THE ECONOMIC COST OF ARGENTINE STEM WEEVIL IN PASTURES IN NEW ZEALAND

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SUMMARY

Argentine stem weevil (*Listronotus bonariensis* (Kuschel)) infests all 7 million hectares of improved pasture in New Zealand. Damage due to Argentine stem weevil predation on perennial ryegrasses (*Lolium perenne* L.) results in reduced animal carrying capacity and the need for pasture renovation. Such damage is estimated to cost \$46-202 M annually. Other costs attributable to Argentine stem weevil include those associated with reduced animal health brought about by changes in pasture quality (ryegrass staggers \$21-30 M, facial eczema \$8-16 M, bloat \$3 M, annually). Total costs of \$78-251 M annually make Argentine stem weevil New Zealand's most important insect pest.

Keywords: economics, *Listronotus bonariensis*, animal diseases

INTRODUCTION

Argentine stem weevil (ASW) infests all 7 million hectares of improved pasture in New Zealand. Most grasses are favourable hosts for adult foliar feeding, larval tiller mining, and stem boring (Goldson 1982; Barker *et al* 1984; Barker 1989). Its true impact as an insect has only recently been widely recognised by agriculturalists with the discovery of endophyte-conferred resistance in perennial ryegrass (Prestidge *et al* 1982). Agronomists and plant breeders can now observe the effects of ASW by the evaluation of *Acremonium lolii* Latch, Christensen and Samuels-infected and *A. lolii*-free seedlines of the same cultivar. Since this discovery and the rapid adoption of *A. lolii*-infected seedlines by farmers, the impact of ASW is probably less than pre-1982.

In pastures, ASW causes tiller and plant death during the summer and autumn especially in drought prone regions (e.g. Barker *et al* 1984; Prestidge *et al* 1984). This leads to reduced animal carrying capacity, increased need for pasture improvement, deterioration in animal health due to changes in pasture quality (for example, ryegrass staggers, facial eczema and bloat), and a reduction in farmer confidence in new grass cultivars which fail to establish and persist. The aim of this paper is to assess the economic cost of ASW within each of these areas.

ANALYSIS OF COSTS ASSOCIATED WITH REDUCED CARRYING CAPACITY AND PASTURE IMPROVEMENT

Perennial ryegrass is New Zealand's most widely sown pasture grass species. Newly sown pastures are particularly vulnerable to ASW and the most serious damage often occurs in the first year of establishment. Damage is related to the percentage endophyte infection in the seedline at sowing, and often to the inclusion of other grasses (in the seed mix at sowing or as volunteers). Kain *et al* (1982) recorded annual yield depressions in mixed perennial ryegrass and white clover swards of 50-60% using insecticides to maintain ASW free plots. Prestidge *et al* (1984) measured annual yield losses of up to 18% using insecticide protection in mixed perennial ryegrass and white clover swards. Other authors have reported similar levels of damage in mixed swards. In general in established pastures (more than 3 years old), yield losses are often small. However, Barker *et al* (1981) recorded that most established pastures in the Waikato and Bay of Plenty had up to 25% of their tillers killed by ASW in summer/autumn. Adult weevil populations of up to 110/m² in established pastures greater than 10 years old have been recorded (R.A. Prestidge unpub. data).

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In the analyses (Table 1) the effects of ASW in newly established pastures (0-3 years old) and in pastures greater than 3 years old were examined. Several assumptions were made based mainly on the necessity to average data collected throughout different regions in New Zealand and different stock classes.

Assumptions:

1. Pastures less than 3 years old produce an average 12 tonnes (T) DM/ha/year.
2. 50% of pastures older than 3 years produce an average of 10 T DM/ha/year and 50% are producing on average 6 T DM/ha/year.
3. Total area of improved grassland is 7 million hectares, of which 5% is renovated/improved each year. Therefore, 1 million hectares (15%) is in pasture less than 3 years old.
4. One stock unit (s.u.) requires 0.565 tonnes DM/year (Underwood and Usher 1987).
5. Gross economic return from one stock unit is \$30.
6. Utilisation of extra dry matter produced through suppression of ASW is 75%.
7. ASW causes 5-30% yield reduction per annum in pastures less than 3 years old, and 2% yield reduction per annum in pastures greater than 3 years old.

TABLE 1: Costs associated with reduced carrying capacity and pasture improvement due to the effects of ASW.

