THE EFFECT OF AUSTRALIAN SOLDIER FLY ON PASTURE, CROPS AND PRODUCTION

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Summary

An account of the type and extent of damage to pasture and cereal crops by the Australian soldier fly (*Altermetoponia rubriceps* (Macq.)) is given. The ultimate effect on hay and butterfat production is discussed and examples illustrate that yields can be reduced by 50% and 33%, respectively. In the Bay of Plenty, hundreds of acres of pasture have had to be regressed over the past two years.

INTRODUCTION

THE Australian soldier fly (*Altermetoponia rubriceps* (Macq.)) was first recorded in New Zealand in the Opotiki district by Muggeridge in 1944. Within ten years of its first sighting, the fly had migrated westward until, by 1960, it was well established in the whole of the Bay of Plenty. By 1968, the known area of establishment extended throughout the South Auckland region and as far south as Rotorua. At present, the heaviest infestations are in the Bay of Plenty, at Te Puke, and on the Rangitaiki Plains. It is now less severe in the Opotiki district.

In New Zealand, it is widely recognized that the larvae of the Australian soldier fly is a serious pest of pastures. Its rapid spread through the Auckland Province is viewed with increasing alarm by the farming community. In the Bay of Plenty it is regarded as the worst known pest of pastures.

HOST PLANTS

Pasture plants, maize, barley, oats and millet are attacked. In addition, so are the vegetable plants, tomatoes and cucurbits. Turnips, which are not damaged, are the only known crop plants which greatly reduce populations when this crop is sown out of infested pasture.

There is little limit to the variety of host plants. Populations are found under permanent to semi-permanent vegetative cover, ranging from that found in ornamental gardens through to light scrub, weeds in waste areas and under pasture. The weeds, inkweed (*Phytolacca octandra*), redroot (*Amaranthus hybridus*), willow weed (*Polygonum persicaria*) and black nightshade (*Solanum nigrum*) are attacked and severely affected.

There is no clear-cut evidence that larvae have preference for any particular plant, though cereal plants such as maize and barley are very susceptible and show spectacular effects from larval attack.

DAMAGE

Muggeridge (1944) reports the work of Irwin-Smith (Australia) who found that the larva obtains its food by sucking the juices from the roots of grasses and that the mouth-parts feature very well the parallel jaws which work upwards, outwards and downwards. The writer commonly

finds the larvae firmly attached to the roots of plants in numbers varying from 1 to 12 or more. Affected plants of grasses and cereals show pitted roots where the larvae have fed. Many of the roots are withered and dead. Less often, but of significance, is the fact that single larvae are observed burrowing into the stems of weeds and cereals just below the ground surface and, in the case of the latter, death results. Most, if not all, grasses are attacked and damaged to varying degrees.

Although a wide variety of plant species is attacked, they do not all exhibit symptoms of damage. Larvae have been found on the roots of white clover (*Trifolium repens*), but this plant, if not retarded in its growth by a turf-like mat of unthrifty paspalum (*Paspalum dilatatum*) and poa trivialis (*Poa trivialis*) plants, will often thrive in swards heavily infested with Australian soldier fly.

IMPORTANCE OF PASTURE IN THE ECONOMY

In the counties of Opotiki, Whakatane and Tauranga there is a total of 1 million sheep, 310,000 dairy cattle and 120,000 beef cattle carried on a cultivated area of approximately ½ million acres. Of this area less than 1% is used for supplementary crops and the remainder is in pasture. It is, however, on the pastures used for dairying, some 200,000 acres, that the Australian soldier fly is regarded as the most serious pest. Normally these pastures yield dry matter with a range of 7,000 lb to 16,000 lb per acre. Many farms are producing 400 lb of butterfat per acre and the highest figure is 550 lb. There is almost a total reliance on pasture as a source of feed. Thus the urgency of maintaining it at a high level of production is of paramount importance to the economy of the region.

