An investigation into the effects of redlegged earth mite (*Halotydeus destructor* Tucker)) and lucerne flea (*Sminthurus viridis* (Linnaeus)) on the performance of subterranean clover in annual pasture in southern New South Wales

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Summary

Management of *Halotydeus destructor* and *Sminthurus viridis* in 1991 using omethoate (Le-mat®) whilst not influencing total pasture shoot dry matter production, maintained subterranean clover (*Trifolium subterraneum*) at 36% of pasture shoot biomass whereas subterranean clover comprised only 9% of untreated pasture shoot biomass by late spring. Seed size and seed set in 1991 and subsequent emergence of subterranean clover in 1992 were significantly reduced by failure to protect subterranean clover from these pests: seed size by 12%, seed set by 42% and seedling emergence by 62%.

Introduction

Redlegged earth mite (RLEM), *Halotydeus destructor* (Tucker) and lucerne flea (LF) *Sminthurus viridis* (Linnaeus) are important exotic pasture pests in southern Australia (Wallace 1940, Allen 1987). Their distributions have been described previously by Wallace and Mahon (1971a, 1971b). Economic impact studies (Sloane *et al.* 1988) estimated that these pests and bluegreen aphid (*Acyrthosiphon kondoi* Shinji) cause approximately $228 million in losses per year to the wool industry in southern Australia. Ridsdill-Smith (1991) has extended the economic impact associated with RLEM to the cattle industry estimating an annual loss of $81 million. Young *et al.* (1995) have provided preliminary estimates of the potential value of removing *H. destructor* from pastures in a region of Western Australia.

Previous research related to pasture damage caused by these two pests, particularly in Western Australia and South Australia, has been reviewed by Hopkins and Taverner (1991). In southern New South Wales, however, there has been a lack of information quantifying the damage caused by these two pests to the subterranean clover component of self-regenerating pastures.

This paper reports the results of a co-operative trial between Bayer Australia Limited and the Centre for Conservation Farming, Charles Sturt University at Wagga Wagga. The aims of this trial were to assess the impact of these two pests on:

i. the quality and quantity of pasture production,

ii. seed production of subterranean clover.

Materials and methods

A 10 ha pasture at Charles Sturt University Farm was chosen for the trial. The pasture was sown in 1986 with subterranean clover (*Trifolium subterraneum* L.) cv. Seaton Park, at 5 kg ha^{-1} and lucerne (*Medicago sativa* L.) cv. Nova, at 2 kg ha^{-1}. This pasture was used in 1990 to assess the influence of management of redlegged earth mite and lucerne flea using omethoate on livestock grazing preferences (Pratley *et al.* 1991).

The pasture was divided into 4 × 2.5 ha strips (500 m × 50 m). Following the autumn break in 1991, alternate strips were sprayed by boomspray (operating pressure 300 kPa and application rate of 50 L ha^{-1}) with omethoate at recommended field rate of 29 grams of active ingredient ha^{-1}. The remaining two strips were left as unsprayed controls. The fenceline around the trial was also sprayed to minimize immigration of arthropods from adjacent fields. Two omethoate sprays were applied on June 26 and September 23. The initial autumn spray was timed following a period of low temperature and sufficient rainfall to promote subterranean clover germination and the emergence of first generation RLEM and LF (Wallace 1970).

The pasture was stocked with 42 adult sheep (4.2 d.s.e. h^{-1}) from 10 days after the initial omethoate spray until just prior to the second spray. Stock were then removed from the paddock from September 23 until the completion of the experiment.

Arthropod sampling

Arthropod population estimates were carried out by core sampling the pasture (Wallace 1956) at fortnightly intervals from June to November. Fifteen stratified core samples were taken from subterranean clover per strip (i.e. 30 per treatment) at 30 m intervals following a zig-zag path along the length of each strip. A 5 m buffer was left at the border between strips and a 20 m buffer at the ends of the strips was not sampled. The arthropods were knocked from the foliage into vials of water and counted. Counts per core were converted to population estimates per square metre.

Pasture production

Pasture production was estimated by handcutting to ground level 8 × 0.25 square metre quadrats in each strip (arranged as paired-value sampling points between control and sprayed strips (i.e. 16 paired comparisons between the two treatments). Pasture cuts were taken on July 23 and October 24. Samples were separated into grass, subterranean clover and broad-leafed weeds and shoot dry weights determined (there was no lucerne remaining in the pasture). The significance of dry matter differences in total pasture shoot biomass and subterranean clover shoot biomass were assessed by ANOVA. The 16 paired values for unsprayed and sprayed treatments were considered as ‘blocks’ for the analysis.

