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WHITE GRUB STUDIES - 1964

by

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INTRODUCTION

Occasional severe white grub damage in the Agassiz Forest Reserve (Prentice and Hildahl, 1957) highlighted by the almost total loss of a 305 acre red pine plantation in the Sandilands Forest Reserve in 1962 (Warren and Hildahl, 1963) has indicated that these insects can be a serious problem in Manitoba plantations. A study of the problem in southeastern Manitoba was begun in 1960 (Warren, 1962). Preliminary studies in the use of chemical insecticide in machine plantings began in 1963 (Warren and Ives, 1964) and are continuing with the aid of the following agencies: the Forest Management Branch of the Manitoba Department of Mines and Natural Resources has supplied machinery and labor for planting and soil sampling, and Chipman Chemicals Limited, Winnipeg, has supplied insecticides and technical advice through their representative Mr. G. R. Fraser. Preliminary studies on the flight activity and response of June beetles to light traps were carried out from 1960 to 1963 (Warren, 1964).

METHODS

Experimental Areas:

The location of experimental areas used prior to 1964 has been indicated by Warren and Ives (1964).

Areas selected for the 1964 experiments, and planting dates are as follows:

Plot No.	Area	Location	Planting Date
IV	Wampum, Sandilands Forest Reserve	L.S. 2-17-1-13E and L.S. 15-8-1-13E	May 4-6, 1964
V	Wampum Sandilands Forest Reserve	L.S. 7-17-1-13E	May 7, 1964
VI	Whitemouth Lake Sandilands Forest Reserve	L.S. 1 and 2-12-4-13E	May 9-12, 1964

Plots IV and V (Wampum) are located on a 300 acre area subjected to a severe forest fire in 1944. Regeneration has been extremely sparse except for small patches of jack pine, red pine and poplar. Ground cover is mainly grasses and herbaceous weeds growing

on a thin sod layer. The soil is typical of the Sandilands series, rapidly drained, minimal podzol on coarse sandy outwash deposits. The area is bordered on the north and west by cultivated fields and on the south and east by moderately stocked stands of 30-40 year-old jack pine and poplar which were untouched by the fire.

Plot VI (Whitemouth Lake) is located on a natural forest opening within 300 feet of Whitemouth Lake. An attempt was made in 1957 to reforest the area to jack pine by scarification and broadcast seeding, but the result was a complete failure. The soil is typical of the Woodridge series; rapidly drained, orthic grey wooded soils on sandy gravelly beach. A road separates the plot from the lake on the south but otherwise it is bordered by a mixed stand of pole-size jack pine, poplar and birch.

The Wampum area is sufficiently large to accommodate five years of planting tests. The Whitemouth Lake area has a number of additional small openings similar to Plot VI, each of which would provide for one year of test planting.

Methods and Chemical Treatment:

2-2 red pine and jack pine were used in the 1964 experimental plantings. The seedlings had healthy stems and root systems and were packed in boxes of moist moss at the nursery. They were maintained in an excellent condition with a minimum of care until the time of planting.

All plantings and chemical treatments were carried out using a Lowther tree planter modified to spot-treat the soil beneath each seedling automatically with a measured amount of liquid and/or granular insecticide or fertilizer (Ives and Warren, 1964).

Seedlings were planted at 6 x 6 foot spacing, with an untreated buffer row between each treated row. Four blocks containing 21 rows, 660 feet long, were planted in each of Plots IV and VI. The blocks in Plot IV were selected at random from a total of 12 blocks, but the four blocks in Plot VI occupied the entire area. In Plot V, 14 rows, 660 feet long were planted in each of two blocks. Figure 1 shows the layout of the blocks for the three plots.

In Plots IV and VI five treatments were applied in each block as follows:

(i) Aldrin - emulsifiable form, 10 ml of 2% aldrin per seedling (0.44 lbs active ingredient per 1000 seedlings).

(ii) Aldrin - emulsifiable form, 10 ml of 4% aldrin per seedling (0.88 lbs active ingredient per 1000 seedlings).

