

Not for publication

**OBSERVATIONS ON SPRUCE WEEVIL
PERMANENT SAMPLE PLOTS AT
GREEN TIMBERS AND NITINAT, B.C.
1959-1969**

by
J. W. E. Harris and R. G. Brown

**FOREST RESEARCH LABORATORY
CANADIAN FORESTRY SERVICE
VICTORIA, BRITISH COLUMBIA**

INTERNAL REPORT BC-22

**DEPARTMENT OF FISHERIES AND FORESTRY
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INTRODUCTION

The spruce weevil, Pissodes strobi (Peck) (formerly known as Pissodes sitchensis Hopkins in coastal British Columbia and Pissodes engelmanni Hopkins in the interior), is a serious pest of spruce reproduction (Holms 1967; Harris et al. 1968). Attacks have sometimes been so severe as to discourage planting of these species on lands favorable to the growth of spruce as a timber crop.

To study the progress of attack in a naturally developing young stand, a sample area was established in 1959 in natural regeneration Sitka spruce (Picea sitchensis (Bong.) Carr.) on bottom-land in the Nitinat River Valley, about 10 miles west of Cowichan Lake on Vancouver Island (Fig. 1). Life history and chemical control studies were also made there by Silver (1968). To study attack on trees of different genetic stock, plantations were established at the Green Timbers Nursery of the British Columbia Forest Service in 1955 (Silver and Ruth 1966). Since these results were published, several annual records have been taken. This report, therefore, summarizes stand development and attack data now available.

METHODS

Nitinat Sample Area

A study area was selected near the west end of Cowichan Lake in the Nitinat River Valley (Fig. 1). Four areas of natural Sitka spruce regeneration were outlined and trees were tagged in 1960 and 1961. Plots 1 and 2 (4/5 acre each) and 3 and 4 (2/5 acre each) contained 231, 253, 137 and 74 spruce, respectively. Plot tree counts varied in subsequent years because of new trees being added, mortality and trees being missed during examinations. Trees selected were examined each spring for weevil attack, mortality and abnormalities, and were measured with a surveyor's levelling rod for height and leader growth. All leaders, including those on multiple-top trees, were measured. The longest living leader on each tree was used each year in determining annual average leader length for each plot. After 1964, leader lengths were estimated as most trees had grown too large to measure. Numbers of trees weevilled were recorded in the spring following attack. Insecticides were applied experimentally to plots 2, 3 and 4 in the spring of 1961 and 1964.

Per cent weevil attack was calculated by year and height class to reduce the variability possibly introduced by trees of different heights differing in attractiveness to the weevil. Each year, average height and leader length of attacked trees was compared with the average height and leader length of all trees examined at the time of attack. It was hoped to relate progress of attack with increase in stand height and determine if there was any gross correlation between leader length and attack frequency. Frequency of attack was tabulated to determine susceptibility to repeated attack.

Green Timbers Sample Area

Three species and one hybrid cross of spruce, from seed sources in Poland, Germany, Denmark, Ontario and British Columbia, were established as 2-0 stock at Green Timbers Forest Nursery, Surrey, B. C., in 1957 (Silver and Ruth 1966). The stock was transplanted in 1962.

Eight plots were established and 578 spruce trees were tagged in 1961. Weevil attack, mortality, abnormalities, height and leader growth were recorded each spring until 1969. Measurements were taken with a surveyor's levelling rod. Weevil attacks noted each spring were those of the previous year. The longest living leader on each tree was used each year in determining annual average leader length.

Per cent weevil attack was calculated annually. Each year, average height and leader length of attacked trees was compared with the average height of all trees examined at the time of attack. Comparisons were necessary to determine if any of the species or crosses were more or less immune to attack. Growth rate of the different strains was plotted and compared with weevil attack.

RESULTS AND CONCLUSIONS

Nitinat Sample Area

Plot 1, begun in 1960, initially included 231 trees. Unlike the other three plots, no insecticides were applied and it represents a natural attack situation.