EFFECT ON PASTURE

Symptoms such as the sward thinning out with the loss of the better grasses, perennial ryegrass (*Lolium perenne*) for example, patchiness and weed invasion, may indicate Australian soldier fly attack. Presence of the larvae is readily confirmed by inspecting the top inch or so of the soil. Although they are found evenly distributed, many are embedded in the rooting systems of the tufted grasses and the mass of rhizomatous tissue of paspalum.

There is often a rapid decline in vigour accompanied by a browning off and death of the sward, but, generally, the damage in permanent pastures carrying a well-balanced sward, is of an insidious nature. On the Rangitaiki Plains in the Whakatane district, there is a large variation in soil types and water levels and, similarly, there is a wide range of pasture species. In such areas, where the sward is initially high in ryegrass, attack results in a rapid decline in vigour and loss of plants and also without an obvious colour change. However, these effects are masked to a large extent by white clover which rapidly fills in the gaps and dominates the sward.

Where the swards are paspalum-poa trivialis dominant, with a moderate cover of white clover and ryegrass, the pattern is different. There is a loss of vigour, but this is accompanied by a rapid yellowing of the poa trivialis leaves and even a loss of colour in the paspalum. Many of the poa trivialis plants die. These effects are most obvious in the spring and late summer months. Also, white clover is slow in forming a cover in the mat-like turf which is formed by the paspalum and the fibrous-rooting poa trivialis and the final result is a very low producing sward.

There is good evidence that paspalum is not only severely damaged but also killed by the Australian soldier fly. There are numerous instances where this grass has disappeared from paddocks where larval numbers are high. A reason why this grass, which possesses such a large mass of storage tissue, should die is possibly associated with the fact that it has a 6-months dormancy period. Further, a cold or dry summer would accelerate the effects of an attack, as there would be slow regeneration of damaged roots.

Although strongly tufted grasses, such as cocksfoot (*Dactylis glomerata*), disappear from infested swards, this phenomenon is probably only an indirect affect of Australian soldier fly damage. The resultant feed shortage from an infestation will cause these grasses to lose their crowns through being continuously hard grazed and this kills them.

While it is obvious that infestations result in pasture imbalance, there is no evidence to suggest that there is selective feeding. Some pasture species are probably better able to withstand attack because of their ability to regenerate root systems.

EFFECT ON CROPS

Maize, barley, oat and millet crops very rapidly display damage from Australian soldier fly. Typical symptoms are yellowing, a scorched appearance on the leaf tips, and a general withering of the whole plant. Many plants are killed at the germinating stage while others collapse and die 2 to 3 weeks after emergence. Surviving plants remain stunted in growth and yellow in colour for many weeks.

The roots of sick plants have numerous larvae adhering to them and, in the case of maize, more often they are concentrated at the base of the roots under the crown of the plant. Single larvae appear to be able to cause the death of young plants by puncturing the stem just below ground level.

With maize, there may be root regeneration in some plants after a period of 6 weeks. However, the final result is a stunted plant with a poorly fertilized and distorted cob.

Where infestations of Australian soldier fly are patchy, cereal crops, particularly barley, display this effect very clearly and spectacularly. Vigorous patches of healthy plants are found growing immediately adjacent to similar-sized areas where all plants are stunted and sickly. The result is a mosaic pattern throughout the whole field.

Yields of grain from a cereal crop that has even a light to moderate infestation of Australian soldier fly can be so low that this farming enterprise becomes uneconomic. When comparing maize-growing with alternative uses of the land, an economic crop is one that yields 100 bushels of dried grain per acre, giving a gross return of \$140. Further, a moderate infestation of Australian soldier fly will reduce yields to such an extent that it is not possible to meet the variable costs in growing this crop. This figure can total \$80, equivalent to the value of 60 bushels of grain.

When sowing maize out of Australian soldier fly-infested pasture, damage is serious only in the first year's crop as a rule. Following crops are generally free of infestation, provided there has been no carry-over of larvae through poor grass growth control. However, first-year damage can be avoided by fallowing the land for a period of at least 3 months prior to sowing. Thorough surface working of the infested sward before ploughing is first necessary. If this is not done, then the larvae survive in the mass of paspalum rhizomes which remain alive in the turned-over sod, for many months.

