TRIALS ON SOLDIER FLY

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Summary

The influence of the soldier fly (*Altermetoponia rubriceps* Macq.) on pasture production has now been demonstrated. Trials have shown that larvae reduce herbage yields. In the field, the toxicity of eleven different insecticides has been tested but the larvae have proved difficult to control. The abnormal rates of chlorinated hydrocarbons required to achieve this eventually induced an inferior sward. Chemical control is therefore considered extremely unlikely at rates acceptable to normal field practice. In view of the fertilizer responses obtained from basal dressings on trial sites, it is suggested that future work should be aimed at this aspect of farm management.

INTRODUCTION

COTTIER (1962) in his review on the life-cycle of the soldier fly (*Altermetoponia rubriceps*) stated that it was first recorded in New Zealand in 1944 in the Opotiki district. Dumbleton (1948) referred to it as occurring within an area of about 7 miles radius from the township of Opotiki. Marryatt (1948) stated that it is a serious pest of first-year maize causing in 1947-48 at least a 25% loss of first crops of maize after grass.

During the mid-1950s the fly migrated into the Whakatane County and became well established in the Waimana and Taneatua districts. On April 14, 1964, large numbers were observed in flight on the Rangitaiki Plains.

Farmers consider that this soil pest has severely damaged pasture swards and affected farm production. Over the season 1960-61 it was held responsible for very light hay crops and lamb weights, a large loss in dairy production and an increase in weed cover. Dr J. M. Hoy, Entomology Division, D.S.I.R., who inspected the infested areas in June, 1961, considered at the time that a clear-cut case implicating the soldier fly as the agent for pasture deterioration had not been established. The writer agreed with this view.

Where larvae are present in numbers above approximately 150 and up to 500 per square foot, pastures are invariably poor with a large proportion of *Poa trivialis*, paspalum (*Paspalum dilatatum*) and flat weeds. There are instances where the number of paspalum plants have been considerably reduced. With few exceptions the ryegrass (*Lolium* spp.) content is very low.

The larvae appear to have a strong preference for *Poa trivialis* as they are found in large numbers where this grass is dominant or subdominant. In a half-acre patch they were concentrated at 1,000 to 2,000 per square foot.

A feature of this pest is that in pasture there are no obvious well-defined symptoms of its depredations and this, together with

its small size (2.5 to 10 mm in length), makes its presence difficult to detect. Thus, larval counting is a laborious and time-consuming task.

This paper reviews the trials laid down on pasture in the Opotiki and Whakatane counties. Also included are two pot trials and the results of early investigations carried out on maize and oats in the Opotiki district. Most of these trials, in which chemicals have been used in an attempt to control the larvae, have been directed at confirming and evaluating pasture damage. In the field trials, effects of treatments have been assessed by visual observation of pasture responses and to a limited extent by larval counts.

EXPERIMENTAL

CONCLUSIONS FROM EARLY WORK

Dumbleton found that:

- (a) severe stunting of oats and maize can be caused by the large populations of larvae which may be expected to be present when old pasture is broken out of grass in Opotiki.
- (b) The use of soil insecticides or soil fumigants which were used to reduce the larval population on the experimental plots would not be practicable as a control measure on maize crops because of their high cost.
- (c) The larval infestation was significantly reduced and the growth of maize was improved by ploughing and working the field three months before sowing the maize.

CURRENT TRIALS ON PASTURE WITH CHEMICALS

Since 1959, fifteen trials have been laid down, seven of which are still under observation. Eleven different insecticides have been used, most of which have been applied dry in wettable powder form and the remainder as pellets. However, in three trials heptachlor at 1¼ and 2½ lb a.i./acre and toxaphene at 1¼ lb and 2½ lb a.i./acre in emulsion form, were sprayed on. Treatments were replicated twice in randomized layouts and plot size was standard at 1/200 acre. Superphosphate at 3 cwt per acre was applied as a basal dressing to all plots including control surround, and, where soil testing showed a need, muriate of potash at 1½ cwt as well.

Larvae estimated to be present in trial sites ranged from 200 to 900 per square foot. As a guide to getting an "eye" for concentrations present, soil samples were taken from some sites and counts were made.

1959-1961 Series

Six trials were completed using chlorinated hydrocarbons. The object of these trials was to select the most suitable material, then investigate for an optimum application rate and use the information for advisory work.

The insecticides were applied at normal field rates as follows (all rates in active ingredient per acre): dieldrin at 4½ and 9 oz, DDT and lindane each at 1 and 2 lb, and heptachlor and toxaphene each at 1¼ and 2½ lb. It became apparent that heavier rates would be needed to control the larvae as results were disappointing and at no stage did any of the treatments yield well-defined differences from control. Further, larval numbers did not appear to be affected.