Per cent weevil attack in 1959, the first year of record, was 7.8% (Table 1). Attack continued at about this level until 1963, when it increased to 23.2% and continued at this new level until the present. During this time the average stand height increased from 4.6 to 12.9 ft. The average height of the infested trees was always slightly higher than the plot average.

Subdividing attack by height classes (Table 2) revealed that attack on trees up to 4 ft was negligible, on trees from 4-7 ft was light, on those from 7-10 ft was high, and on those from 10-20 ft was still higher. Even higher attack was noted in the 20-30-ft class, but the numbers of trees was small.

The average leader length increased to 18.7 inches in 1965, but thereafter levelled off. The average length of attacked leaders was almost twice that of the stand average.

The results obtained from examining trees in plots 2-4 were similar to those from plot 1 except that the per cent attack, as of the last examination period, was continuing to rise (Tables 3-8). There were more large trees in these plots and the results showed that there were higher percentages of trees being attacked in the upper height categories than in the lower categories.

The insecticide applications on plots 2, 3 and 4 resulted in lower per cent attacks during the 1961 and 1964 treatment years (Silver 1968), but the check in attack was not lasting and did not seem to reduce the overall effect of the weevil on the stand. The insecticide application did reduce the frequency of attack (Table 9). On plots 2, 3 and 4 the average frequency of attack per tree up to spring 1968 was:

Plot no.	Height class (ft)	
	10.1 - 20.0	20.1 - 30.3
2	1.19	1.55
3	1.40	2.53
4	1.49	1.48

On the untreated plot 1 the frequency was:

Height class (ft)	
10.1 - 20.0	20.1 - 30.3
2.34	3.22

Green Timbers Sample Area

When the data from the Green Timbers sample area was last summarized (Silver and Ruth 1966), the trees were too small to be attacked. In this summary of data taken four years later, the trees in some of the plots have begun to grow into the susceptible height class (Table 10). In plantations, which averaged 4.1 to 7.8-ft high in 1968, the average height of weevilled trees ranged from 8.1 to 10.1 ft.

The highest incidence of attack, 3, 12, 20 and 15 trees in the years 1965 to 1968, respectively, was in the native Picea sitchensis. The second highest incidence, 2 and 6 trees in the years 1967 and 1968, respectively, was in the Picea sitchensis x glauca hybrid from Lundsgard, Denmark. The other test plots had few or no attacks. Three plots were unattacked; two of these, however, had the lowest average tree heights, 4.1 and 4.0 ft, but the other had an average height of 7.6 ft.

When average heights of trees in each of the eight plots were compared by year, height in plots F-9, F-15 and F-19 were observed to begin to fall behind the others around 1966 (Fig. 2). Average height growth in the other stands continued to climb sharply except in the case of the heaviest hit plot (native Sitka spruce), where the rate of increase declined as the effect of relatively heavy weevil attack (up to just under 40%) took hold in 1967 (Fig. 3).

The weevil attack in this area seems to be developing, and no clear evidence of susceptibility of the different species and hybrids being tested has been demonstrated. This information should be available in several years and the examinations should be continued.

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Table 1. Nitinat spruce weevil plot No. 1

Tree growth and attack data

Item	Year of attack									
	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968
No. trees	231	231	228	232	228	229	230	230	248	236
% trees attacked	7.8	11.7	9.6	10.8	23.2	21.0	31.3	26.5	18.1	26.7
Avg height of trees (ft)	-	4.6	5.5	6.5	7.7	8.8	10.0	11.2	11.6	12.9
Avg height of attacked trees (ft)	-	6.6	8.3	9.5	10.0	11.1	12.7	13.9	14.8	15.0
Avg length of leaders (inches)	-	8.7	11.7	13.4	15.2	17.8	18.7	16.5	14.4	17.1
Avg length of attacked leaders (inches)	-	13.0	20.1	21.1	21.7	23.6	25.1	24.1	21.4	24.1