CHEMICAL CONTROL IN MAIZE

This is not a paper on experimental work. However, it is worth recording the preliminary results of using the insecticide, ethyl parathion, in a pilot trial on maize, if only because of the fact that the results demonstrate the effect of Australian soldier fly damage.

The trial was laid down on November 6, 1968. The insecticide was applied at the rate of 1.7 lb active ingredient per acre. It was mixed with the manure and sown in the rows at the same time as the seed. Two treated rows alternated with two control rows throughout the trial area of 4/5th acre. Infestation with Australian soldier fly was light to moderate.

On January 21, 1969, plant counts were taken. The increase in the number of plants in the treated rows was 17.5%.

On May 1, 1969, the cobs were harvested, counted and weighed. The mean increase in the weight of cobs from the treated rows was 24.6%. Because of the large number of very poor cobs in the control plots, it is anticipated that difference in yield of dry grain will exceed this figure.

EFFECT ON PRODUCTION

Pasture damage by the Australian soldier fly has had the effect of severely reducing the production of hay and silage crops, butterfat, wool and meat. The effect on yields of cereal crops has been discussed. In addition, many farmers have reduced stock numbers. Generally, it is the replacement animals that have suffered in numbers and, less often, producing stock. Lambs forwarded to the works have failed to yield a satisfactory weight and carcass reductions in the order of 30% have been recorded. Those farmers who have been increasing carrying capacity each year have had to stabilize numbers, even though topdressing rates have been increased.

The effect on hay and butterfat production is discussed.

HAY CROPS

On most dairy farms in the Bay of Plenty, it is customary to harvest two crops of hay from pasture each season. On land susceptible to the Australian soldier fly, normal yields for the two cuts range from a total of 100 bales (approximately 3 tons) to 150 bales per acre. Typically, damaged swards drop away to 50% of this yield. Often, on light soils, it is only the first cut which is worth harvesting, as the following crop would not meet harvesting costs. Low summer rainfall accentuates the damage on these soils and, in such cases, second crops of hay rapidly become invaded with low producing, annual grasses, such as summer grass (*Digitaria* spp.).

BUTTERFAT

The percentage drop in butterfat production on affected farms is not as great as that for hay crops. However, the decrease is of greater significance since this item is the main source of revenue on a dairy farm. The reduction is often buffered by sacrificing potential hay and silage crops for the immediate needs of the milking herd. Nevertheless, there is ample evidence to prove that there is, in general, a clear-cut and significant downward trend.

Generally, it is the more progressive farmers who recognize and are aware of an Australian soldier fly problem on their farms. These farmers

are often stocked to capacity and normally they are attaining annual increases in production. Thus, a simple record of annual production figures over the affected period often understates the true position on these farms.

The effects of Australian soldier fly damage on dairy farms are illustrated by the following two examples on the Rangitaiki Plains:

FARM A: AREA 145 ACRES WITH A 70-ACRE RUNOFF

<i>Season</i>	<i>Butterfat (lb)</i>	<i>Cows Milked</i>	<i>Conserved Feed, Home Farm</i>	<i>Bales Hay Runoff</i>
1966-7	60,000	180	6,000	6,000
1967-8	57,000	180	Nil	7,000
1968-9	45,000	180	400	5,300

FARM B: AREA 240 ACRES WITH A RUNOFF

<i>Season</i>	<i>Butterfat (lb)</i>	<i>Cows Milked</i>	<i>Conserved Feed, Bales Hay</i>	<i>Acres Silage</i>
1966-7	92,000	240	7,000	60 (heavy crop)
1967-8	69,000	240	3,500	50 (light crop)
1968-9	60,000	240	3,500	50 (light crop)
1969-70	Herd will be reduced to 210 cows.			

