in managing internal parasites on organic farms. The major parts of the internal parasite life cycles occur outside of the host animal so grazing management strategies based upon the interrelationships between the animals, the plants they eat and the soil on which these plants grow and a thorough knowledge of the parasite lifecycle are used to reduce parasite levels on the pasture and reduce usage of chemical de-wormers (Wells, 2005).

Grazing is managed to provide animals with clean pastures. A “clean” pasture is a pasture with nil or very low risk of infection when animals are first grazed on it. This can be achieved by allowing sufficient time between grazing for most of the eggs and larvae on the pasture to die. Clean pasture has not been grazed by the host animal for 12 months and may be a new pasture, pasture grazed by livestock such as cattle or horses which do not share parasites with sheep (not goats) or pasture that has been hayed, renovated, or rotated with row crops. A three year rest is required to become completely clean (Patra, 2007).

A “safe” pasture is minimally contaminated. It takes approximately 3 to 9 months for pasture infectivity to decrease significantly for most species, depending on the climate and the time of year (Rahman & Seip, 2007). Preparing low worm risk paddocks for lambing ewes and weaners is a key non-chemical strategy (Kelly et al, 2010; Wormboss, 2013). Ewes temporarily lose some of their immunity to worms at and after lambing and as a result contribute to the seasonal increase in worm numbers and infection of lambs. Weaners are also highly susceptible to worms so low risk weaning paddocks give weaners a good start so they can build immunity without suffering high initial infections. Low worm risk paddocks can be prepared by spelling or grazing with cattle in the months prior to lambing or weaning. The length of preparation time will depend on the time of year the paddock will need to be used and the climate.

Sub-dividing paddocks and frequently moving animals from one paddock to the next to optimise grass use also assists with parasite management (Duval, 1997). Parasite load is reduced by not putting animals back into the same field until the risk of infection has diminished. Wells (2005) compared rotational grazing to a set stocked grazing system where animals continuously graze a pasture, eating the grass into the ground and contaminating the soil with so many parasites there is nothing outside regular de-worming with chemicals to control them. Using rotational grazing methods allowed pastures to rest and soil life to function well and reduced parasite contamination. Soil organisms such as earthworms, dung beetles and nematophagous fungi will destroy or keep a lot of the parasite eggs and larvae from developing. Rotational grazing also serves to keep the grass in a vegetative state and toll and healthy to provide better feed quality to animals, strengthening their immune system.

Timing stock movements between paddocks in a rotational grazing system can also be manipulated to prevent parasitism by controlling the grazing height of pastures. 80% of parasites live in the first five centimetres from the ground on vegetation (Duval, 1997). Parasite infection can be prevented by allowing animals grazing only 10cm from the ground in a field where there are parasites. Warmth, oxygen and moisture increase the survival of larvae on pasture so knowing when your pastures are apt to be the driest and coldest will help manage them for parasite control (Wells, 2005). In dry grass parasite larvae will stay at the base of the plants but in wet grass larvae can move up the grass and have been found over 30cm away from the ground in wet low light conditions.

Parasite infection becomes more prevalent in warm seasons of the year, particularly when there is good moisture so animals should be put onto clean pastures when infection is expected to be high and fields which are highly contaminated should be restricted from grazing in the infection season (Patra, 2007; Hankin, 2003). Worm eggs can survive summer

in moist areas around dams so preventing access to these areas may help control worm infestation. If liver fluke are present, infection can be prevented by fencing out areas that harbour snails and draining wet areas to avoid grazing snail infested areas by susceptible animals (Wormboss, 2013).

Alternation of sheep and cattle grazing on an annual basis or more often has been found to result in effective nematode control and good weight gains in sheep (Thamsborg et al, 1999). Running cattle in pastures that have had sheep in them helps break up the life cycle of the sheep parasites since sheep and cattle do not have the same species of worms infecting them (Patra, 2007). Cattle can be grazed before sheep to control pasture quality, cattle and sheep can be grazed together where vegetation is abundant (Duval, 1997).

Grazing management can enable non-chemical control of parasites by diluting pasture infectivity by mixing young susceptible stock with another species, older resistant stock or simply by reducing stocking rates (Thamsborg et al, 1999). Lower stocking rates lead to reduced worm burdens as pastures get less contaminated and sward height remains higher as stock are not eating low down where there are higher numbers of larvae (Patra, 2007).