Table 2. Nitinat spruce weevil plot No. 1

Attack by tree height classes

Year	Height classes											
	0.1-4.0		4.1-7.0		7.1-10.0		10.1-20.0		20.1-30.0		30.1+	
	No. trees	% trees attacked	No. trees	% trees attacked	No. trees	% trees attacked	No. trees	% trees attacked	No. trees	% trees attacked	No. trees	% trees attacked
1960	114	1.8	86	18.6	24	29.2	7	28.6	0	0	0	0
1961	78	0	90	6.7	44	25.0	16	31.2	0	0	0	0
1962	55	0	87	4.6	65	23.1	25	24.0	0	0	0	0
1963	39	0	66	7.6	76	32.9	47	48.9	0	0	0	0
1964	22	0	55	3.6	68	19.1	84	39.3	0	0	0	0
1965	15	0	39	7.7	59	17.0	115	51.3	2	0	0	0
1966	11	0	35	0	41	17.1	136	37.5	7	42.9	0	0
1967	13	0	34	2.9	45	11.1	141	22.0	15	53.3	0	0
1968	8	0	24	16.7	45	11.1	140	35.0	18	27.8	0	0

Table 3. Nitinat spruce weevil plot No. 2

Tree growth and attack data

Item	Year of attack									
	1960	1961*	1962	1963	1964*	1965	1966	1967	1968	
No. trees	253	253	250	249	248	245	244	286	277	
% of trees attacked	8.7	2.4	14.0	14.9	10.5	13.1	20.5	26.6	16.6	
Avg height of trees (ft)	-	7.0	8.5	10.1	11.6	13.3	15.4	15.6	17.1	
Avg height of attacked trees (ft)	-	11.0	11.2	12.2	14.5	14.8	17.2	18.2	19.8	
Avg length of leaders (inches)	-	17.5	18.0	20.4	22.8	24.0	26.9	22.6	21.2	
Avg length of attacked leaders (inches)	-	24.7	23.0	24.0	22.2	28.4	35.4	27.9	28.8	

* Insecticide applied

Table 4. Nitinat spruce weevil plot No. 2

Attack by tree height classes

Year	Height classes											
	0.1-4.0		4.1-7.0		7.1-10.0		10.1-20.0		20.1-30.0		30.1+	
	No. trees	% trees attacked	No. trees	% trees attacked	No. trees	% trees attacked	No. trees	% trees attacked	No. trees	% trees attacked	No. trees	% trees attacked
1961*	37	0	103	1.9	76	1.3	37	8.1	0	0	0	0
1962	17	0	77	5.2	89	10.1	67	32.8	0	0	0	0
1963	11	0	52	9.6	73	9.6	110	20.9	3	66.7	0	0
1964*	4	0	34	2.9	55	9.1	148	12.1	7	28.6	0	0
1965	2	0	14	0	40	7.5	174	14.9	15	20.0	0	0
1966	0	0	12	0	35	8.6	151	21.9	46	30.4	0	0
1967	5	0	27	0	35	8.6	143	30.8	74	37.8	2	50.0
1968	2	0	21	0	26	3.8	136	18.4	85	21.2	7	28.6

* Insecticide applied

Table 5. Nitinat spruce weevil plot No. 3

Item	Tree growth and attack data									
	Year of attack									
	1960	1961*	1962	1963	1964*	1965	1966	1967	1968	
No. trees	134	134	134	135	132	134	134	141	135	
% trees attacked	26.1	0	4.5	5.2	9.1	17.2	26.1	24.8	28.9	
Avg height of trees (ft)	-	5.9	7.2	8.4	9.8	11.3	12.9	13.5	14.8	
Avg height of attacked trees (ft)	-	-	12.6	10.7	14.6	13.8	16.6	16.2	17.0	
Avg length of leaders (inches)	-	15.3	15.8	16.2	19.4	20.3	20.6	14.5	16.4	
Avg length of attacked leaders (inches)	-	-	24.7	23.9	31.8	25.7	32.2	18.0	21.4	