(iii) MAGAMP® - (Magnesium, Ammonium, phosphate, 8-40-0), a controlled-release fertilizer at the rate of 33 grams per seedling.

(iv) MAGAMP and 2% of aldrin.

(v) Control

The five treatments were applied in a modified random block design of 10 treatment rows with alternate buffer rows and replicated four times at each of the two locations. In Plot V the block design was similar except that only two replications were made, with red pine and jack pine seedlings treated as follows:

Red pine - (i) Diazinon - emulsifiable form, 10 ml. of 2% per seedling.

(ii) Aldrin - emulsifiable form, 10 ml. of 2% per seedling.

(iii) Control

Jack pine - (i) Aldrin, 10 ml. of 2% per seedling.
(ii) MAGAMP, 33 grams per seedling.
(iii) MAGAMP and 2% aldrin.
(iv) Control

The arrangement of randomized treatments and the number of seedlings per treatment is shown in Table I.

Grub Population Assessment :

Soil sampling for white grubs was carried out from July 14 to July 24. Fifty 1-cubic foot samples were taken at random from the buffer rows in each block, 25 including a seedling and 25 between the seedlings. The samples were processed with the aid of a power-driven shaker from which the soil passes onto a continuous conveyer belt where it can be carefully examined for grubs. Counts were made of Phyllophaga and Serica larvae, pupae, and teneral adults.

Seedling Mortality and Growth Assessment :

The 1964 seedling mortality was assessed in both the 1963 and 1964 experimental plantations in early October, 1964. All seedlings in the treatment rows were examined, the dead seedlings were removed and the cause of mortality assigned to one of the following categories: (i) white grubs, (ii) planting damage, (iii) unknown causes. In the 1964 plantations, 1964 height growth was measured at this time to evaluate the effect of fertilizer treatments. The current year's height growth was measured to the nearest centimeter for a 10% sample of the red pine and a 25% sample of the jack pine.

Measurement of Adult Flights:

Adult populations of white grubs were assessed from the catches in six battery-operated ultra-violet light traps operated in the 1964 experimental planting areas from mid-May to mid-July. The traps were switched on for three hours each night, from 2230 to 0130 hours C.S.T., by battery-operated timers. Catches were collected weekly and the beetles counted and identified. The trap locations were as follows: Trap 1 in the vicinity of Plot V; Trap 2 and 3 near Plot IV; Trap 4 near Plot VI; and Trap 5 and 6 in two future planting sites in the Whitemouth Lake area.

Adult flight activity is also being studied by use of a timed collecting device on two ultra-violet traps. These traps permit separate catches to be made for each one-half-hour interval throughout each night. In 1964 these traps were operated at Milner Ridge in the Agassiz Forest Reserve; with data simultaneously recorded on temperature, humidity, precipitation, and atmosphere pressure.

RESULTS

1964 Experimental Plantings:

White grub populations were very low and resulting damage very light in all 1964 plantings (Table II). Once again, therefore, it is not possible to evaluate conclusively the effectiveness of insecticide applications in the year of planting. Data on grub population and seedling mortality on untreated rows from Table II may be synopsized as follows:

	PLOT			
	IV(rP)	V(rP)	V(jP)	VI(rP)
Grubs per Foot^3	0.16	0.07	0.07	0.08
Seedling mortality %				
All causes	5.0	8.5	4.7	11.4
Grub damage	2.1	1.4	0.5	1.0

Some of the mortality may be attributed to the effects of drought as little or no rain fell in the planting areas from time of planting until mid-June and some of the surrounding established trees were exhibiting symptoms of drought by the second week of June. Seedlings in Plot VI had a decidedly higher mortality due to incorrect planting by an inexperienced man. No serious phytotoxic effect was evident with any of the treatments.

