A contribution to assessing the economic impact of redlegged earth mite on agricultural production in Australia

T.J. Ridsdill-Smith, CSIRO Division of Entomology, Private Bag, Wembley, WA 6014, Australia.

Summary

The Sloane, Cook and King study considered the economic impact of mites on wool production, which is extended here to the impact on the beef industry. Losses to wool production are estimated at $56 – 112 million and to the cattle industry $81 million. A very limited trial on the effect of feeding by redlegged earth mite on pasture digestibility support indirect estimates that the mites can cause a 10% loss of livestock production.

Introduction

The Sloane, Cook and King (1988) report to the Australian Wool Corporation assessed the economic impact of pasture weeds, pests and diseases on wool production. Redlegged earth mite (RLEM), *Halotydeus destructor*, is one of three pests, including bluegreen aphid (BGA), *Acyrthosiphon kondoi*, and lucerne flea (LF), *Sminthurus viridis*, whose effects were not separated in the survey. The annual losses of production to the wool industry attributed to these pests were estimated at $228 million and cost of insecticides at $10 million. In the survey, RLEM was consistently ranked as the most important and widespread pest of temperate pastures in Australia (Sloane, Cook and King 1988).

RLEM can cause high mortality of legume seedlings in germinating pastures, losses of production to growing pastures, and losses of seed yield (Sloane, Cook and King 1988). Annual pastures depend on the seed bank in the soil for growth of the pasture each year, and seed losses can therefore affect clover density in subsequent years. In the Sloane, Cook and King study all these losses are expressed in one figure for a loss in the value of production. In the Sloane, Cook and King study RLEM is reported to be a severe pest in eleven Australian Bureau of Agricultural and Resource Economics (ABARE) zones, and a minor pest in two zones, all in southern Australia. In the zones where RLEM, BGA and LF are most abundant this figure is taken to be a 10% loss in a standard value for gross margin per livestock unit, and in zones where they are more sporadic pests the figure is a 2% loss. Some workers believe that pasture losses due to RLEM on a regional scale are less than these figures, but that economic losses to vegetables may be substantial (M.M.H. Wallace, personal communication).

It was suggested by Dr B. Purser (CSIRO Animal Production) that feeding mites may reduce pasture digestibility for sheep and cattle, and that this could be quantified because the effects of changes of digestibility on animal production are already described. A reduction in pasture quality as a result of RLEM feeding might thus provide a better estimate of losses to animal production than a reduction in pasture quantity. Feed quality for stock shows considerable seasonal variation in winter rainfall regions. In summer, feed for sheep and cattle is of low quality but quantity is adequate, and in autumn both quality and quantity are low. Feeding by RLEM on green pasture in spring may affect the quality of senescent pasture in both summer and autumn.

The Sloane, Cook and King report was specifically concerned with the wool industry, and here I extend this analysis to include the beef industry. Also, I report the results from a preliminary experiment measuring the effect of RLEM feeding on pasture quality, and use these data to predict a tentative estimate of the level of economic losses attributable to RLEM.

Table 1. Numbers of sheep and cattle in ABARE zones where RLEM is a pest (1989/90 data)

ABARE regions	Severe losses (10%)	Shorn sheep and lambs (000's)	Beef cattle (000's)
123	South Murrumbidgee, NSW	16,735	701
131	Hunter, NSW	14,550	1,431
221	Wimmera, northern Vic	2,078	41
222	Central, southern Wimmera, Vic	3,688	63
223	Northern Vic	5,237	255
231	Eastern Vic	19,325	1,515
422	York, Pirie, SA	6,485	79
431	South east SA	8,894	457
521	Midlands, WA	25,023	426
522	Greenough River, WA	8,966	16
531	Great Southern, WA	6,229	430
	Total	117,212	5,414
	Minor losses (2%)		
122	Northern Murrumbidgee, NSW	12,516	548
631	Tasmania	5,417	349
	Total	17,933	897