In two trials heptachlor gave a doubtful to slight response in pasture improvement, but failed to persist. In one of these trials the initial larvae count was 366 per square foot. During the period of these trials there was no appreciable deterioration of pasture, but this is not regarded as significant since the swards were generally poor consisting of: paspalum, *Poa trivialis*, white clover (*Trifolium repens*) and a trace of some ryegrass, Yorkshire fog (*Holcus lanatus*), sweet vernal (*Anthoxanthum odoratum*) and flat weeds. In one trial there was a very marked pasture response to the basal dressing of superphosphate and potash and in another a good response to superphosphate.

1962 Series

Five trials were laid down using dieldrin, endrin and "Telodrin" mostly in pelleted form and at rates generally aimed to kill the larvae and thus confirm pasture damage.

It was now evident that the larvae were extremely difficult to kill. Two trials were put down in March and April, 1962, using heavy rates of dieldrin at 4, 8 and 16 lb in wettable powder form. The pasture had a large amount of *Poa trivialis* but very little ryegrass and one was white clover dominant and in the other paspalum and *Poa trivialis* were co-dominant.

Response was fair to good from all treatments, mainly more vigorous pasture growth, and in one trial there was an increase in ryegrass content. Results of the best trial assessed in July, 1962, are shown in Table 1.

TABLE 1: RESULTS WITH HEAVY RATES DIELDRIN

Treatment (lb)	Replicates		Mean
	A	B	
Control	0	0	0
Dieldrin 4	2	3	2½
Dieldrin 8	3	3	3
Dieldrin 16	3	4	3½

(Response points 0-5 scale. 0 = none and 5 = excellent.)

In the two controls, growth height was 5 in. and species composition was similar, both having more white clover and buttercup than the treatments. In the treatments, growth height was 8 in. and the sward denser. *Poa trivialis* was dominant in all plots.

Deterioration of dieldrin Plots

Within a year of commencement of trials, the pasture under the dieldrin treatments had become markedly inferior to controls, much as if it had been treated with a herbicide. Under the 8 and 16 lb treatments the growth was shorter, colour yellow-red, and there was much dead and dying herbage. Under all treatments, a turf mat ¼ to ½ in. in thickness formed on the surface of the soil but none appeared on the control plots. The soil here had a better structure, was damper and not so massive in appearance as compared with that under the treatments.

In September, 1963, soil samples to a depth of 6 in. from all plots were examined by R. Nielson of Ruakura Agricultural Research Centre, and he found that:

- (1) All rates of dieldrin markedly reduced earthworm numbers.
- (2) A complete kill of soldier fly larvae was not attained even with dieldrin at 8 and 16 lb, young larvae being more susceptible than older ones.
- (3) There was little sign of other insect life in any of the samples.
- (4) A turf mat was found in all dieldrin-treated turves reaching an average of $\frac{1}{2}$ in. in thickness in the 8 and 16 lb rates.
- (5) A noticeable feature was the altered state of the clover nodules in the high-rates turves, but they appeared to be normal in the 4 lb rate turves.

TABLE 2: EARTHWORM AND SOLDIER FLY LARVAE COUNTS
(2 samples per plot, each sample = $\frac{1}{2}$ sq. ft in area)

Treatment (lb)	Earthworms		Soldier Fly Larvae	
	<i>A. caliginosa</i>	<i>L. rubellus</i>	0-2 in. depth	2-6 in. depth
	(Mean numbers per sample)			
Control	15.3	7.0	73.7	3.3
Dieldrin 4	5.3	5.0	8.3	1.0
Dieldrin 8	0.7	1.0	3.3	2.4
Dieldrin 16	0.8	0.5	3.5	3.0

In February, 1964, Dr J. Timlin, Entomology Division, D.S.I.R., Auckland, sampled each plot and counted the larvae (Table 3).

TABLE 3: SOLDIER FLY LARVAE COUNTS
(10 samples per plot, each sample = $\frac{1}{9}$ sq. ft in area)

Treatment (lb)	Replicates		Mean	Number per sq. ft
	A	B		
Control	44.0	55.4	49.7	447.3
Dieldrin 4	2.3	5.0	3.6	32.4
Dieldrin 8	1.0	0.9	0.9	8.1
Dieldrin 16	0.4	1.0	0.7	6.3

By this date, the pasture under the dieldrin treatments had improved considerably and by May the turf mat was reduced to less than $\frac{1}{4}$ in. and a few earthworms along with very few larvae were found. An encouraging sign was the appearance, for the first time, of ryegrass, prairie grass and cocksfoot plants. The sward was a healthy green colour. A marked feature was that, while cow pats were very numerous and obvious in the treatments, they were almost absent in the controls.