(d) Husbandry practices:

"Organic animal husbandry is based on the harmonious relationship between land, plants and livestock, respect for the physiological and behavioural needs of livestock and the feeding of good quality organically grown feedstuffs", Lund (2006). Organic farmers provide protection against excessive sunlight, temperature, wind, rain and other harsh climatic conditions through the provision of windbreaks and/or housing for livestock (Neeson, 2008). Minimising physical or physiological stress in livestock promotes wellbeing and reduces the incidence of disease. Management practices aim to minimise stress during handling or periods such as after shearing by providing pasture with low or no parasitic infection to reducing the impact of parasites. Animals are able to develop and maintain resistance to internal parasites when animal husbandry practices incorporate good nutrition, minimal stress and grazing rotations to clean pastures at key times of stress (late pregnancy, lambing and weaning) (Neeson, 2008).

Monitoring Internal Parasites in Organic Sheep Enterprises

Monitoring internal parasites in organic sheep enterprises helps to guarantee animal welfare and protect animals against unnecessary suffering. If animals require treatment for parasites in organic systems only individual animals are treated so before any treatment can be administered monitoring enables identification of the individual animals which are physically affected by parasites (Rahman & Seip, 2007).

(a) Animal health records:

Observation is a vital part of internal parasite management for organic farmers. Keeping daily or frequent records assists the farmer to assess possible origins of disease (Neeson, 2008). Close monitoring means the farmer is more likely to observe problems and intervene early reducing possible prolonged suffering. When observing sheep there are three

commonly applied methods to determine worm infestation: scoring general body condition, determining faecal egg counts and scoring for deviate physical conditions (Rahman & Seip, 2007). Pale skin and eyes, bottle jaw, weight loss, a tail in the mob and deaths can indicate a worm issue but these signs occur well after production losses from worms are already occurring (Wormboss, 2013). Individual records of animal health observations including FEC's facilitate improved breeding outcomes in terms of increasing parasite resistance and also are a vital part of the certification standards. Long term records of larval activity observations, FEC's and other monitoring measures undertaken along with climatic observations allow organic farmers to identify peaks and troughs in parasite infectivity for their environment and better determine the timing of prevention and management strategies aimed at reducing parasitism in their flocks.

(b) Faecal Egg Counts (FEC's):

FEC measures the number of worm eggs in faeces providing a good indication of the worm burden of sheep. Conventional sheep producers check worm burdens with FECs to enable correct and timely drenching decisions and FEC's have become an important tool in dealing with drench resistance issues. In contrast, organic producers can use FEC's as an early warning of internal parasite problems so preventative action can be taken. Individual FEC's can be used to confirm diagnosis to enable appropriate treatment of individual animals which are heavily infected with parasites. FEC's can be done through a laboratory or producers can do their own tests if they have the equipment and skills. Some laboratories can also undertake larval differentiation to identify the types of worms present and their proportions (Wormboss, 2013).

(c) Haemonchus Dipstick Test:

The Haemonchus dipstick test can be used to check barbers pole (Haemonchus contortus) burdens. It can be used at any time but is most useful in spring, summer and autumn to detect rapidly developing infections in mobs that may not have been tested for FEC, in mobs between worm tests, and two weeks after ideal weather conditions for worms have occurred (warm and rainy for some days) and when pastures are likely to be contaminated with infective worm larvae. (Wormboss, 2013).

(d) FAMACHA:

This is an eye colour chart used to determine the degree of haemonchosis in sheep and goats. It is designed to give farmers the ability to assess the clinical condition by the colour of the eye mucosa and drench only those animals with a score indicative of a high worm burden (Rahman & Seip, 2007).

Treatment of Internal Parasites in Organic Sheep Enterprises

Organic Standards do not permit farmers to use routine anti-helminthics for controlling internal parasites in sheep. Drenching is carried out on a needs basis only when permitted substances or practices do not satisfactorily treat an animal as animal welfare takes priority over organic status (Neeson, 2008). As with conventional systems, it is essential to utilise

management practices which hold drenched animals in the location for 12 – 24 hours after drenching before being turned out on to clean pastures to minimise re-infection (Wells, 2005).

(a) Drenches:

Organic treatments include drenches made from natural products such as garlic, herbs (eg wormwood), molasses, vegetable oil, cider vinegar, sea minerals and diatomaceous earth. Copper Sulphate in minute doses is also used. (Neeson, 2008).

