CONTROLLING THE EUROPEAN WIREWORM, *AGRIOTES OBSCURUS L.*, IN CORN IN BRITISH COLUMBIA

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ABSTRACT

Six insecticides at various rates and formulations, applied by three methods over three seasons, were evaluated for controlling the European wireworm, *Agriotes obscurus L.* in corn planted in silt loam. The insecticides were in granular form, applied as a broadcast, in a band, or in the seed furrow. Most of the materials, rates and methods gave good protection. Insecticide applied in the furrow was placed either in contact with the seed, or just ahead of it and mixed with soil. When it was in contact with the seed the yield was slightly lower, indicating some phytotoxicity. The furrow methods were the most economical in material and labour.

INTRODUCTION

Damage caused by wireworms to susceptible crops such as corn and potatoes is increasing in the lower Fraser Valley. The problem is serious in corn grown for the fresh market, canning and ensilage, especially near Agassiz where the wireworm *Agriotes obscurus L.* was accidently introduced from Europe about 1900 and has become well established (King *et al.* 1952; Wilkinson 1963). Much of the infested land in this area has been treated with the cyclodiene chlorinated hydrocarbons, aldrin and heptachlor, which gave protection for at least nine years following a single application (Wilkinson *et al.* 1964). Later tests showed that the small amounts of insecticide remaining in the soil were still toxic to young wireworms even 13 years after the soil was treated. In many fields the wireworms were eradicated by these chemicals but nearby headlands and road allowances provided a continuing source of reinfestation. Restoration of this wireworm to its previous levels is slow because the adults do not fly and the life cycle takes 3 to 4 years, so that an infestation may take several years to build up to economic levels. The worst problem at present involves land that was not cleaned up with the long-lasting chemicals of the late 1950s and early 1960s, but in time all the fields, treated or not, will need treatment.

A series of tests of short-lived insecticides and methods of application, were made during several seasons to find an effective, economic control. The most effective chemicals and the initial rates were determined in the laboratory and the field tests were done near Agassiz in silt loam.

MATERIALS AND METHODS

1970 Experiment: The land was infested with 80 *A. obscurus* per m^2 which destroyed corn planted in May. On June 10, insecticides were applied in randomized blocks replicated four times. The granular insecticides were broadcast evenly over the surface and worked in to a depth of 10 cm. Oats, peas, and vetch were planted since these crops can be grown successfully on heavily infested land. The effect of the treatment was determined in September

TABLE 1. Average numbers and percentage reduction of *A. obscurus* after broadcast soil treatments with various insecticides, Agassiz, B. C., 1970.

Insecticide	% granules	Toxicant (Kg/ha)	Wireworms/m^2	Control (/)
Fonofos	20	5.6	12.16 a**	84.8
Carbofuran	5	5.6	12.16 a	84.8
Carbofuran	10	5.6	14.53 a	81.8
Bux*	15	5.6	19.37 a	75.8
Check		—	79.97 b	—

* A 3:1 mixture of m-(1-methylbutyl)phenyl methylcarbamate and m-(1-ethylpropyl) phenyl methylcarbamate.

** Values followed by the same letter are not significantly different (Duncan, 1955).

by counting the wireworms in 10 cylindrical soil cores taken at random from each plot with an augur. Each core was 103 cm^2 by 38 cm deep. The results are shown in Table. 1.

1974 Experiment: The population was 75.3 *A. obscurus* per m^2. Granular insecticides were applied in a band, in the furrow and by the broadcast method. The purpose of adding the band and furrow treatments was to reduce the amount of insecticide and thus the cost. Carbofuran was not included in the 1974 and 1975 experiments because of instability in some soils. Bux was withdrawn by the manufacturer.

In the band method the insecticide was applied in a strip 30 cm wide at 18.6 g toxicant per 100 m of row then worked into a depth of 10 cm. The corn was seeded in the middle of the band. In the furrow method the insecticide was applied with the seed at 9.3 g toxicant per 100 m of row. The treating and planting was done May 30. In September any differences in yield were shown by counting and weighing the corn stalks from 10 m of row. Wireworms were counted by sifting the soil and examining the roots in five samples per plot, each 15 cm square by 20 cm deep, dug with a spade, with a corn root at the centre of the sample. The results are shown in Table 2.

TABLE 2. Growth and yields of corn and average numbers of *A obscurus* per corn root after various treatments with four granular insecticides at Agassiz, B.C., 1974.

Insecticide	% granules	Method of Application	Toxicant (Kg/ha)	Avg. wt. plants (Kg)	Avg. no. wireworms/ corn root	Avg. no. stalks/ 10 m row	Avg. wt./ 10 m row (Kg)
Fonofos	10	Broadcast	5.6	1.04 a	.55 a	47.5 a	44.3 a
Counter[1]	15	Broadcast	5.6	1.03 a	.50 a	44.0 ab	40.1 ab
Fonofos	10	Band	2.0	1.02 a	1.40 ab	41.7 ab	37.9 ab
N 2596[2]	10	Broadcast	5.6	1.01 a	1.40 ab	41.2 ab	36.6 ab
Counter	15	Furrow	1.0	.96 ab	1.85 ab	45.0 ab.	36.5 ab
N 2596	10	Furrow	1.0	.93 ab	1.40 ab	46.7 ab	35.5 ab
Bay 92114[3]	10	Furrow	1.0	.92 ab	3.30 b	38.5 bc	32.2 bc
Fonofos	10	Furrow	1.0	.89 ab	.95 a	40.7 ab	31.3 bc
Bay 92114	10	Broadcast	5.6	.87 ab	1.50 ab	31.5 cd	23.6 cd
Check		—	—	.80 b	6.25 c	27.2 d	19.2 d