On both farms, record productions were achieved in the 1966-7 season when Australian soldier fly was in the early stages of establishment. Since then, there has been a drop of 25% and 33%, respectively, on the properties.

On Farm B, initially the runoff was used for running beef cattle only, but since the farm was struck by Australian soldier fly, the dry and replacement dairy stock have had preference. Annual fertilizer applications on these properties are in the order of 5 to 8 cwt/acre of 30% potassic superphosphate. Management on these two farms is, as on similarly affected properties, severely complicated by a heavy incidence of bloat, owing to white clover dominance.

CONTROL AND DEFENSIVE MEASURES EMPLOYED

CHEMICAL

Trials have clearly demonstrated the resistance of the pest to available and permissible insecticides. At present there is no indication that there is any hope of finding a chemical suitable for pasture use.

STOCKING

It is considered by some farm advisory officers that heavy and controlled winter stocking is beneficial as it considerably alleviates the problem by growing more grass. The method used is to winter on one-third of the farm and the tramped sward is progressively lightly cultivated and sown with

seed throughout the heavy stocking period. It is not known whether or not the larval population is reduced to any great extent, but pasture production is significantly increased in the following season.

CULTIVATION

The effect of cultivation to reduce populations in land for cereals has already been discussed in the "Effect on Crops" section. The same principle of killing the larvae is used when resowing infested pastures directly back to grass again, without the use of a crop. The damaged sward is thoroughly surface worked during the late summer-autumn months. This continued cultivation in the hot weather, for a period of 8 weeks and more, reduces larval numbers below danger level, probably by a process of disturbance, desiccation and ultimately starvation. In 1968 and 1969, hundreds of acres were resown by this method in the Bay of Plenty. Seed firms report tremendous increases in grass seed sales.

Individual farmers have, over the past two autumns, resown up to 50% of their properties because of damage by Australian soldier fly. A typical case is that on a 240-acre dairy farm where 115 acres have been resown in the past two years. Field and soil inspections 15 months after sowing down the first 60 acres show that the new pastures are in excellent condition and that the larval population is greatly reduced. The direct and some indirect costs to the farmer for this operation totalled \$14.50 per acre.

Although there has been a large resowing programme carried out in the region, nevertheless, there remain many acres of damaged pasture as yet not touched. Not all farmers have the financial resources, the machinery, or the organizational ability to carry out effectively such a large programme.

DISCUSSION

The weight of stock carried on a dairy farm with a carrying capacity of 1 cow and the necessary replacement stock, would be approximately 900 lb/acre. This is equivalent to 3 oz/ sq. yd. It would be no exaggeration to state that, on many infested farms, the liveweight of Australian soldier fly larvae in the soil below would equal this. Thus the competition for feed, whether it be plant nutrients or herbage, must be intense. Why so many farmers have been able to feed their stock to the extent that they have is no doubt due to one or a combination of reasons.

The main ones are:

- (1) Not all paddocks on a farm are infested at the same time.
- (2) Within individual paddocks, infestation may be patchy.
- (3) The farm was originally understocked.
- (4) The grazing animal has priority in available feed, so hay and silage paddocks are sacrificed.
- (5) Hay supplies are purchased.
- (6) Less replacement stock are carried or else they are grazed out.

In spite of these factors and any precautions taken to maintain an adequate standard of feeding, production, as already shown, has fallen dramatically on many farms.

CONCLUSION

Many farmers are reluctant to take full advantage of the stock-carrying potential of their farm, because of the threat of heavy infestation with Australian soldier fly. While there is great cause for alarm at the rapid spread of the pest, and as chemical control is not feasible, farmers should take heed of the fact that, to combat the effects of damage, at present the most profitable course of action is to adopt cultural and managerial practices.

REFERENCE

- Muggeridge, J., 1944: Record of an Australian fly (*Metoponia rubriceps*, Macquart) found in pastures in Opotiki. *N.Z. J. Sci. Tech.*, 26A: 190-2.