Pastures less than 3 years old

Production Costs

15% of improved pastures produce 12 T DM/ha/year	= 12.6 M T DM/year
ASW causes 5-30% yield reduction	= 0.6-3.8 M T DM/year
equivalent s.u. @ 75% utilisation	= 0.83-5.03 M s.u./year
@ \$30 per s.u.	= \$24.9-150.9 M/year

Renovation Costs

Area renovated per year (ha)	= 350,000
50% with herbicide and/or cultivation (\$200/ha) ¹	= \$35 M
50% without herbicide and/or cultivation (\$80/ha) ¹	= \$14 M
Total	= \$49 M
Lost production opportunity (1 T DM/ha)	= 0.35 M T DM
Equivalent s.u. @ 75% utilisation	= 0.46 M s.u.
@ \$30 per s.u.	= \$13.8 M
Total renovation costs	= \$68 M/yr
10-40% renovation is due to the effects of ASW	= \$6.8-27.2 M/yr

Pastures greater than 3 years old

3M ha produce 10 T DM/ha/year	
3M ha produce 6 T DM/ha/year	
2% yield loss due to ASW	= 0.36-0.6 M T DM/year
equivalent s.u. @ 75% utilisation	= 0.48-0.80 M s.u./year
@ \$30 per s.u.	= \$14.4-24 M/year

Total Costs

Production costs (pastures less than 3 years old)	= \$24.9-150.9 Million
Renovation costs	= \$6.8-27.2 Million
Production costs (pastures greater than 3 years old)	= \$14.4-24 Million
Total Costs	= \$46.1-202.1 Million

¹Underwood and Usher 1987

ANALYSIS OF COSTS ASSOCIATED WITH ANIMAL ILL THRIFT

The effects of ASW on animal health are difficult to quantify as in most cases they have not been measured. Animal diseases which may be linked to ASW include perennial ryegrass staggers (associated with stock grazing ASW resistant pastures e.g. Prestidge 1991), bloat (associated with an increased white clover content in pastures, e.g. Carruthers *et al* 1987), facial eczema and mycotoxin poisoning (associated with increased litter in pastures in summer and autumn, e.g. Towers 1987; di Menna *et al*

1987). These diseases occur most often in specific stock classes, e.g. bloat in dairy cattle, or in specific regions of New Zealand, e.g. ryegrass staggers is most severe in sheep and deer in Canterbury and Hawkes Bay, and facial eczema in northern New Zealand.

Ryegrass Staggers

Ryegrass staggers (RGS) is a temporary neuromuscular disease caused by the consumption of *A-lolii*-infected perennial ryegrass. It usually occurs during summer and autumn when pasture growth rates are low and animals are forced to graze near the base of the plant where the endophyte and toxins are concentrated. Hawkes Bay and Canterbury are particularly prone to chronic and severe outbreaks. At present it is not practical to use endophyte-free ryegrass in most areas of New Zealand to reduce ryegrass staggers as these grasses do not persist due to selective ASW feeding. Everest (1983) estimated deaths due to RGS at 4% and Hewitt (1983) reported economic losses due to RGS at \$10/s.u. in Canterbury. Fletcher (1986) recorded a 1.6 kg live weight advantage in spring in lambs grazing endophyte-free swards. In the economic analysis (Table 2) it is assumed that the cost of RGS is \$3/s.u. and that 50-70% of those costs are due to the effects of stem weevil. Losses have been calculated for Canterbury and Hawkes Bay only. The estimate is therefore conservative as it does not include other regions in New Zealand. Furthermore, it is based only on sheep farming and not other stock types, some of which are very susceptible (e.g. Prestidge 1991).

TABLE 2: Costs of ASW associated with RGS in Canterbury and Hawkes Bay.

	Canterbury	Hawkes Bay
Area in grassland (million ha) ¹	1.12	0.78
Total s.u. (million) ¹	6.19	8.08
Losses at \$3/s.u. (\$ million)	18.6	24.2
Total losses ²	\$42.8 M	
Assume 50-70% due to ASW ³		
Total losses due to ASW	\$21.4-30.0 Million	

¹ Anon (1989).

² Does not include increased costs associated with stock management difficulties.

³ Not all endophyte-free ryegrass mortality is due to ASW. Other insects and vertebrates also selectively feed on endophyte-free ryegrasses.

Facial Eczema

Facial eczema is particularly severe in northern New Zealand where warm moist autumns promote rapid growth of the fungus *Pythomyces chartarum*. Facial eczema causes sheep and lamb mortality, lower wool production, lower lambing percentage, increased susceptibility to other diseases, and lower liveweight.