The effect of fertilizer and other treatments on the 1964 height growth was examined with an analysis of growth data by multiple range tests (Kramer, 1956), summarized as follows:

Plot IV - Red Pine

	Fertilizer & 2% Aldrin	Fertilizer	2% Aldrin	4% Aldrin	Control
No measurements	84	79	82	81	80
Average height growth in cm.[1]	5.83	5.46	5.46	5.05	4.86

Plot V - Jack Pine

	Fertilizer & 2% Aldrin	Fertilizer	Control	2% Aldrin
No measurements	51	52	50	50
Average height growth in cm.[1]	9.14	7.85	6.66	6.48

[1] Any two means not underscored by the same line are significantly different and any two means underscored by the same line are not significantly different. Significance was attained at the 0.05 level in Plot IV and at 0.01 level in Plot V.

Red pine in Plot IV treated with fertilizer combined with 2% aldrin had a significantly better growth than the untreated control seedlings and those treated with 4% aldrin. In Plot V, jack pine seedlings treated with fertilizer combined with 2% aldrin showed a significantly better growth than the control seedlings and those treated with 2% aldrin. However, in both Plot IV and Plot V, seedlings treated with fertilizer alone showed no significant growth differences when compared with all other treatments. No significant differences were found between treatments on red pine seedlings in Plot V and VI.

Mortality Assessment in 1963 Experimental Plantings:

All seedlings in the treatment rows of the 1963 plantations were examined in the fall of 1963 and the results reported (Warren and Ives, 1964). The assessment was repeated in the fall of 1964 and the results are shown in Table III. Although the percentage of seedlings killed by white grubs in 1964 was again very low in each plot there is an indication on all plots that some degree of protection has been provided in the second year following the application of the insecticide. Aldrin, both liquid and grandular, and liquid heptachlor appear to give better control than grandular toxaphene.

Adult Flight Studies:

A prime objective of this phase of the study is to assess the feasibility of predicting hazard to the plantings from a knowledge of adult populations in previous seasons. This will require an analysis of several years' data on adult abundance, which must then be related to subsequent larval populations and seedling damage. Tests were continued to determine the optimum timing for light trap operation and light traps were operated on the experimental planting sites for the first time in 1964.

The major flight period of June beetles at the Milner Ridge site was from June 1 to June 17. Due to mechanical failure, one of the two traps designed to segregate catches by half-hour intervals was inoperative from June 1 to June 9; therefore data for this trap have been excluded from the analysis. Data from the operating trap are summarized in Tables IV and V.

Analysis of species representation in the total catches at Milner Ridge (Table IV) shows the following:

Phyllophaga drakii (Kirby)	77%	97% males
P. nitida (Le Conte)	3%	
P. anxia (Le Conte)	2%	
Serica spp.	18%	

Comparison was made of air temperatures taken from the recording hygrothermograph and the catches by half-hour intervals; no June beetles were trapped at air temperatures below 47°F and no beetles were caught on the nights of June 2-3, 3-4, 9-10, and 15-16 when the nightly temperatures did not exceed 45°F. The reduced catches on the night of June 11-12 and 13-14 may be attributed to precipitation during the flight period. Several more seasons' data on humidity and atmosphere pressure in relation to flight activity are required before an adequate evaluation of these factors can be made.

The season's catch of beetles by half-hourly and hourly periods is shown in Table V. The hourly records were available for

20 days longer than the half-hourly records; hence hourly catches exceed the totals of half-hourly catches in the Table. The trap was operated for half-hour periods and serviced daily from May 27 to June 18. From June 18 to July 8 the trap was set to make hourly collections and serviced every two days, and from July 8 to July 26 daily collections were made. This change in timing was necessary due to other work committments. An error occurred in setting the timer for the period June 18 to June 22, and the hourly catches were not obtained for these three nights, however the total catch for each night during this period was recorded.

The data on the distribution of nightly flight times from the above traps were used to adjust the light traps on the experimental planting plots for the optimum 3-hour period of nightly operation. These traps are battery-operated and 3 hours per night for one week has been found to be the maximum operation time before the batteries require recharging.

