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# THE IMPORTANCE OF PASTURE PESTS IN ANIMAL PRODUCTION

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## SUMMARY

Research effort on combating pasture insect problems in New Zealand has recently been expanded and is being co-ordinated. The most important pasture pest problems in New Zealand are listed and the effects of some of these on animal production discussed. A statement is made on the policy of the Insect Control Group of the N.Z. Ministry of Agriculture and Fisheries in relation to pasture pest research, and the difficulty of measuring pasture pest damage in terms of animal production is briefly reviewed.

## INTRODUCTION

ASSESSMENT of pasture pest damage is essential in order to decide research priorities within the field of entomology and distribution of resource in relation to other agricultural research disciplines.

It is relatively easy to estimate losses due to crop pests, because of their direct effects on crop yield, but in contrast it is a complex, costly and difficult problem to assess pasture pest damage in terms of animal production (Kain and Atkinson, 1975). Most assessments on the importance of pasture pests have been in terms of either plant yields; informed farm advisory officer estimates based on budget information; equation of the pest biomass with the equivalent weight of grazing animals; or changes in factory production where pest infestations are the only obvious variable. There are deficiencies in all these methods.

Quite obviously the best measures of the overall impact of pasture pests are through the amount of animal products sold off the farm, and changes in farm costs and profitability. Realistically, however, assessment of damage in terms of pasture production and ability to predict pest populations and their damage is all that is likely to be feasible (Kain and Atkinson, 1975).

This paper is concerned with New Zealand's pasture plant pests, a problem which has come to the fore in the past decade for three main reasons:

- (1) Cheap, relatively long lived, environmentally acceptable insecticides, active in most soils and against most pasture pests, have not become available to replace DDT and dieldrin since use of these materials was prohibited.
- (2) The status of many pasture pests has changed adversely — e.g., black beetle (*Heteronychus arator*) and soldier fly (*Inopus rubriceps*) have extended their ranges.
- (3) The increase in stock numbers that has occurred throughout New Zealand since 1945 has accentuated the severity of pinch feed periods when associated with pasture pest damage.

#### THE OVERALL SITUATION IN NEW ZEALAND

National Research Advisory Council (NRAC, 1974) reviewed pasture pest research and stated that over the whole of New Zealand annual losses due to pasture pests could be between \$50 and \$100 million, while Banfield (1976) stated depredations of insects may reduce the productivity of pastures by more than 50%. The accuracy of these claims is questionable, but they are the best available in absence of quantified pest surveys and damage assessment studies. Several factors influence the expression and importance of pest damage in pastures including differences in soils, fertilizer status, pasture composition, climate, farm type, farmer ability, management systems, timing of pest damage in relation to pinch feed periods, and the size of the pest populations. In addition to the costs of pasture renewal and chemical control, decreased stock performance in areas heavily infested by soldier fly (Hewitt, 1969) grass grub (*Costelytra zealandica*) (Gordon and Kain, 1972) and black beetle have occurred, because controls currently available have not been particularly effective. However, there is little point in working toward a 5 to 15% increase in plant production if pests (or diseases) do not allow realization of the full benefit of this improvement (Banfield, 1976).

As a result of recommendations made by NRAC (1974), research on pasture pests is being rapidly expanded in New Zealand. To overcome the problem of duplicating research and ensure better integration between the Ministry of Agriculture and Fisheries and the Department of Scientific and Industrial Research, a Pasture Pests Research Co-ordinator was appointed in 1975. The organization of entomological research within DSIR and the MAF, and the role of the Co-ordinator has been reviewed by Pottinger (1975).

TABLE 1: THE MAJOR PASTURE PEST PROBLEMS IN NEW ZEALAND RANKED IN ORDER OF IMPORTANCE

<i>Indigenous Origin</i>	<i>Exotic Origin</i>
(1) Grass grub ( <i>Costelytra zealandica</i> )* RF/NP	(2) Clover and lucerne eelworms*, particularly <i>Ditylenchus dipsaci</i> , <i>Heterodera trifolii</i> and <i>Meloidogyne</i> spp. RF and stem feeding/NP
(6) Porina ( <i>Wiseana cervinata</i> and <i>W. signata</i> )* FF/NP	(3) Black beetle ( <i>Heteronychus arator</i> )* RF/MRP
	(4) Argentine stem weevil ( <i>Hyperodes bonariensis</i> )* SB/NP
	(5) Soldier fly ( <i>Inopus rubriceps</i> )* RF/MRP
	(7) White fringed weevil ( <i>Graphognathus leucolona</i> )* RF/MRP
(8) Pasture seedling pests — a complex of several native and introduced species, particularly weevils, slugs and lucerne flea ( <i>Sminthurus viridis</i> ).	
(11) Black field cricket ( <i>Teleogryllus commodus</i> ) FF/RP	(9) Grass and clover aphids* Vectors of virus diseases/NP rated on potential
(12) Manuka beetle ( <i>Pyronota festiva</i> * and other spp.) OM & RF/RP	(10) New pest introductions* (e.g., <i>Sitona humeralis</i> , <i>Atrichonotus taeniatulus</i> and <i>Floresianus sordidus</i> ) RF and FF/RP — rated on potential
(15) Native armyworm ( <i>Persectania aversa</i> ) FF/RP	(13) Tasmanian grass grub ( <i>Aphodius tasmaniae</i> )* FF/RP
(16) Sod webworms (a complex of Lepidoptera spp.) FF/RP	(14) Introduced armyworm ( <i>Pseudoleitia seperata</i> ) FF/RP

