CHEMICAL CONTROL OF ARGENTINE STEM WEEVIL (*Hyperodes bonariensis* Kuschel) IN RYEGRASS SEED CROPS

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Summary

Seven insecticides; five emulsifiable concentrates and two granular compounds, were applied to Tama (tetraploid *Lolium multiflorum)* and Manawa *(L. multiflorum x perenne)* ryegrass seed crops. The aim was to control the larval population and therebv prevent reproductive tiller damage caused by Argentine stem weevil *(Hyperodes bonariensis* Kuschel) .Oxamyl and methomyl gave the best results although oxamyl was significantly better than the latter.

INTRODUCTION

Argentine stem weevil can be a major problem in ryegrass seed stands as a result of larvae tunnelling in both vegetative and reproductive tillers. Only one larva survives per tiller. Vegetative tillers are killed because the grub damages the growing point, whereas most reproductive tillers survive infestation despite severence of vascular tissues supplying the seed head. Occasionally infestations in grass seed crops are so damaging that farmers cut them for hay rather than harvest seed.

The eggs are layed singly or in groups, within pockets in the leaf sheaths and incubate for 17 to 21 days, the larvae feeding for 50 to 60 days within tillers before pupating in the soil (Buchanan, 1966). Two generations occur each year in Canterbury, but it is only the first generation which coincides with the development of grass seed crops and damages them (Pottinger, 1961a). In reproductive tillers symptoms of damage include 'whiteheads', 'stembreaks', 'node girdling', internode tunnelling, pinched seed and premature ripening. Damaged tillers are shorter than undamaged tillers and produce less (Pottinger, 1961b). Adult feeding damage on foliage can be important in newly emerged summer sown grass, but is not important in seed stands.

Very little work has been conducted on the chemical control of Argentine stem weevil. Most of the effort has been aimed at controlling the adults with organochlorines (Kelsey, 1958) and organophosphates (Buchanan, 1966). The preliminary trials reported in this paper were motivated by the need to find an acceptable, highly efficient, systemic insecticide to use on grass seed crops (and possibly spring sown cereals), infested with this pest.

EXPERIMENTAL METHODS

Two trial sites within Manawa and Tama ryegrass seed stands respectively, were selected at Lincoln College. The Tama was at the late tillering stage (15 cm high) when treated on 19th October, and

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the Manawa at the stem-extension stage (30-40 cm high) when treated on 9th November, 1973. On the 19th October, less than 50% of the eggs had hatched and most of the larvae were in the first or second instar, whereas on the 9th November most of the eggs had hatched.

Ten treatments as outlined in Tables 1 and 2 each replicated three times, were included in each trial. Plots were four by ten metres and treatments were randomised. Liquids were applied using a modified Oxford precision sprayer fitted with (D5-45) hollow cone nozzles operating at 413 kPa and delivering 450 litres of water/hectare. Surfactant was added at 0.5 percent. The granules were applied by sprinkling them three ways through shakers with sand which acted as a bulking agent and indicator. Rain fell within a week of applying both treatments, 18.2 mm after treating the Tama and 10.9 mm after treating the Manawa. The post-spray assessment of population was made 21 days after the chemicals

TABLE 1: POPULATION MEANS FOR 100 REPRODUCTIVE TILLERS PER TREATMENT, BEFORE AND AFTER APPLICATION OF THE INSECTICIDES, ON TAMA GRASS

Treatment	*Rate/ha*	*% a.i.*	*Mean pre-treatment counts/100 tillers*	*Mean post-treatment counts/100 tillers*
carbofuran G	1 kg	10	49.8* abA**	18.1 aA
diazinon EC	2 kg	80	51.3 abA	13.2 aA
methomyl EC	2 kg	30	52.2 abA	11.4 aA
trichloronat EC	1 kg	55	78.2 aA	11.0 aA
phorate G	1 kg	10	38.5 bA	10.9 aA
control	—	—	37.1 bA	10.4 aA
methomyl EC	1 kg	30	42.7 bA	9.6 aAB
chlorpyrifos EC	1 kg	40	34.9 bA	9.4 aAB
oxamyl EC	1 kg	20	36.9 bA	2.6 bB
oxamyl EC	2 kg	20	43.1 bA	2.3 bB
CV%			37	44

G = granules
EC = emulsifiable concentrate
* Population means are eggs plus larvae for pre-treatment counts and larvae alone for post-treatment counts.
** Duncans Multiple Range test carried out on transformed means.