The seed bank of subterranean clover was estimated in February of 1991 and 1992. A trenching shovel was used to remove soil samples to 5 cm depth (the depth of burr burial). Each sample covered an area of 8.5 × 100 cm and 15 randomly selected sampling points were taken along the length of each strip (arranged as paired sampling points). The subterranean clover seed was separated from the soil and weighed. Differences between the seed extracted from unsprayed and sprayed treatments were assessed by ANOVA, the 30 paired comparisons between the two treatments being considered as ‘blocks’ for the analysis. Sub-samples of seed from three successive isolations per strip were bulked and the 1000 seed mass was determined. This produced 10 paired comparisons of seed weight between control and spray treatments. These were treated as ‘blocks’ for analysis by ANOVA.

Rainfall in late February 1992 stimulated an early germination of subterranean clover. Estimates of subterranean clover emergence were made in March 1992 using core sampling, stratified again along the length of the strips to give paired comparisons between the treatments (n = 15 per treatment/strip). Subclover seedlings were removed from each core and counted. ANOVA was used to test the significance of differences in emergence (data square root transformed) between pasture previously omethoate-sprayed and the unsprayed control. Again, the 30 paired comparisons were considered to be ‘blocks’ for the analysis.

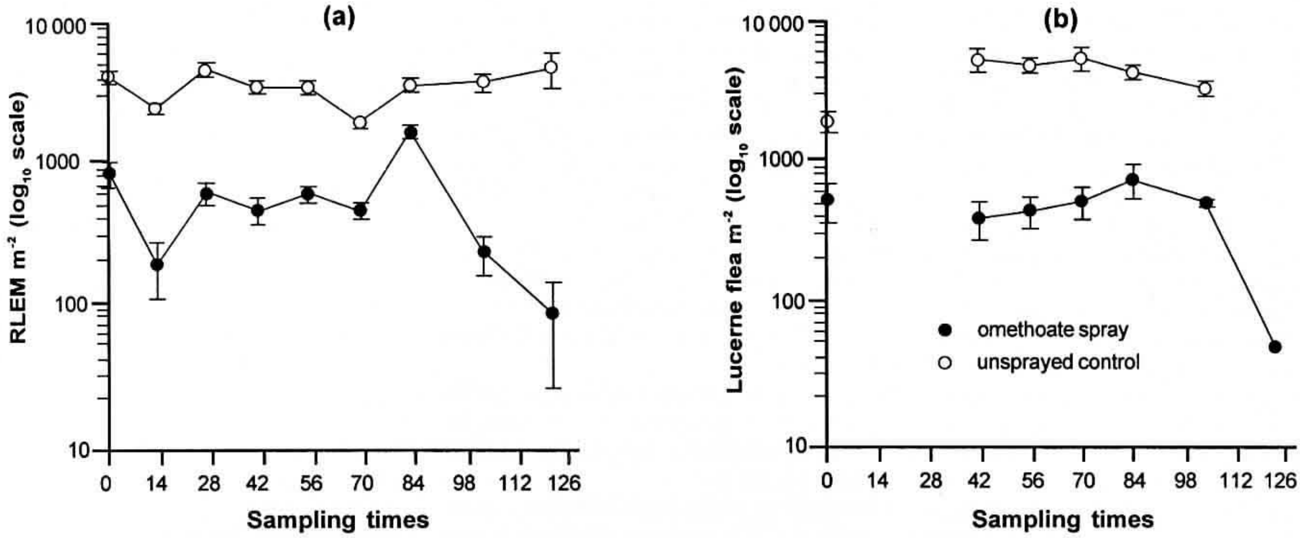

Figure 1. Population numbers of redlegged earth mite (a) and lucerne flea (b) in pasture sprayed and unsprayed with omethoate. Sampling times (day 0 = June 25). Times of spraying = day 1 (June 26) and day 90 (Sepember 23).

Results

Arthropod sampling

The results of the fortnightly core sampling of redlegged earth mite and lucerne flea are shown as Figure 1, the data being converted to numbers per square metre. Associated standard errors for each sample mean are shown as error bars.

Pasture production

The data for pasture cuts taken on July 23 and October 24, 1991 is shown as Table 1. Weed biomass was very low and has been excluded. There were no significant differences between sprayed and unsprayed pasture in either total shoot or subterranean clover biomass in July. By October 24 however, whilst there was no significant difference in total shoot biomass, there were significant differences in pasture composition. Omethoate sprayed pasture produced significantly more subterranean clover than the unsprayed pasture ($F_{1,15}$ = 16.07, P <0.01). Conversely, there was significantly more grass ($F_{1,15}$ = 6.33, P <0.05), predominantly as annual ryegrass, *Lolium rigidum* Gaudin, brome grasses, *Bromus diandrus* Roth and *B. mollis* L., and silvergrass, *Vulpia myuros* C. Gmelin, in the unsprayed pasture compared with the omethoate sprayed pasture.