Economic losses to due to RLEM

The number of shorn sheep plus lambs, and the number of cattle, are given for each ABARE zone where RLEM are a problem, for 1989/90 (Table 1). About 7% of the pastures vulnerable to RLEM/BGA/LF losses are sprayed annually (Sloane, Cook and King 1988). Losses due to RLEM are estimated as: (proportion of pastures not sprayed with chemicals) × (total number of animals in affected zones) × (loss rate) × (gross margin per animal unit). There are 117 million shorn sheep and lambs and 5.4 million cattle in the zones where losses are 10%, while there are 18 million sheep and 0.9 million cattle in the zones where losses are 2% of production (Table 1). The current gross margins per shorn sheep or lamb are taken to range from $5 to $10 (E.J. O'Loughlin, WADA; B. Purser, CSIRO, personal communication), giving total losses of $56 million to $112 million per year respectively. The gross margin for cattle is taken to be $155 per head, and total losses are $81 million. Losses to the sheep industry and the cattle industry are thus approximately the same. Costs of chemicals used to control RLEM are also a cost of the pest, although the area treated is then assumed to be free of mite damage. About $2 million is spent annually on agricultural chemicals for RLEM control, with a further cost of $6 million for application, giving a total cost of $8 million a year (Sloane, Cook and King 1988). Total cost of RLEM, including that of chemical control, is thus estimated to be $145-$201 million.

In the zones listed in the table as being subject to severe RLEM damage there were 19.6 million ha sown pasture and 12.4 million ha of crops, and in the zones with minor RLEM damage there were 2.1 million ha of sown pasture and 1.8 million ha crop. Miles (1983) suggested that in winter rainfall regions of Australia insect feeding on pasture legumes would cause the legumes to produce less nitrogen in the soil, which when the pasture was replaced by a crop, would result in losses equivalent to 8% of the crop value. While no direct attempt is made to estimate a value here, because of the complexities involved, it is evident that the economic losses to crops in rotation with pastures could also be high, both indirectly because of loss of nitrogen, and directly due to seedlings being attacked by the RLEM.

Effect of RLEM on animal production through pasture quality

In collaboration with Dr B. Purser, Mr L. Klein and Dr S. Baker of CSIRO Animal Production, a small trial was set up to determine if RLEM feeding in spring reduced pasture digestibility in spring or summer. Two adjacent plots, each 10 × 27 m, were pegged in a pasture grazed by cattle at Keysbrook, WA. One plot was sprayed with 200 ml ha^{-1} of dimethoate, the rate recommended for RLEM control, at three week intervals from 8 August to 11 October 1990, to keep it free of mites. By the end of October very few active RLEM remained in the surrounding pasture and spraying was stopped (T.J. Ridsdill-Smith, unpublished data).

On October 11, when the pasture was green, and again on 4 December, after the pasture had senesced, a number of samples were clipped from different parts of each block and bulked into a single sample. The clover was separated from weeds and grasses, freeze-dried and its dry matter digestibility measured by the pepsin/cellulase method in samples from each treatment (Table 2). This provides some idea of the variability of the chemical measurements, but no estimate of pasture variability. RLEM did not significantly affect the dry matter digestibility of green pasture in October, which averaged 77.9% ($t = 1.72$, 6 df, NS), but on senescent pasture in December mites reduced digestibility from 46.3% to 44.5% ($t = 7.67$, 6 df, $P < 0.001$).

These data, with estimates of pasture quality, the clover content of the pasture, and of average seasonal temperatures, were used as inputs to the model "GrazFeed" (Anon 1990) to predict sheep and cattle production parameters. RLEM are assumed to reduce the quantity of pasture in spring by 15% (Wallace and Mahon 1963). The model predicted that RLEM feeding would cause a 3% reduction in wool production in spring and 15% in summer (for a 66 kg wether) (Table 2). In summer the effect of reducing the quantity of pasture was a 4% loss, but the reduction in digestibility caused a 12% loss. The model predicted that the change in weight for cattle was reduced by 18% over the summer (for a 300 kg steer). Changing the quantity of summer pasture without changing the digestibility in the model caused a 5% reduction, but changing digestibility without changing quantity caused a 13% reduction. It is evident from this simplistic use of "GrazFeed" that the reduction of pasture quality caused by RLEM feeding could result in a loss of the gross value of animal production which was greater than that caused by the reduction in pasture quantity. The mean RLEM population in the adjacent unsprayed pasture during the spring period was 10,000 mites per square metre, which is not at an outbreak level. Thus, moderate RLEM populations could lead to a reduction in value of animal production of at least 10%. To confirm the magnitude of these effects, considerably more data are required.

Table 2. Effects of RLEM on digestibility of clover, and predicted effect on daily rate of wool production by a large wether (66 kg). Output from "GrazFeed".

	Spring		Summer	
	No mites	Mites	No mites	Mites
Digestibility of clover (%)	78	78	47	45
	78	77	46	44
	78	78	46	45
	79	77	46	44
Clean wool (g $head^{-1}$ day^{-1})	19.0	18.5	7.8	6.6

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