The occurrence and severity of outbreaks is dependant on weather conditions and feed supplies, and therefore varies from year to year. Ryegrass dominant pastures on north facing slopes with a predominance of dead matter (litter) are at greatest risk (Towers 1987). The proportion of litter increases in ASW damaged swards and this therefore contributes to a build-up of *P. chartarum* spores. Recent economic analyses (Anon. 1990) estimated the annual average cost of facial eczema to North Island sheep production is between \$63 and \$126 million. In outbreak years the cost is nearly treble the long term average (Towers 1987). Dairy cattle are also affected by facial eczema. A survey during an "average" facial eczema year in Taranaki and Manawatu districts estimated the combined cost of preventative measures and lost milkfat to be \$2.3 million (\$4.1 million in 1991 dollars) annually (Faull 1986). Considering that Taranaki and Manawatu regions have 25% of the milking herd in the northern North Island, the cost to the industry is estimated at an average of \$16 million annually (Table 3). This figure is very conservative because more northern regions of New Zealand are at greater risk and the original survey by Faull (1986) only accounted for lost milkfat production and costs of prevention. No estimates were provided for mortality, lower calving percentage, increased susceptibility to other diseases and flow on effects of lower liveweight. Thus the true cost of facial eczema to the dairy industry is probably

considerably higher. Assuming that 10% of the costs of facial eczema are due to the effect of ASW, losses of \$8-16 M have been calculated (Table 3).

TABLE 3: National costs of ASW in contributing to facial eczema.

	\$ (Million)
Cost to sheep industry ¹	63-126
Cost to dairy industry ²	16- 32
Total ³	79-158
Assume 10% of this due to ASW	
Estimated cost of ASW	\$8-16 Million

¹ Anon 1990

² Faull 1986

³ Does not include the cost in time to administer facial eczema controls.

Bloat

In the major dairying regions of New Zealand, 87% of dairy herds have mild to severe bloat (Carruthers *et al* 1987). The percentage of cows dying of bloat between 1984-1986 was 1.01% and 85% of farmers used chemicals to control bloat. Although it is not the only cause, the incidence and severity of bloat is related to the percentage of white clover in the pasture (O'Connor *et al* 1987). ASW damaged pastures become clover dominant in summer contributing to the economic costs of bloat in dairy herds (Table 4). It is assumed that 10% of the costs of bloat are due to the effects of ASW.

TABLE 4: National cost of bloat and cost attributed to ASW.

Total milking cows ¹	2.23 M
Deaths at 1.01% ²	0.0223 M
Cost of milking cow @ \$750	\$16.7 M
Cost of bloat reducing chemicals ³	\$16 M
Total costs ⁴	\$33 M
Assume 10% due to ASW	\$3.3 Million

¹ Anon 1989

² Carruthers *et al* 1987

³ Anon 1988

⁴ Does not include a cost for time to administer bloat reducing chemicals

DISCUSSION

The economic estimate provides a realistic annual cost of Argentine stem weevil in pastoral agriculture (Table 5). When accurate data were not available, an estimate based on the collective experience of more than 50 years research knowledge was used after consultation with scientists and consultants in other regions of New Zealand. In general the estimates are conservative. For example, ryegrass staggers occurs sporadically throughout most of New Zealand but estimates (Table 2) have been restricted to Canterbury and Hawkes Bay. Similarly, in the dairy industry, the gross returns are \$60-70/s.u., not \$30/s.u. as was used in the calculation. This value is more realistic for sheep and beef farming. Additionally gross returns from pastoral farming are currently low and this has an important influence on the value of each stock unit.

TABLE 5: The annual economic cost of ASW to the pastoral sector.

	\$ (Million)
Reduced carrying capacity/pasture renovation	46-202
Ryegrass staggers	21- 30
Facial eczema	8- 16
Bloat	3
Total	\$78-251 Million

The cost of animal ill health, particularly ryegrass staggers, attributable to ASW is considerable. Most ryegrasses in pastures greater than 3-5 years old are infected with *A. lolii* (Prestdige *et al* 1985). The widespread demand for *A. lolii*-infected seedlines since 1982 has probably increased the incidence and severity of ryegrass staggers in grazing animals. Even if it was practical and economical to control ASW in pastures using pesticides and farmers were to use endophyte-free seed, there is no guarantee that endophyte-free plants would persist as other insects also selectively feed on endophyte-free plants (Gaynor and Rowan 1986). This trend is apparent in the USA, where environmental and management stresses favour greater persistence of endophyte-infected tall fescue (*Festuca arundinacea*) plants and decline in endophyte-free, even in the apparent absence of pests (Read and Walker 1990).

Based on these very conservative calculations, Argentine stem weevil is New Zealand's most important insect pest. This fact is often not realised because damage caused by other insect pests like grass grub (*Costelytra zealandica* White) has a far greater visual impact and larvae can readily be observed at the scene of the damage.

An integrated approach to minimise the impact of ASW is currently under investigation. Firstly the use of *A. lolii* selections have been made which confer resistance to ASW without incurring ryegrass staggers, and secondly a Hymenopteran biological control agent has recently been released (Goldson *et al* 1990). Their combined action may maintain ASW populations at low levels, greatly reduced animal ill thrift, and reduce costs associated with ASW in pastures.

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