There was no apparent change in nightly distribution of flight times for the various species of June beetles during the period June 4 to July 8. The battery-operated traps at the plots were adjusted early in the season to operate between 2230 hours and 0130 hours C.S.T. The effectiveness of this 3-hour period in relation to the total nightly catches for the season is shown in Table V. It would appear that this period is adequate for sampling P. drakii and P. anxia when more than 90% of the total catch would be trapped. For P. nitida and Serica spp. 62.7% and 70.8% respectively, were caught during the same 3-hour period. However, little would be gained by shifting the 3-hour period to an earlier or later time, but a more complete sample of these species could be obtained by extending the operating time of the trap to 4 hours. This would require an additional two batteries for each trap, and is probably not justified at the present time.

The results from six battery-operated traps on the plots are shown in Table VI. Traps 1, 2 and 3, and 4 measured the adult flight for Plots V, IV, and VI respectively. The majority of June beetles caught in all traps were Phyllophaga spp. Serica spp. occurred in all traps but were most prevalent in the Wampum area. P. drakii was the predominant species caught in the Wampum area (Trap 1, 2, and 3) and in Trap 6, the most westerly located trap in the Whitemouth Lake area. Trap 4 and 5 near Whitemouth Lake caught P. drakii and P. nitida in approximately equal numbers P. anxia was caught in low numbers in all six traps. 96% of trapped Phyllophaga spp. were males.

The high proportion of P. nitida caught in Traps 4 and 5 is of interest. This may be because both traps were located adjacent to Whitemouth Lake and the other four traps were located at least three miles from open water other than small creeks.

DISCUSSION

No major difficulties were encountered with the planter attachments and after two years of testing this equipment can now be recommended for operational-scale planting programs.

Time studies were carried out during the 1964 planting operation. With an experienced tractor-man and a planter-man of three days training, a rate of 700 treated trees per hour was easily maintained. Because of the nature of the planting experiment, no attempt was made to increase the planting rate. Over similar terrain it is estimated that a fully experienced planting team should plant 1000 trees per hour without treatments and 900 trees per hour with treatments, including time for mixing and handling insecticide. A treatment of 10 ml. of 2% aldrin per seedling costs $0.67 per acre for insecticide applied to trees spaced 6 ft x 6 ft (1210 trees per acre). Machine planting costs without treatment are estimated to be $29.16 per acre, based on the following: 1210 seedlings at $20.00 per thousand; labour at $2.85 per hour; and tractor costs of $1.25 per hour. The estimated cost of planting, with a 2% aldrin treatment, would then be $30.38 per acre, an increase of $1.22 per acre or 4%.

Again, as in 1963, very low white grub populations and low seedling mortality were found in the 1964 experimental plantations and thus a conclusive assessment of the various treatments is not yet possible.

Two additional permanent areas will be established at Vassar and Piney in former pasturelands with a moderate sod layer. They are expected to have higher grub populations than have been encountered in the past two years' experimental plantings. The provincial reforestation planting program on this site type is expected to increase as more marginal lands are returned to provincial ownership. Further experimental planting at Whitemouth Lake will be discontinued due to the unsuitability of the sites for machine planting.

Soil sampling for white grubs was carried out in 1964 on the 305 acre plantation that was badly damaged by grubs in 1962 (Warren and Hildahl, 1963) using sequential sampling tables developed for pre-planting surveys and infestation ratings (Ives and Warren, In Press). The table for pre-planting surveys indicated that no control would be needed if the area was replanted in 1965. The table for infestation ratings indicated, after 27 samples were examined, that the grub infestation was light (less than 0.2 grubs per cubic foot). This type of assessment and/or seedling mortality assessment will be extended in 1965 to include as many newly established and proposed provincial plantations as possible in order to obtain a better appraisal of the importance of white grubs at large in the Manitoba-Saskatchewan Region.

To expedite evaluation of experimental insecticide treatments, an investigation into the feasibility of "seeding" white grub larvae in some of the treatment rows will be initiated in 1965.

