ESTIMATION OF THE EFFECTIVENESS OF AUTUMN SURFACE CULTIVATION FOR THE CONTROL OF THE AUSTRALIAN SOLDIER FLY

C. R. WILCOCKS

Ruakura Agricultural Research Centre, Hamilton

S. R. HEWITT

Department of Agriculture, Whakatane

Summary

Hewitt (1969) recommended thorough and repeated surface cultivation of the damaged sward during the late summer-autumn months for Australian soldier fly (*Inopus rubriceps*) control. The above method has been quantitatively assessed on a local scale. The larval numbers were significantly reduced.

INTRODUCTION

HEWITT (1969) recommended thorough and repeated surface cultivation of the damaged sward during the late summer-autumn months as a control measure for the Australian soldier fly (*Inopus rubriceps*). The object of the present reported work was to evaluate quantitatively the effectiveness of the above method in reducing the larval population.

METHOD

The trial site was situated on 22 acres of a badly infested soldier fly area near Whakatane. The soil type was Paroa silt loam. The pasture composition before the trial was as follows: Grasses 20%; clovers 35%; weeds 30%; bare ground 15%. Dominant species was white clover (*Trifolium repens*), followed by creeping buttercup (*Ranunculus repens*), narrow-leaved plantain (*Plantago lanceolata*) and summer grass (*Digitaria sanguinalis*). Of the other grasses, paspalum (*Paspalum dilatatum*), *Poa trivialis*, ryegrass (*Lolium* sp.), prairie grass (*Bromus unioloides*) and Indian doab (*Cynodon dactylon*) were present in about equal quantities.

The plot size was 30 × 30 yd. Control and treatment plots were paired adjacent to each other to reduce any inherent differences between them and each pair was replicated three times. Which plot of the pair was to be the control and which the treatment one was decided on a random basis.

Cultivation was commenced on 2/3/70 and terminated on 20/4/70, beginning before and finishing just after the autumn flight peak. The larval population was sampled on the following dates: 18/2/70, 10/3/70, 14/4/70, 9/7/70 and 20/10/70. The larvae were extracted from the soil using the washing method developed by Wilcocks and Oliver (1971).

From initial pilot sampling, it was decided to take 8 samples per plot (3 in. diameter, 6 in. deep soil cores). This number of samples was main-

tained throughout the trial and although the 95% confidence limits fluctuated they were under $\pm 20\%$ of the log ($\chi + 1$) transformed plot mean, except on one occasion. This was on 20/10/70, when all the treatment plots exceeded this value, and their 95% confidence limits were 51.71%, 62.47% and 26.72%, respectively. These wide limits were considered acceptable at this stage because of the gross difference between the number of larvae in the treatment plots compared with the number in the control ones.

Apart from the control plots, the whole 22 acres was treated as described in Table 1.

The rainfall during the period of cultivation was as given in Table 2.

TABLE 1: TREATMENT OF CONTROL PLOTS

<i>Date</i> 1970	<i>Time</i> <i>taken</i> (hr)	<i>Equipment used</i>
Mar. 2	5¼	3 in. cultivation using 13 stump jump tines, 11 ft wide
Mar. 3	6	Tandem discs
Mar. 4	6	Tandem discs
	3	3 ton flat roller
Mar. 5	5	3 ton flat roller
Mar. 6	3	6-8 in. cultivation with tines
Mar. 17	3	6-8 in. cultivation with tines
Mar. 22	6	Tandem discs
Mar. 29	2½	5-6 in. cultivation with tines
Mar. 30	6	Tandem discs
Apr. 6	2½	Cultivation with tines
Apr. 13	4	Tine harrows
Apr. 14	2	Cambridge roller
Apr. 16	2	Tine harrows
Apr. 18	1	Chain harrows
	1	Grass sown
Apr. 19	2	Chain harrows
	2	Grass sown
Apr. 20	2	Cambridge roller

TABLE 2: RAINFALL DURING CULTIVATION PERIOD (INCHES)

<i>Date</i>	<i>Mar.</i>	<i>Apr.</i>	<i>Date</i>	<i>Mar.</i>	<i>Apr.</i>	<i>Date</i>	<i>Mar.</i>	<i>Apr.</i>
1		1.15	11	0.48		21		
2		0.09	12	0.03		22		
3	0.01	0.48	13	1.23	0.20	23		
4		0.46	14		0.02	24		
5	0.02		15	0.02		25	2.60	
6			16			26	0.91	
7	4.00		17	0.07		27		0.02
8	0.06		18	0.05		28		0.09
9		0.06	19			29		0.01
10	0.02		20			30		
						31	0.26	

Although 11.32 inches of rain fell during the treatment period, 87.37% of this fell during 6 days out of a total period of 50. Thus, despite the amount of rain, the ground was able to dry out during the course of the trial. However, no record was kept of the soil moisture content.