Pelleted Hydrocarbons

In December, 1962, two trials were laid down with dieldrin and endrin at 2 and 4 lb and "Telodrin" at 1 and 2 lb. In a third trial, dieldrin and endrin were applied at 2 lb only and "Telodrin" at $\frac{1}{4}$, $\frac{1}{2}$, 1 and 2 lb.

TABLE 4: RESULTS WITH PELLETTED HYDROCARBONS
(Pasture response points 0-5 scale means of replicates)

Treatment (lb)	Trial Number		
	1	2	3
Control	0	0	0
Dieldrin 2	1½	½	-2
Dieldrin 4	2	—	-3
Endrin 2	2	½	-2½
Endrin 4	2	—	-2½
"Telodrin" ¼	—	0	—
"Telodrin" ½	—	1½	—
"Telodrin" 1	3	1	-4
"Telodrin" 2	2	2½	-4

The responses shown in Table 4 were observed within nine to eleven months of application of treatments. In Trial 1 the initial sward was very open and weedy and was a general mixture of plant species. The response obtained was a better colour, more vigour and an increase in grass and clover growth. It is persisting. In Trial 2 (now closed) ryegrass, although sparse, was more prominent in the treatment plots. A thin turf mat developed in the "Telodrin" and 2 lb plots. Pasture degeneration, similar to that in the heavy rates of the dieldrin trial set in very rapidly in Trial 3, and at no time was there a positive response. The turf mat was approximately 3-16 in. thick.

1963 Series

Four trials were laid down in June and August using materials in pelleted form except azinphos methyl.

In two, the same hydrocarbons as in the 1962 series were used, but only one trial is worthy of note. In three months, dieldrin and endrin at 4 lb gave a good response, but the other treatments slight to fair. By May, 1964, pastures under all treatments had reached a stage where they were worse than the controls.

In the other two trials, the chemicals used were dieldrin 4lb, "Telodrin" ½, 2 and 4 lb, a brominated hydrocarbon 2 lb and the organophosphates diazinon 2 lb, phorate 2 lb, and azinphos methyl 4 lb. Again, only one has given results and here the main feature is that the pasture under dieldrin, phorate and particularly "Telodrin" (including the ½ lb rate) has deteriorated as compared with controls. Diazinon and a brominated hydrocarbon are slightly better than control in one replicate.

POT TRIALS

Two pot trials have been conducted. The object of the 1961 trial was to test the toxicity of five insecticides against the larvae. Treatments were replicated twice, there were ten controls, and materials used were heptachlor, toxaphene, lindane, and DDT all at 3 and 6 lb and dieldrin at 2¼ and 4½ lb. Each pot was seeded with 50 larvae containing a ryegrass plant as a food source. During the experimental period there was a marked drop in numbers of larvae per pot, possibly owing to the emergence of adult flies.

No insecticide produced a significant difference from the control. In 1962, A. C. W. Whatman, Department of Agriculture, Whakatane, conducted a replicated trial with the object of obtaining a

measurement of the damage, if any, done to perennial ryegrass and white clover by the soldier fly larvae. It was assessed by weighing the cut herbage. The trial satisfactorily demonstrated for the first time that the larvae will reduce the herbage yield from perennial ryegrass.

Plants were established from seed sown in thirty pots. Twelve were sown with ryegrass only, twelve with white clover, and six with a mixture of these species. On May 5, fifteen weeks later, half the number of pots were each seeded with 50 larvae, and on June 28 a herbage cut was taken from all pots except from the clover only.

The mean yields were:

<i>Treatment</i>	<i>Green Herbage (g/pot)</i>
Ryegrass with larvae	10.0
Ryegrass controls	17.6
Clover and ryegrass, larvae	10.0
Clover and ryegrass, controls	17.5

The weights were statistically analysed and there was significant depression in yield of ryegrass in those pots seeded with larvae.

CONCLUSIONS

It has been shown that the soldier fly is a pest of pastures and that the larvae are extremely difficult to control. However, the abnormal amounts of insecticide required to achieve control eventually induced an inferior sward. It now seems certain that there is very little hope of being able to use any chemical at a rate sufficiently toxic to control the larvae and yet be acceptable in normal field practice.

Pasture management could alleviate the economic loss. For instance, in these trials basal dressings of fertilizer often gave very good pasture responses. It is now planned to conduct fertilizer trials to demonstrate this point and to determine whether larval populations can be reduced.

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REFERENCES

- Cottier, W., 1962: *Proc. 15th N.Z. Weed Control Conf.*, p. 228.
Dumbleton, L. J., 1948: The economic status of *Metoponia rubriceps* Macquart. *N.Z. J. Sci. Tech.*, 30B: 224-32.
Marryatt, E. R., 1948: Investigation of Australian soldier fly in Opotiki District. *N.Z. J. Agric.*, 77: 164.