The length of the life cycle and the period of most active larval feeding for June beetles is not accurately known in Manitoba. This is of vital importance in attempting to develop control measures for the insect. In 1965, adults of known species of Phyllophaga will be induced to lay eggs in sod plots isolated from adjacent sod areas and protected from further grub invasion. The development of the progeny will be carefully studied until maturity under natural conditions.

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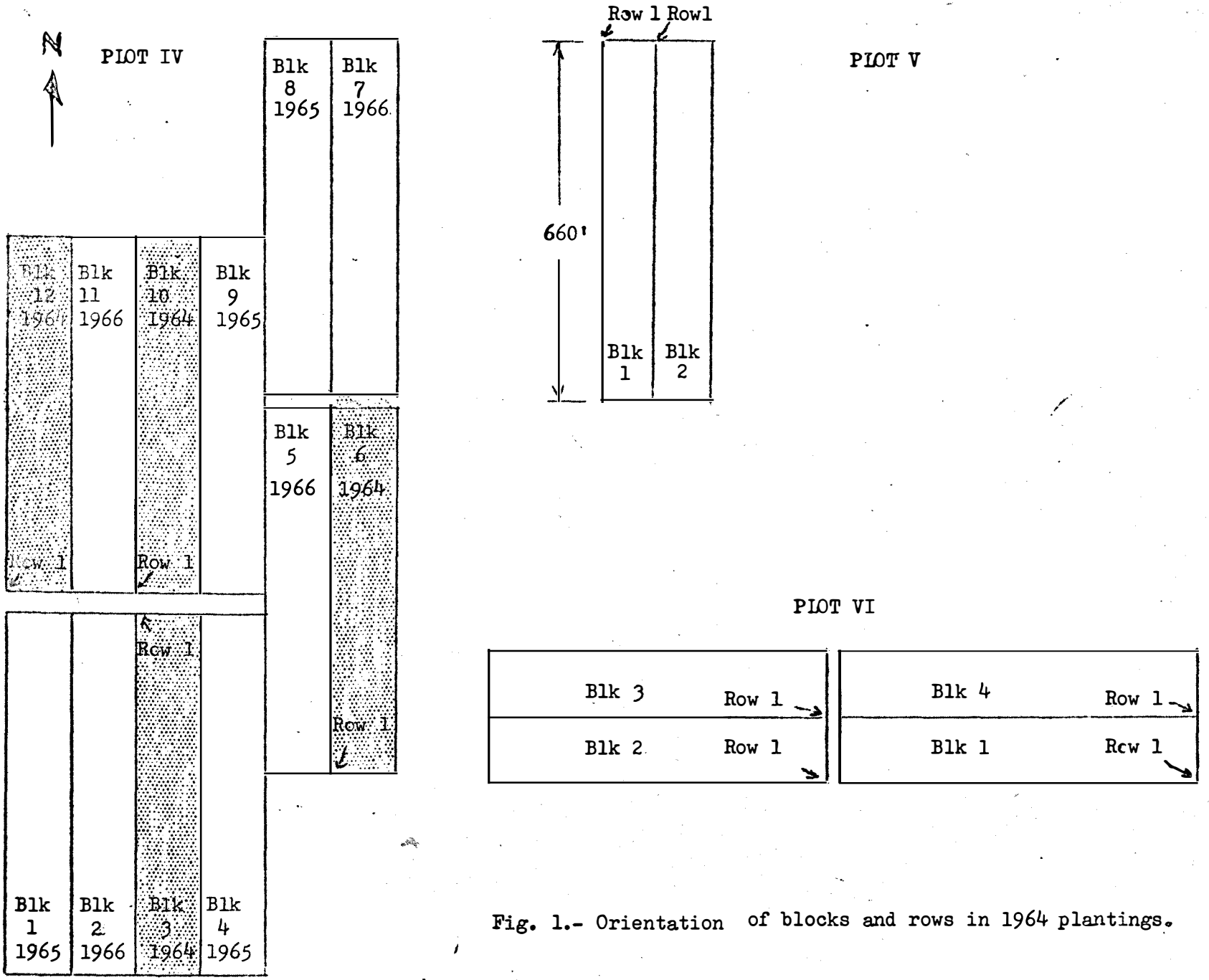

Fig. 1.- Orientation of blocks and rows in 1964 plantings.