Subterranean clover seed bank and seedling emergence

Results from the subterranean seed bank studies are shown as Table 2.

There were highly significant increases in subterranean clover seed set ($F_{1,29}$ = 46.03, P <0.001), 1000 seed mass ($F_{1,9}$=24.77, P <0.001) and seedling emergence (data square root transformed) in March, 1992 ($F_{1,29}$ = 47.5, P <0.001) where redlegged earth mite and lucerne flea were controlled in pasture.

Table 1. Shoot dry matter production of omethoate sprayed and unsprayed pasture in July and October 1991.

Treatment	Dry shoot biomass g m^{-2}					
	July 30			October 24		
	Grass	Subclover	Total	Grass	Subclover	Total
Omethoate	8.44^a	2.35^a	10.79^a	138.02^a	77.93^b	215.95^a
Control	8.82^a	1.70^a	10.52^a	188.12^b	18.66^a	206.78^a

Means with different letters within each column are significantly different (P <0.05).

Tabie 2. Subterranean clover seed bank size, seed mass and subsequent emergence in omethoate sprayed and unsprayed pasture.

Treatment	Subclover seed			1000 seed mass		Emergence	
	(g m^{-2})		(s.e.)	(g)	(s.e.)	(× 10^3 m^{-2})	(√‾/ s.e.)*
	1991	1992					
Sprayed	6.733^a	7.983^b	(0.34)	5.12^b	(0.1)	3.95^b	(2.72/0.13)
Unsprayed	7.859^a	4.543^a	(0.34)	4.54^a	(0.1)	1.50^a	(1.54/0.13)

*√‾ and s.e. for numbers per 5 cm core.
Column means followed by different letters are significantly different (P <0.05).

Discussion

The 1991 season commenced with a late autumn break. There was negligible rainfall between April and the third week of May. In the period from the fourth week of May to the second week of June, sufficient rainfall (79.9 mm) stimulated the hatching of over-summering eggs of redlegged earth mite and lucerne flea.

The first omethoate spray gave good control of both pests, numbers remaining low at less than 1000 m^{-2} until mid-September. Numbers of RLEM in the unsprayed pasture first peaked in late July at over 8000 m^{-2}, then declined to 300 m^{-2} in early September. From that time RLEM numbers increased to their maximum population of 9000 m^{-2} in late October when monitoring ceased. It is suspected that populations after this time would decline sharply since the pasture was senescing. LF populations lagged behind RLEM fluctuations. LF first peaked at 6800 m^{-2} in early September, then fell to a low of 2800 m^{-2} in early October.

Differences in pasture production and composition between sprayed and unsprayed treatments in July were not significant, however, by October 24 there was a very significant difference in the legume/grass composition of the pasture (Table 3). Omethoate sprayed areas retained pasture with 36% subterranean clover and 64% grass whereas unsprayed pasture had only 9% subterranean clover and 91% grass. There was therefore a most significant impact of RLEM and LF on the quality of the pasture when not controlled, resulting in 593 kg ha^{-1} reduction in subterranean clover shoot dry matter. It is suspected this would also have a significant effect in reducing the levels of nitrogen fixation in the pasture. There are important implications for following field crops in a rotation in terms of the anticipated buildup of soil nitrogen under legume-based pastures. Grimm *et al.* (1995) have shown that adjusting stocking rates to defined feed on offer can reduce the impact of RLEM and LF below damaging levels. Whilst grazing pressure was low in this experiment until the time stock were removed, this is typical of the on-farm situation in southern New South Wales. Farmers cannot efficiently utilize spring increases in pasture production by adjusting stocking rates to defined levels of feed on offer because they simply do not have sufficient stock. Alternatively, they generally cannot capitalize on the increased pasture growth by increased fodder conservation.

Failure to control RLEM and LF led to subterranean clover seed set being reduced by 42%, seed size by 12% and in March of 1992, subclover emergence was reduced by 62%. These data support the findings of previous workers and indicate further that seed from damaged plants may have lower seed mass and consequently possibly reduced seedling vigour. This may lead to poorer establishment the following season.

Conclusions

i. This trial has confirmed the significant damage which RLEM and LF can cause to the subterranean clover component of self-regenerating annual pastures.

ii. The use of omethoate at two sprays per season can result in significant increases in pasture quality in terms of the legume component of pasture.

iii. Omethoate gave very effective control of both pests whose populations remained low for 12–13 weeks after the initial autumn spray.

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