* Insecticide applied

Table 6. Nitinat spruce weevil plot No. 3

Attack by tree height classes

Year	Height classes											
	0.1-4.0		4.1-7.0		7.1-10.0		10.1-20.0		20.1-30.0		30.1+	
	No. trees	% trees attacked	No. trees	% trees attacked	No. trees	% trees attacked	No. trees	% trees attacked	No. trees	% trees attacked	No. trees	% trees attacked
1961*	35	0	64	0	27	0	8	0	0	0	0	0
1962	16	0	55	0	43	0	20	30.0	0	0	0	0
1963	11	0	43	4.6	40	0	41	12.2	0	0	0	0
1964*	8	0	33	3.0	29	0	61	16.4	1	100.0	0	0
1965	4	0	27	3.7	24	8.3	78	24.4	1	100.0	0	0
1966	3	0	16	0	26	11.5	75	32.0	14	57.1	0	0
1967	6	0	16	6.2	23	8.7	75	30.7	21	42.9	0	0
1968	1	0	15	6.7	17	23.5	74	29.7	28	42.9	0	0

* Insecticide applied

Table 7. Nitinat spruce weevil plot No. 4

Tree growth and attack data

Item	Year of attack									
	1960	1961*	1962	1963	1964*	1965	1966	1967	1968	
No. trees	74	74	74	74	74	74	74	74	74	74
% trees attacked	12.2	1.4	8.1	10.8	4.0	12.2	25.7	36.5	25.7	
Avg height of trees (ft)	-	6.3	7.7	9.1	10.6	12.6	14.4	15.8	17.0	
Avg height of attacked trees (ft)	-	4.3	9.7	9.2	14.3	14.1	15.9	16.7	19.8	
Avg length of leaders (inches)	-	14.9	16.6	17.8	22.2	26.3	24.0	22.0	20.4	
Avg length of attacked leaders (inches)	-	16.0	15.0	20.9	48.0	27.8	27.9	26.1	28.5	

* Insecticide applied

Table 8. Nitinat spruce weevil plot No. 4

Attack by tree height classes

Year	Height classes											
	0.1-4.0		4.1-7.0		7.1-10.0		10.1-20.0		20.1-30.0		30.1+	
	No. trees	% trees attacked	No. trees	% trees attacked	No. trees	% trees attacked	No. trees	% trees attacked	No. trees	% trees attacked	No. trees	% trees attacked
1961*	12	0	41	2.4	18	0	3	0	0	0	0	0
1962	5	0	30	0	25	16.0	14	14.3	0	0	0	0
1963	1	0	17	5.9	35	11.4	21	14.3	0	0	0	0
1964*	0	0	10	0	23	4.4	41	4.9	0	0	0	0
1965	0	0	7	0	11	9.1	52	13.5	4	25.0	0	0
1966	0	0	4	0	8	25.0	51	25.5	11	36.4	0	0
1967	0	0	3	0	5	40.0	53	35.8	13	46.2	0	0
1968	0	0	1	0	6	0	49	26.5	17	29.4	1	100.0

* Insecticide applied

Table 9. Frequency of attack on trees at Nitinat Study Area

Plot no.	Height class	Total no. trees spring 1968	No. of times trees attacked - 1959-1968							
			1	2	3	4	5	6	7	8
1	0.1- 4.0	8	0	0	0	0	0	0	0	0
	4.1- 7.0	24	3	0	0	0	0	0	0	0
	7.1-10.0	45	8	3	1	0	0	0	0	0
	10.1-20.0	140	23	28	23	15	9	10	1	1
	20.1-30.0	18	3	3	4	4	3	1	0	0
2	0.1- 4.0	2	0	0	0	0	0	0	0	0
	4.1- 7.0	21	0	0	0	0	0	0	0	0
	7.1-10.0	26	1	3	0	0	0	0	0	0
	10.1-20.0	136	37	27	14	10	0	0	0	0
	20.1-30.0	85	26	22	9	7	0	0	1	0
	30.1+	7	2	1	2	0	0	0	0	0
3	0.1- 4.0	1	0	0	0	0	0	0	0	0
	4.1- 7.0	15	3	0	0	0	0	0	0	0
	7.1-10.0	17	6	2	0	0	0	0	0	0
	10.1-20.0	74	24	21	8	1	2	0	0	0
	20.1-30.0	28	1	6	10	7	0	0	0	0
4	4.1- 7.0	1	0	0	0	0	0	0	0	0
	7.1-10.0	6	2	0	0	0	0	0	0	0
	10.1-20.0	49	13	15	6	3	0	0	0	0
	20.1-30.0	17	5	3	3	0	1	0	0	0
	30.1+	1	1	0	0	0	0	0	0	0

N.B. Insecticides were applied to trees in plots 2-4 in 1961 and 1964.