\*Problems being researched

( ) Author's ranking of importance

RF = Root feeder

FF = Foliage feeder

OM = Organic matter feeder

SB = Stem borer

NP = National problem

RP = Regional problem

MRP = Major regional problem

The most important pasture pests in New Zealand, ranked in order of importance by the writer, are listed in Table 1.

It is not possible in a paper of this nature to review comprehensively the whole pasture pest field, so comment is mainly made in relation to grass grub and on selected points on some of the problems listed in Table 1.

#### GRASS GRUB

Grass grub is widespread from Hamilton southwards and causes particularly severe damage in pumice soils of Taranaki and the Central Volcanic Plateau and in recent alluvial soils of the southern North Island, and South Island. Damage is caused by root pruning and is most severe in autumn and winter. As in all pest infestations, pasture composition changes occur. The balance of productive species alters and/or the productive species are largely replaced by low producing weed species.

Flay and Garrett (1942) examined the grass grub problem from a farm management point of view and budgeted the immediate losses and the subsequent increased management costs necessary to overcome the problem in Canterbury. They revealed the effects that grass grub has in the absence of quick-acting control procedures. The following points made by them illustrate the ways in which pasture insects affect the grazing animal.

- (1) Pastures were wholly or partially ruined and winter production lost.
- (2) Pastures lasted only 1 or 2 years against an expected 5 to 6 years.
- (3) Supplementary feed had to be supplied in greater quantity than usual.
- (4) Severe damage affected the condition of ewes, metabolic disorders became more prevalent, lambing mortalities increased, and lamb growth rates reduced. On badly affected farms, lambing percentage dropped from 100 to 78.
- (5) Heavy infestations subsequently resulted in reduced stock numbers and more attention to provision of higher cost winter green-feed.
- (6) In order to recoup losses and prepare land for pasture re-establishment cropping was intensified, which accentuated the "pinch" period before rape was ready for fattening and predisposed lambs to heavy worm infestations.
- (7) In some instances wool clips declined 0.7 to 0.9 kg per sheep.

In a recent farmlet trial at Takapau, Kain and Atkinson (1972) substantiated Flay and Garrett's (1942) observations. They showed that autumn and winter pasture production losses ranged from 25 to 30%. Although this represented an annual loss of only 15 to 16%, animal performance declined to the extent of 5 kg liveweight and 0.38 to 0.60 kg wool weight per hogget.

There are some interesting features in Flay and Garrett's paper. First, they recognized the sporadic and irregular nature of grass grub attack and noted the difficulty that such pest infestations create in setting a stocking and cropping programme. Secondly, they clearly differentiated between short-term and long-term production losses. It was noted that disorganization of farming policy by the pest subsequently increased farm expenditure. The authors suggested that 800 000 ha of Canterbury were prone to infestation, that average annual losses were \$1 200 000 but that without grass grub infestation annual farm productivity on this land could have increased by \$24 000 000.

Whether the grass grub problem is now of this magnitude in Canterbury is debatable. Even without DDT the whole status of the pest has changed with currently available control procedures and management practices.

There have been no studies since Flay and Garrett's, however, which have comprehensively budgeted farm expenditure in an attempt to assess the impact of a pasture pest infestation over a period of time. There is undoubtedly a place for this in conjunction with current research programmes.

More recently, Gordon and Kain (1972) have highlighted how severe grass grub can be on the Central Volcanic Plateau. In the Mangakino district 60 dairy farmers on land development blocks had to be resettled and emphasis on dairying reduced. A survey by Gordon and Kain (1972) showed an overall decrease of 19.8% in stock expressed as ewe equivalents even though only 25% of the farm area was extensively damaged. Owing to accentuation of soil erosion, most of the reduction was in cattle numbers, although hogget numbers declined significantly. This supports the contention that significant changes in stock numbers and performance occur with relatively small changes in overall pasture production. Quite obviously the importance of damage is dependent on many factors, not least, stocking rate, pasture production relative to stock requirements, and timing of pest damage relative to "pinch" feed periods on the farm and the provision of green-feed for lambing purposes.