Table I

Arrangement of randomized treatments and number of seedlings per treatment in the 1964 experimental plantations

	ALDRIN 2%		ALDRIN 4%		FERTILIZER		FERTILIZER & ALDRIN 2%		DYLZINON		CONTROL	
	Block & Row	No. Seedlings	Block & Row	No. Seedlings	Block & Row	No. Seedlings	Block & Row	No. Seedlings	Block & Row	No. Seedlings	Block & Row	No. Seedlings
Plot IV Red Pine	3- 4	101	3- 2	102	3- 3	96	3- 5	96	-	-	3- 1	99
	- 6	100	- 8	103	- 7	97	- 9	104	-	-	-10	101
	6- 6	104	6- 2	99	6- 1	103	6- 4	107	-	-	6- 5	103
	- 8	106	- 9	102	- 3	106	-10	107	-	-	- 7	105
	10- 1	98	10- 4	98	10- 5	101	10- 2	101	-	-	10- 7	96
	- 8	99	-10	96	- 6	101	- 3	102	-	-	- 9	102
	12- 5	104	12- 6	105	12- 7	105	12- 1	104	-	-	12- 3	103
	-10	101	- 9	102	- 8	104	- 2	107	-	-	- 4	104
	Total	813		807		813		828				818
Plot V Red Pine	1- 5	104	-	-	-	-	-	-	1- 3	102	1- 6	106
	2- 7	106	-	-	-	-	-	-	2- 6	99	2- 4	106
	Total	210								201		212
Plot V Jack Pine	1- 1	98	-	-	1- 7	100	1- 2	102	-	-	1- 4	105
	2- 2	98	-	-	2- 1	104	2- 3	103	-	-	2- 5	107
	Total	196	-	-		204		205				212
Plot VI Red Pine	1- 5	105	1- 4	103	1- 3	100	1- 1	99	-	-	1- 6	103
	- 9	100	- 7	105	-10	101	- 2	100	-	-	- 8	101
	2- 5	98	2- 2	104	2- 6	104	2- 3	98	-	-	2- 7	98
	-10	103	- 1	106	- 9	100	- 4	100	-	-	- 8	101
	3- 7	102	3- 1	90	3- 4	100	3- 8	101	-	-	3- 3	106
	- 9	104	- 2	100	- 5	99	-10	97	-	-	- 6	99
	4- 6	95	4- 3	104	4- 1	99	4- 4	98	-	-	-11	94
	- 8	95	- 7	103	- 2	93	- 5	103	-	-	4-10	99
	- 9	103									-11	102
	Total	905		815		796		796				903

Table II

Seedling mortality from all causes for each treatment in the 1964 experimental plantations

Plot	Treatment	No Seedlings	Grubs Per Foot^3	% Seedling Mortality			
				Killed by Grubs	Planting	Unknown	Total
IV Red Pine	Aldrin 2%	813	0.16	1.4	0.9	3.0	5.3
	Aldrin 4%	807		0.5	0.9	3.2	4.6
	Fertilizer & Aldrin 2%	828		0.8	2.7	2.4	5.9
	Fertilizer	813		1.7	1.6	4.6	7.9
	Control	818		2.1	0.9	2.0	5.0
V Red Pine	Aldrin 2%	210	0.07	0.5	1.0	2.9	4.4
	Diazinon	201		1.0	0.0	2.5	3.5
	Control	212		1.4	1.4	5.7	8.5
V Jack Pine	Aldrin 2%	196	0.07	0.5	1.5	3.1	5.1
	Fertilizer & Aldrin 2%	205		0.5	0.5	1.5	2.5
	Fertilizer	204		0.0	1.5	4.4	5.9
	Control	212		0.5	0.9	3.3	4.7
VI Red Pine	Aldrin 2%	905	0.08	0.4	3.4	4.9	8.7
	Aldrin 4%	815		0.6	5.0	3.9	9.5
	Fertilizer & Aldrin 2%	796		1.4	6.3	7.5	15.2
	Fertilizer	796		1.3	6.4	6.5	14.2
	Control	903		1.0	4.1	6.3	11.4