ANALYSIS OF RESULTS

To extract as much information from the results as possible, it was decided to build a linear model describing the change in larval numbers, based on a least-square analysis. For a detailed mathematical account on the development of such a model, Seal (1968) should be consulted.

The results were expressed as follows: for each pair the number of larvae in the treatment plot was expressed as a percentage of the total number of larvae in both the control and treatment plots. Thus, when the number of larvae in the treatment plot equalled the number in the control, $p = 50\%$, when the number in the treatment plot exceeded the number in the control, $p > 50\%$, and when the above situation was reversed, $p < 50\%$. The resulting percentages, after an angular transformation (p') were as follows:

Sampling Time	Actual Date	Replications			Mean
		1	2	3	
1	18/2/70	52.42	53.61	39.70	48.58
2	10/3/70	37.11	38.12	41.15	38.79
3	14/4/70	37.11	30.79	28.39	32.10
4	9/7/70	22.22	21.13	28.86	24.07
5	20/10/70	16.00	23.18	17.36	18.85

In considering the outcome of the control method, it was expected that there would be a reduction in the larval numbers in the treatment plots compared with their respective controls—i.e., the value of p' would decrease. Let the expected decrease by sampling time 2, compared with the base line value measured at time 1, be equal to R_2 . Similarly, let the corresponding reduction differentials measured from the base-line data of time 1 at times 3, 4 and 5 be R_3 , R_4 and R_5 , respectively.

Although the reduction between any two immediately successive sampling times was not significant, the following reductions were significant.

R_3 : 16.48 ± 14.29 significant at the 10% level

R_4 : 24.51 ± 22.56 significant at the 1% level

R_5 : 29.73 ± 22.56 significant at the 1% level

DISCUSSION

One of the most interesting results was that the reduction differentials increased in magnitude with time. The reduction R_2 was not significant, but the reduction R_3 was significant at the 10% level. This reduction in larval numbers must have been due to the effects resulting from cultivation on both the first- and second-year-old larvae. Death probably resulted from either desiccation or bird predation. Large flocks of seagulls were observed during the cultivation period, pecking on the ground, and as larval skins were found in their excrement it was assumed that the gulls were eating the larvae.

The reduction R_4 was significant at the 1% level. Although the model was not sensitive enough to determine whether reductions were significant between any two immediately successive sampling times, the considerable lowering of the level at which R_4 was significant compared with R_3 indicated that the reduction between time points 3 and 4 was real. This further reduction in larval numbers was probably due to the effects of the cultivation on the pupal and egg stages. Both would have been subject to desiccation and the former to possible bird predation and mechanical damage resulting from the cultivation. Because of the bare ground existing during the flight period on the treatment plots, ovipositing preference for the control plots rather than the treatment ones could have been a factor in reducing the first-year larval population on the treatment plots.

The reduction R_5 was also significant at the 1% level. Since there was a continuing reduction trend throughout the period of the trial, the further reduction between times 4 and 5 was probably real. This further reduction could possibly have been due to a change in the age structure of the existing larval population in the treatment plots. This change could have accentuated the effect of some mortality factor in the treatment population compared with the control.

CONCLUSION

The Australian soldier fly larval population was significantly reduced as a result of the treatment. At the start of the trial there were $1.29 \times$ more larvae in the treatment plots compared with the control. By the 5th sampling time, there were $8.65 \times$ more larvae in the control plots compared with the treatment ones. On a number of larvae/sq.ft basis, $\pm$ the 95% confidence limits, the control population was reduced from 791 ± 249 to 445 ± 142 , whilst the treatment population was reduced from 1023 ± 314 to 51 ± 19 .

Although the reduction was considerable in the treatment plots, whether it was enough to make the process profitable remains to be seen.

A considerable amount of work still needs to be done to understand exactly how the reduction in numbers occurred. However, from work reviewed by Wilcocks (1971a, b) it appears that (weather conditions being favourable), it is best to cultivate during the period when both pupae and eggs are present in peak numbers. Then all three stages, larvae, pupae and eggs, are subjected to the effects of cultivation.

REFERENCES

- Hewitt, S. R., 1969: *Proc. 22nd N.Z. Weed & Pest Control Conf.*: 280.
 Seal, H., 1968: *Multivariate Statistical Analysis for Biologists*. Methuen, London, p. 209.
 Wilcocks, C. R., 1971a: *Proc. 24th N.Z. Weed & Pest Control Conf.*: 151.
 ——— 1971b: *Proc. 24th N.Z. Weed & Pest Control Conf.*: 155.