Table 10. Green Timbers spruce weevil study

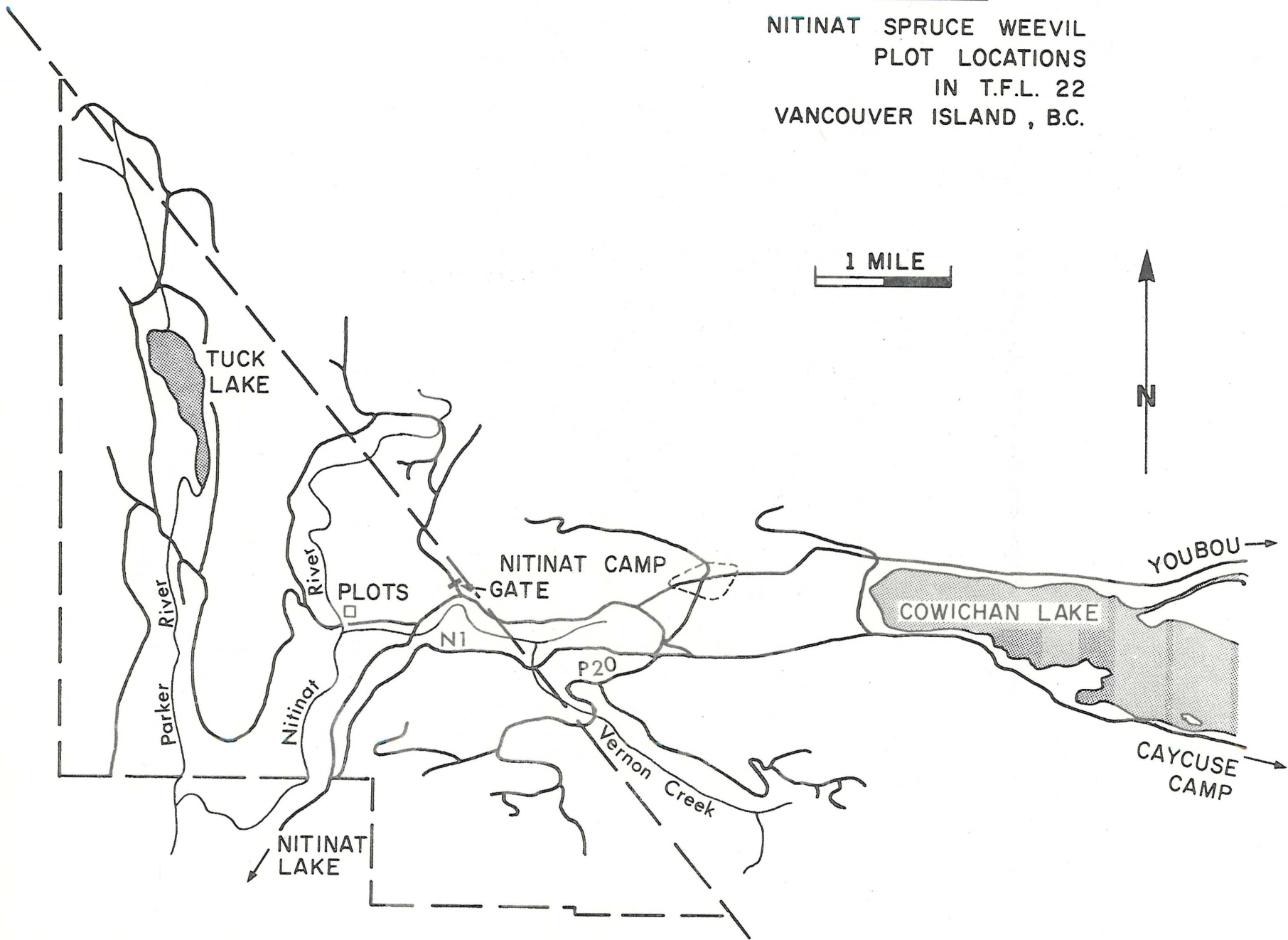
Tree growth and attack data

Item	Year of attack			
	1965	1966	1967	1968
PLOT F-9 (<u>Picea glauca</u> , Vankleek Hill, Ont.)				
No. trees	57	44	40	33
% trees attacked	0	0	0	0
Avg height of trees (ft)	2.8	3.3	3.5	4.1
Avg height of attacked trees (ft)	-	-	-	-
Avg length of leaders (inches)	6.3	4.7	3.3	5.7
Avg length of attacked leaders (inches)	-	-	-	-
PLOT F-15 (<u>Picea abies</u> , Istebena, Poland)				
No. trees	48	46	45	41
% trees attacked	0	0	0	2.4
Avg height of trees (ft)	3.6	3.9	4.2	4.8
Avg height of attacked trees (ft)	-	-	-	8.6
Avg length of leaders (inches)	8.0	5.0	4.0	5.8
Avg length of attacked leaders (inches)	-	-	-	12.0
PLOT F-16 (<u>Picea abies</u> , Schwartzwald, Germany)				
No. trees	71	66	55	54
% trees attacked	0	0	3.6	1.8
Avg height of trees (ft)	3.1	4.1	5.1	6.7
Avg height of attacked trees (ft)	-	-	5.0	9.7
Avg length of leaders (inches)	6.0	11.1	9.8	19.8
Avg length of attacked leaders (inches)	-	-	6.0	22.8
PLOT F-18 (<u>Picea glauca</u> , Jutland, Denmark)				
No. trees	53	52	52	51
% trees attacked	0	0	1.9	2.0
Avg height of trees (ft)	4.2	5.2	6.1	7.8
Avg height of attacked trees (ft)	-	-	8.6	10.1
Avg length of leaders (inches)	11.2	13.0	10.9	19.1
Avg length of attacked leaders (inches)	-	-	15.6	31.2

Table 10. (concluded)