Table III

Seedling mortality from white grubs in 1963 and 1964 in the 1963 experimental plantations

Treatment	Plot I (Agassiz)			Plot II (Marchand)			Plot III (Piney)		
	No. of Seedlings 1964	% Killed by Grubs 1964	% Killed by Grubs 1963	No. of Seedlings 1964	% Killed by Grubs 1964	% Killed by Grubs 1963	No. of Seedlings 1964	% Killed by Grubs 1964	% Killed by Grubs 1963
Aldrin 2% (liquid)	792	0.0	0.0	839	0.4	0.0	553	0.0	0.5
Neptachlor (liquid)	788	0.0	0.2	822	0.0	0.0	751	0.4	0.3
Aldrin (granular)	761	0.0	0.4	729	0.0	0.0	739	0.3	0.0
Toxaphene (granular)	772	1.4	0.1	725	0.1	0.0	756	1.6	0.1
Control	739	2.0	1.2	813	1.1	0.0	722	1.9	0.5

Table IV

Nightly catches of June beetles in one light trap at Milner Ridge in the Agassiz Forest Reserve, 1964

Night of	P. drakii	P. anxia	P. nitida	Serica spp	Night of	P. drakii	P. anxia	P. nitida	Serica spp
May 27-28	1	0	0	0	June 24-25	3	0	1	2
28-29	0	0	0	0	25-26	5	2	0	0
29-30	0	0	0	0	26-27	6	0	1	2
30-31	0	0	0	0	27-28	6	0	1	26
May 31-June 1	0	0	0	0	28-29	8	0	7	28
1-2	29	0	2	0	29-30	3	1	0	0
2-3	0	0	0	0	June 30-July 1	0	0	1	0
3-4	0	0	0	0	1-2	2	0	0	2
4-5	522	6	5	107	2-3	0	0	1	0
5-6	212	5	1	1	3-4	0	0	0	4
6-7	119	3	0	0	4-5	4	0	1	24
7-8	136	8	8	48	5-6	0	0	0	10
8-9	42	0	0	2	6-7	0	0	0	2
9-10	0	0	0	0	7-8	0	0	2	2
10-11	100	1	3	7	8-9	0	0	0	1
11-12	3	2	2	4	9-10	0	0	2	0
12-13	106	3	5	4	10-11	0	1	3	6
13-14	3	1	0	0	11-12	0	0	0	2
14-15	22	0	3	0	12-13	0	0	0	3
15-16	0	0	0	0	13-14	0	0	0	1
16-17	26	2	8	14	14-15	0	0	1	0
17-18	7	2	1	0	15-16	0	0	0	3
18-19	0	0	0	0	16-17	0	0	1	0
19-20	3	0	0	0	17-18	0	0	0	0
20-21	7	1	0	0	18-19	0	0	0	0
21-22	13	2	0	0	19-20	0	0	0	1
22-23	13	0	2	15	20-21	0	0	0	1
23-24	5	0	4	1	21-22	0	0	0	0
					22-26	0	0	0	1
					Totals	1406	40	66	324

Table V

Total June beetles caught during half-hourly periods from May 27 to June 18 and during hourly periods from May 27 to July 8, 1954, in one light trap at Milner Ridge in the Agassiz Forest Reserve