TABLE 2: POPULATION MEANS FOR 100 REPRODUCTIVE TILLERS PER TREATMENT, BEFORE AND AFTER APPLICATION OF THE INSECTICIDES, ON MANAWA RYEGRASS

Treatment	*Rate/ha*	*% a.i.*	*Mean treatment counts/100 tillers*	*Mean post-treatment counts/100 tillers*
control	—	—	45.3* A**	16.5 aA
phorate G	1 kg	10	39.3 A	9.8 abAB
trichloronat EC	1 kg	55	38.5 A	8.2 abcAB
diazinon EC	2 kg	80	46.9 A	7.5 abcAB
chlorpyrifos EC	1 kg	40	32.7 A	7.1 abcAB
carbofuran G	1 kg	10	56.2 A	7.1 abcAB
methomyl EC	1 kg	30	65.5 A	5.8 abcAB
methomyl EC	2 kg	30	36.5 A	4.5 bcAB
oxamyl EC	1 kg	20	50.7 A	1.5 cB
oxamyl E C	2 kg	20	32.2 A	1.3 cB
CV%			41.4	36.8

* Population means are eggs plus larvae for pre-treatment counts and larvae alone in post-treatment counts.
** Duncans Multiple Range test carried out on transformed means.

were applied. Thirty plants were taken from each replicate and a sub-sample of five reproductive tillers per plant was assessed by pulling back the leaf sheath, splitting the tillers and visually examining both for eggs and live larvae. An area of two square metres was cut and threshed from each replicate in the Tama trial to determine in a preliminary way the effects of larval control on yield.

RESULTS

The results are presented in Table 1 for the trial on Tama ryegrass and on Table 2 for the trial on Manawa ryegrass. Treatments are ranked in both trials according to the post treatment means. The seed yields obtained from the Tama trial are given in Table 3. Because of the need to sample eighteen days prior to the actual harvest and artificially dry the seed, these yields are an underestimate and should only be used for comparison of treatment effects.

TABLE 3: SEED YIELDS (g/m^2) OBTAINED BY THRESHING SEED FROM TWO SQUARE METRES PER TREATMENT ON TAMA RYEGRASS*

Treatment	*Yield g/m^2*	*Treatment*	*Yield g/m^2*
diazinon 2 kg	27	methomyl 1 kg	32
control —	31	oxamyl 1 kg	34
phorate 1 kg	31	chlorpyrifos 1 kg	35
carbofuran 1 kg	32	trichloronat 1 kg	35
methomyl 2 kg	32	oxamyl 2 kg	35

* No significant difference was found between treatments.

DISCUSSION

The most outstanding result of this study has been the success of oxamyl to reduce significantly Argentine stem weevil larval populations in comparison with other treatments. This result was achieved in both trials and was reflected in the assessment of seed yield from the Tama ryegrass plots. It is obvious that further work is required in order to determine to what level the rate of oxamyl applied can be lowered before losing effectiveness.

The results achieved for carbofuran and phorate were not as good as expected and this undoubtedly reflects the fact that both were granular formulations. The rain which fell was probably sufficient to break down the granules, but because of dry soil conditions, which typify Canterbury in October-November, was probably insufficient to allow uniform uptake by plants over all the plots. Irrigation is not always available and if applied to crops in a late stage of stem elongation, could cause damage. Consequently, foliar systemics, such as oxamyl as proven in this trial, appear a better proposition. Contact insecticides such as diazinon and trichloronat gave inconclusive results for reducing stem weevil larval populations.

The reductions in grub populations were as good in the later treated Manawa ryegrass as in the Tama ryegrass trial. Whether this effect is reflected in seed yields is not known and requires further investigation. From a practical point of view, if ground applicating equipment is used, crop treatment in the last two weeks of October seems desirable. In spite of no significant differences in seed yield betwe.n treatments, if at current high prices for seed a 10 to 20% increase in yield can be achieved then this has economic significance and justifies the use of insecticides.

It was not the purpose of this study to produce a finite sampling plan, but the following points in relation to sampling emerged in this study and may be of help to other workers. Firstly, Argentine stem weevil populations are aggregated, even within small plot areas, and consequently high variability in counts occurs between plots. To overcome this problem a larger number of replicates appears warranted. Our analyses suggests a sample of at least 90 plants taken over six replicates. Secondly, when treatments were applied to both trials the populations included both eggs and larvae, and more than two weevils per tiller were common. Pottinger (1961b) noted that only one grub survives per tiller, and that this reduction is probably due to larval combat. As only one grub damages a particular tiller, for insecticide trial work only tillers infested with a live weevil have agronomic significance and therefore need be counted. By discontinuing examination of a tiller once a viable stage has been found a considerable saving can be made in sampling time. N.B. Covariance analysis of post treatment counts using initial counts as covariate showed that initial counts did not significantly affect post treatment counts and that, therefore, post treatment counts provide an adequate basis for comparing treatment effects on surviving populations.

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REFERENCES

Buchanan, R. S. 1966. Toxicological studies on the Argentine stem weevil *Hyperodes bonariensis*. Thesis *M. Agr. Sc. Lincoln College,* University of Canterbury.

Kelsey, J. M., 1958. Damage to ryegrass by *Hyperodes griseus* Hust. *N.Z. Jl. Agric. Res. 1:* 790-5.

Pottinger, R. P. 1961a. Argentine stem weevil *Hyperodes bonariensis,* an insect pest of pastures. *Canterbury Chamber Commerce Agric. Bull.* 380.

Pottinger, R. P. 1961b. A study of the biology and economic importance of Argentine stem weevil, *Hyperodes bonariensis* Kuschel, in New Zealand. *Thesis M. Agric. Sc. Lincoln College,* University of Canterbury.