[1]AC 92100 S-([tert-butylthio] methyl) 0,0, diethyl phosphorodithioate
[2]S(p-chlorophenyl) o-ethyl ethane phosphorodithioate
[3]1 methylethyl 2 [[ethoxy] (1 methylethyl) amino] phosphinothioyl]oxy] benzoate

1975 Experiment: The methods of application were the same as in 1974 except for a modification of the furrow method. To determine if the insecticide applied with the seed caused phytotoxicity and reduced the yield, a second method was included whereby the insecticide was applied just ahead of the seed. Rates of 9.3 and 13.9 g of toxicant per 100 m were tested. The efficacy was determined by differences in the number of stalks, weight of the yield in 6 m of row and in wireworms counted by the method used in 1974. The treatments were made and the corn was planted May 13; it was harvested September 26. The wireworm counts were made September 30 and October 1. The results are shown in Table 3. The data were examined by analysis of variance and the results compared with Duncan's Multiple Range Test (Duncan 1955).

RESULTS AND DISCUSSION

Based on population counts the broadcast treatments of granules in 1970 all gave good control of wireworms (Table 1). There were no significant differences between the efficacy of the chemicals even in the two granular formulations of carbofuran.

In 1974 the results showed that in general the broadcast treatments were slightly better than the band or furrow treatments (Table 2). With the exception of the Bay 92114 broadcast treatment all the chemicals and methods gave significantly better yields than the control and all significantly reduced the number of wireworms. The furrow treatment of Bay 92114 was slightly, but not significantly, better than the broadcast treatment.

In 1975 all the treatments gave significant reductions in the number of wireworms over the control but the differences in yield were less clear, although significant differences were obtained. The broadcast treatments generally reduced the wireworm population more than did the furrow treatments. There were differences between the two furrow methods; most of the treatments in which the insecticide was applied with the seed had low yields, which indicated some phytotoxicity (Table 3). The heavy rate used in the furrow seemed to have little effect on yield but did give a greater re-

Table 3. Growth and yields of corn and average number of *A. obscurus* per corn root after various treatments with three granular insecticides, Agassiz, B.C., 1975.

Insecticide	% granules	Method of Application	Toxicant (kg/ha)	Avg. no. wireworms/ corn root	Avg. no. stalks/ 6 m row	Avg. wt./ (Kg/6 m row)
N 2596	10	Furrow*	1.8	.15 ab	30.5 abc	22.4 a
Counter	15	Furrow†	1.2	—	33.2 ab	21.8 ab
Fonofos	10	Broadcast	5.6	0.0 a	31.2 ab	21.4 abc
Fonofos	10	Furrow*	1.8	.5 abc	31.0 abc	20.9 abcd
Fonofos	10	Furrow*	1.2	1.05 c	29.7 abc	20.7 abcd
Counter	15	Furrow*	1.8	.15 ab	34.5 a	20.4 abcd
Fonofos	20	Furrow*	1.2	.55 abc	31.2 ab	20.4 abcd
N 2596	10	Broadcast	5.6	.1 ab	29.0 abcd	20.0 abcd
N 2596	10	Furrow†	1.8	—	27.5 abcde	19.9 abcd
Counter	15	Furrow*	1.2	.75 bc	28.5 abcde	19.5 abcde
Fonofos	20	Furrow†	1.2	—	24.0 cde	18.8 abcde
N 2596	10	Furrow*	1.2	.5 abc	31.2 ab	18.6 abcde
Counter	15	Broadcast	5.6	.3 abc	28.2 abcde	18.2 abcde
N 2596	10	Furrow†	1.2	—	26.5 bcde	18.2 abcde
Counter	15	Furrow†	1.8	—	28.0 abcde	17.6 bcde
Fonofos	10	Furrow†	1.2	—	26.5 bcde	17.2 cde
Fonofos	10	Furrow†	1.8	—	22.7 de	16.9 de
Untreated	—	—	—	2.25 d	22.0 e	15.5 e

*Insecticide applied ahead of the seed in the furrow.
†Insecticide applied with the seed.

duction in the number of wireworms than the low rate. Four months after application, dead and dying larvae were found in the plots treated by the furrow methods, which indicated that there was some persistence in the chemicals. Fonofos, N 2596 and Counter appeared to give about equal control regardless of method of application.

Over the years the broadcast treatments have given the greatest reduction in the number of wireworms and generally the best protection to the corn crop. The differences in control are not great but the cost of insecticide for the furow treatment is only ¼ that of the broadcast. Further savings are made because it does not require extra passes over the land to apply the insecticide or one or more additional diskings or rototillings to work in the insecticide. The band treatment requires about twice as much insecticide as the furrow treatment and does not have the advantage of easy application. The fact that wireworms were still being killed four months after the furrow treatments were made indicates that all the chemicals tested in 1975 remained toxic when in high concentrations in the soil. Thus, chemicals applied by this method will give protection during a growing season.

References

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