In Taranaki grass grub is held to be a limiting factor to farming and dairy production losses in excess of \$6 000 000 per annum have been cited (G. Miller, pers. comm.) Grass grub control is difficult and expensive on dairy land because of the prohibition on the use of all organochlorine insecticides to prevent contamination of dairy products, and the need for repeat applications of less effective organophosphate insecticides dependent on high soil moisture and rain to enhance their activity. Because of the lack of research to find controls for grass grub in dairy situations, the Ministry of Agriculture and Fisheries has recently purchased a farm near Hawera with the intention of developing integrated control strategies which will be evaluated on a cost:benefit basis.

#### CLOVER AND LUCERNE EELWORMS

The problem of clover and lucerne eelworms in pasture production is an important national problem recognized within the last decade (Wood, 1972; Healy *et al.*, 1973; Widdowson *et al.*, 1973; Yeates *et al.*, 1973). All three species, clover cyst eelworm (*Heterodera trifolii*), clover root knot eelworm (*Meloidogyne hapla*) and lucerne eelworm (*Ditylenchus dipsaci*) appear to have a national distribution, although specific eelworms are absent from some districts. All cause stunting and reduction in yield and in some cases death of clover plants. The published work to date has been concerned with glasshouse assessments of damage and there is an urgent need to extend this in the field throughout New Zealand as white clover is very susceptible to attack by *H. trifolii* and *M. hapla*. Healy *et al.* (1973) found that seedling plants grown in unsterilized soil produced only 20% as much herbage as plants in sterilized soil, whilst Yeates (1974) in another experiment recorded losses in white clover production of up to 55% depending on the size of the eelworm population. Widdowson *et al.* (1973) discovered that the efficiency of phosphorus utilization by white clover is markedly reduced in nematode-infested plants. Consequently, up to five times the amount of phosphorus is required to give yields equivalent to plants free of nematodes. This immediately raises the question of what savings could be achieved in fertilizer costs if the eelworms could be controlled? Unfortunately, chemical control of eelworms in field situations is difficult and costly so that control procedures must be developed around use of resistant plants and possibly management procedures.

### BLACK BEETLE

Black beetle attacks most pasture grasses and is partial to *Paspalum*, the main summer producing grass in the north. It is undoubtedly the most important northern pest. It is sporadic and, unlike grass grub, damaging infestations can result within a few months from beetles flying in from elsewhere. Dieldrin provided an effective and cheap means of control, but alternative organophosphate insecticides are not reliable because the grubs attack pasture in the drier summer months, and in some situations high soil organic matter adsorbs the insecticide (Watson and Webber, 1975).

Advisory Services Division of the Ministry of Agriculture and Fisheries have estimated that, in Northland alone, 400 000 ha are susceptible to infestation, annual production losses exceed \$5 000 000, and on average butterfat production drops 22.7 kg/cow on infested farms. A cost of \$35 to \$50/ha to ryegrass badly damaged swards is additional to this production loss.

### SOLDIER FLY

Soldier fly is distributed throughout the Bay of Plenty, Waikato, Gisborne and South Auckland areas and is now extending into Northland. Damage is caused by the maggots feeding on the roots, resulting in loss of vigour, loss of grasses from the sward, and a subsequent increase in the clover and weed components. Very little quantitative information is available on the economic loss caused by the pest, although Hewitt (1969) has noted that soldier fly can lower carrying capacity and the level of butterfat production by one-third, reduce hay yields, and devastate crops such as maize sown after grass. Control at present is expensive and hinges around cultivation, undersowing of pastures and the use of systemic insecticides. Present research is oriented toward manipulation of stock and pasture management procedures and screening of pasture species for resistance.

### PORINA

Porina caterpillars (*Wiseana* spp.) can severely defoliate pastures, eliminating grasses and clovers. Autumn and winter damage is usually localized and sporadic but is more regular in wet localities where damage tends to extend from winter into spring. It occurs in most of New Zealand, although damage is mainly

confined to the South Island and southern North Island. Wet years favour this pest in Canterbury when its infestations on lighter land are often confused with grass grub. It is relatively easy to control with insecticides and/or management techniques on cultivable land. Because of the cost and impracticability of these methods on low producing North Island hill country, however, it presents a major limiting factor to production. French (1973) has studied the control of this pest in Canterbury and Otago and assessed its importance on farms by means of feed budgets. He concluded that if properties are properly managed in these regions porina should rarely present a problem. French (1976) suggested mob stocking with sheep during the surface-dwelling larval stage; use of resistant or tolerant grass species; cultivation of infested pasture and subsequent use of autumn sown Tama ryegrass; use of infested pasture as a winter run-off on which meadow hay is fed out; and drilling of grass into damaged patches in the spring.