Trapping Period[1] C. S. T. From	To	P. drakii Half-Hourly May 27 June 18	P. drakii Hourly May 27 July 8	P. anxia Half-Hourly May 27 June 18	P. anxia Hourly May 27 July 8	P. nitida Half-Hourly May 27 June 18	P. nitida Hourly May July	Serica spp. Half Hourly May 27 June 18	Serica spp. Hourly May 27 July 8
0700	2130	0	0	0	0	1	1	2	5
2130	2200	14	-	1	-	4	-	5	-
2200	2230	26	45	1	3	3	10	17	42
2230	2300	39	-	18	-	1	-	78	-
2300	2330	99	146	7	26	1	4	19	135
2330	0000	301	-	3	-	2	-	21	-
0000	0030	418	724	1	5	6	12	7	46
0030	0100	300	-	1	-	7	-	8	-
0100	0130	65	393	0	2	3	21	8	35
0130	0200	38	-	1	-	8	-	9	-
0200	0230	18	65	0	1	2	11	10	-
0230	0300	5	-	0	-	0	-	2	-
0300	0330	2	7	0	0	0	0	0	-
0330	0400	2	-	0	-	0	-	0	-
0400	0430	0	2	0	0	0	0	1	-
0430	0700	1	1	0	0	0	0	0	42[2]
Totals		1328	1383	33	37	38	59	187	305
% Total Season's Catch		94.5	98.4	82.5	92.5	57.6	89.4	57.7	94.1
% Caught 2230-0130		92.0	91.3	90.9	89.2	52.6	62.7	75.4	70.8

[1] The trap light was operated continuously for 24 hours with timed collections commencing at 2130 hours and ending at 0430 hours. Traps were serviced at 0700 hours.

[2] All caught from 0130 hours to 0700 hours.

Table VI

Seasonal catches of June beetles in light traps in the Sandilands Forest Reserve, 1964

Date Operated 1964	Species Caught	TRAP					
		WAMPUM			WHITEMOUTH LAKE		
		1	2	3	4	5	6
May 15-21	P. drakii	0	0	0	*	*	*
	P. anxia	0	1	0			
	P. nitida	0	0	0			
	Serica spp.	1	1	0			
May 21-28	P. drakii	3	8	4	5	3	1
	P. anxia	5	5	6	6	4	5
	P. nitida	0	0	0	15	1	0
	Serica spp.	3	3	10	2	0	4
May 28-June 4	P. drakii	0	0	0	1	0	0
	P. anxia	0	0	0	0	0	0
	P. nitida	0	0	0	0	0	0
	Serica spp.	0	0	0	0	0	0
June 4-11	P. drakii	68	167	174	70	22	316
	P. anxia	17	21	15	16	13	34
	P. nitida	0	1	3	66	34	6
	Serica spp.	1	13	16	11	2	17
June 11-18	P. drakii	56	*	157	82	40	*
	P. anxia	2		6	11	2	
	P. nitida	0		1	75	25	
	Serica spp.	3		1	1	0	
June 18-25	P. drakii	9	12	11	17	9	38
	P. anxia	1	1	0	1	2	5
	P. nitida	0	0	0	13	7	1
	Serica spp.	5	0	0	5	0	3
June 25-July 2	P. drakii	2	7	5	18	2	38
	P. anxia	0	1	0	1	4	3
	P. nitida	0	0	3	37	10	8
	Serica spp.	34	32	75	15	1	10
July 2-9	P. drakii	2	2	3	13	1	18
	P. anxia	0	0	0	0	0	1
	P. nitida	0	1	0	6	4	1
	Serica spp.	9	9	10	3	2	15
July 9-20	P. drakii	3	2	0	5	2	6
	P. anxia	0	0	0	1	0	0
	P. nitida	0	0	0	1	2	3
	Serica spp.	12	4	2	1	1	2
Totals	P. drakii	143	198	354	211	79	417
	P. anxia	25	29	27	37	25	48
	P. nitida	0	2	7	213	83	19
	Phyllophaga spp.	168	229	388	461	187	484
	Serica spp.	68	62	114	38	6	51

* Trap not in operation