(b) Botanical Dewormers:

Plants with anti-helminthic properties were a part of traditional husbandry practices before chemical de-wormers were invented. In Canada it was common to feed evergreen branches such as pine, spruce or fir to sheep (Duval, 1997). Patra (2002) lists several botanical de-wormers that can be added to feeds which include garlic, pumpkin seeds, wormwood (Artemesia spp), neem seed, tansy, wild gingers, mustard, juniper and pyrethrum. Blackberries and raspberries are plants that can be made available in pastures with deworming properties. Duval (1997) also adds yarrow, agrimony, calendula, hemp, bloodroot, nettle, valerian, verbena and periwinkle to their list of botanical de-wormers. These plant species can be planted in paddocks to increase dietary diversity and assist parasite control. Sheep have their own natural intelligence and learn to eat botanical dewormers such as wormwood when they are infected with worms (Hankin, 2003). Care is needed as these plants can have side effects and be potentially poisonous in excess.

(c) Homeopathy:

Homeopathic remedies are widely used in organic agriculture with mixed results (Neeson, 2008). There has been little scientific research on homeopathic remedies. A study was conducted in Pakistan (Ahmad et al, 2011) to record the efficacy of various herbal, allopathic, homeopathic and biological products and found that the homeopathic remedy was effective in combating Haemonchosis in sheep.

(d) Biological Control:

Nematophagus fungi (Duddingtonia flagrans) have been trialled as a biological control agent of parasitic nematodes. Nematophagus fungi are a naturally occurring enemy of free living nematodes and have been found to be able to reduce populations of pre-parasitic nematodes significantly. They are easily cultured and can be released into the environment of the target organisms (Thamsborg et al, 1999). Nematophagus fungi reduce the number of infective larvae developing in faeces but have no effect on larvae already passed to the vegetation or present as worm burdens within animals. Their use as an integrated control strategy needs further development and would require suitable practical application systems (perhaps incorporation into feeds, mineral licks or feed blocks).

Animal Welfare Considerations

Parasite infestation is a high risk factor for animal welfare. There are times when the adoption of good management practices in an organic system alone is insufficient to guard against internal parasites and there is not always a satisfactory result obtained from organic treatments. When an organic treatment is not effective conventional treatment must be used since the welfare of the animal is the primary objective (Neeson, 2008).

Certification implications

If organically certified animals are treated with parasiticides the standards specify a number of management conditions which must be applied. Treated stock must be excluded for a period of time from certified organic land and separated in a defined quarantine area from non-treated organic stock during and following treatment for a period equivalent to three times the legal withholding period of the substance in question or a minimum of three weeks, whichever is longer. Following this quarantine period treated stock are permitted to mingle with the organic livestock and range on certified organic land provided that they are clearly identifiable from the organic livestock and traceable through farm records.

Meat from organic livestock who have been treated with parasiticides can never be sold as organic. The offspring of treated livestock however may attain organic status for meat if managed in accordance with organic standards from the last trimester of pregnancy. Wool regains its organic certification status 18 months following treatment and milk 180 days following treatment (Neeson, 2008). When implementing a breeding program to improve resistance to internal parasites it is important to note that organically certified livestock must be bred on the property, introduced animals can never be certified as organic (McCoy & Rarlevleit, 2001). Progeny can be certified as organic if they have been managed organically since the third trimester of pregnancy (Neeson, 2007).

Conclusion

Internal parasite control is a huge challenge for all sheep producers and can be a major barrier to conversion to organic sheep production in many locations. It is clear to see why most certified organic sheep production occurs in rangeland environments where internal parasites are not as problematic. For a sheep producer converting to organic certification internal parasite control would need to be a major issue of consideration in the planning stages when assessing feasibility of the enterprise.

Organic sheep producers require excellent farm management skills. Their priorities for implementing effective internal parasite prevention strategies include ensuring a high plane of nutrition to improve the animal's ability to cope with parasites, effective grazing management to interrupt the parasite life cycle, the implementation of selective breeding programs and maintaining a focus on good animal husbandry. Close observation of livestock is a crucial factor in organic sheep management as it allows issues to be dealt with early and ensures a high standard of animal welfare is maintained. Organic farmers need to keep

detailed records and follow certification guidelines when an animal requires chemical deworming.

The strategies employed by organic sheep producers clearly offer benefits to conventional sheep producers who are struggling with internal parasite issues due to increasing drench resistance. There are also uses for monitoring procedures developed for use by conventional sheep producers in organic management systems to improve internal parasite control. The sheep industry will benefit from ongoing research and development in the future into non chemical means of controlling and preventing internal parasites in sheep across the board. Hopefully this will be assisted by the fact that conventional sheep producers are having so many problems with drench resistance. Any work which can be done to improve non-chemical management skills and techniques regarding internal parasite control will be of use to all sheep producers regardless of whether they are organically certified or not.

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