#### RESISTANCE OF PASTURE SPECIES

Recent research on screening pasture grasses and clovers for resistance to pests raises several questions in relation to the utilization of such plants by grazing animals. Lucerne which is resistant to grass grub (Kain and Atkinson, 1970), black beetle (King *et al.*, 1975) and clover eelworms (Yeates *et al.*, 1973) is the only pasture species being widely used to alleviate the impact of pests. From an animal management point of view, the greater bulk of feed and seasonal spread of production must be highly attractive, but the adverse effects on lambing of high oestrogen levels in autumn will counteract some of these benefits. *Phalaris tuberosa* Grasslands selection G 14 is highly resistant to grass grub (Kain *et al.*, 1975) but unfortunately this cultivar which has been bred for New Zealand conditions is toxic to stock (Kains, pers. comm.). On the other hand, however, *Lotus pedunculatus* cv. 'Maku' which does not induce bloat in cattle has been shown to resist grass grub (Kain *et al.*, 1975; Farrell and Sweny, 1972), porina (Farrell *et al.*, 1974), and clover eelworms (Yeates *et al.*, 1973). It appears to be a plant with tremendous potential in terms of pest control, but insufficient is known about its establishment and subsequent management in pastures to contemplate its immediate widespread use. The finding by Kain *et al.* (1975) that white clover, more than other pasture plants, favours growth of grass grub larvae suggests that

manipulation of the clover content in pastures may provide a means to dampen the growth of grass grub populations, but requires further research.

#### DISCUSSION AND CONCLUSIONS

Quite obviously more quantitative work is required on the measurement of pasture pest damage, as expressed through the grazing animal. Farm budgeting could be a useful tool for assessing the longer term effects of pest damage on the economy of farming and for highlighting production potential in the absence of pests.

The question arises as to how far it is necessary to continue with assessment of pest damage in relation to production by grazing animals and the priority which should be placed on this type of research in current programmes. To achieve a better understanding of the relationship there is a need for greater integration of animal scientists, agronomists and entomologists within research teams.

There is a need for the entomologist to provide more precise information on the distribution of insect populations and relate different pest densities to plant and animal performance, while accounting for the inter-farm variability that exists, within and between regions.

Measurement of pasture production tends to overlook pasture quality, which insects modify by increasing the amount of dead material, fouling of feed as sometimes occurs with armyworm infestations, and by modification of plant composition. Pests such as black beetle and soldier fly which favour dominance of white clover in the sward may accentuate bloat, whilst Argentine stem weevil by creating a litter problem in summer months may enhance outbreaks of facial eczema.

Dairy, fat and store stock obviously vary in their response to insect-induced fluctuations in pasture quality and production, whilst the response of pasture plants to specific pest densities varies amongst farms because of differences in farm management, soil type, soil moisture and nutrient level, stocking rate, pasture composition, climate, farm type and timing of pest damage in relation to pinch feed periods.

Lack of effective controls acceptable to farmers has necessitated re-orientation of entomological activity to labour-demanding ecological and physiological research in order to develop control procedures. The concensus amongst farmers and advisory work-

ers, particularly in the North Island, is that pasture insect pests pose the greatest restraint on pasture productivity, whether this is expressed directly in monetary loss, or in lack of farm confidence to maintain or expand production.

Even without comprehensive measurement of the absolute effect of pests on pastoral production, it is obvious that funding of a large-scale research programme designed to develop successful control strategies for New Zealand's major pasture pests is justified. Whether or not research on pasture pest control will offer a greater return on investment than the increases sought by agronomic and animal research is a speculative point at this stage. Theoretically, a 5 to 15% improvement in animal and plant production by breeding could affect every pastoral farm in New Zealand, whereas a 20 to 50% increase in productivity from pest control would be possible on only a small proportion of farms owing to the localized and often sporadic infestations of the pests concerned. One of the great problems of developing pasture pest control programmes in New Zealand, however, is the number of different species involved.

#### MAF POLICY

The first priority for the Insect Control Group of the Ministry of Agriculture and Fisheries is to find practical pest control techniques for use by New Zealand farmers. At the same time, the group is developing a programme of research which should lead to a better estimate of how important New Zealand's pasture pests are in relation to animal production. The second priority is to try to foresee problems before changes in management procedures become widely adopted, or new pests become widely established. The third priority is to survey the extent and establish the importance of pasture pests. So far the Group has most of its work force directly involved with the development of control measures for the major problems. In order to meet the second and third priorities, the equivalent of one scientist in the North and South Islands has become involved in pest survey research and another is undertaking studies in conjunction with DSIR on the three newly discovered species of weevils in Hawke's Bay (Esson, 1975). In the future, there is a real need for entomologists to work alongside agronomists and animal scientists in their trial programmes, in order to monitor the effects of different management systems on the pasture pest complex.

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