Item	Year of attack			
	1965	1966	1967	1968
PLOT F-19 (<u>Picea sitchensis</u> x <u>glauca</u> , Jutland, Denmark)				
No. trees	27	26	21	18
% trees attacked	0	0	0	0
Avg height of trees (ft)	2.1	2.5	2.8	4.0
Avg height of attacked trees (ft)	-	-	-	-
Avg length of leaders (inches)	5.9	5.3	5.5	10.7
Avg length of attacked leaders (inches)	-	-	-	-
PLOT F-20 (<u>Picea sitchensis</u> x <u>glauca</u> , Lundsgard, Denmark)				
No. trees	60	58	41	40
% trees attacked	0	0	4.9	15.0
Avg height of trees (ft)	4.1	5.0	5.9	7.3
Avg height of attacked trees (ft)	-	-	6.2	8.4
Avg length of leaders (inches)	10.8	11.5	10.2	16.2
Avg length of attacked leaders (inches)	-	-	12.0	23.5
PLOT F-21 (<u>Picea sitchensis</u> x <u>glauca</u> , Jutland, Denmark)				
No. trees	34	28	17	16
% trees attacked	0	0	0	0
Avg height of trees (ft)	3.6	4.6	6.2	7.6
Avg height of attacked trees (ft)	-	-	-	-
Avg length of leaders (inches)	7.4	9.0	10.4	15.6
Avg length of attacked leaders (inches)	-	-	-	-
PLOT F-S (<u>Picea sitchensis</u> , British Columbia)				
No. trees	67	65	52	50
% trees attacked	4.5	18.5	38.5	30.0
Avg height of trees (ft)	4.6	5.5	6.7	7.1
Avg height of attacked trees (ft)	7.0	6.5	7.9	8.1
Avg length of leaders (inches)	7.9	11.0	9.8	12.4
Avg length of attacked leaders (inches)	16.0	12.2	12.9	14.7

FIGURE 1
NITINAT SPRUCE WEEVIL
PLOT LOCATIONS
IN T.F.L. 22
VANCOUVER ISLAND, B.C.



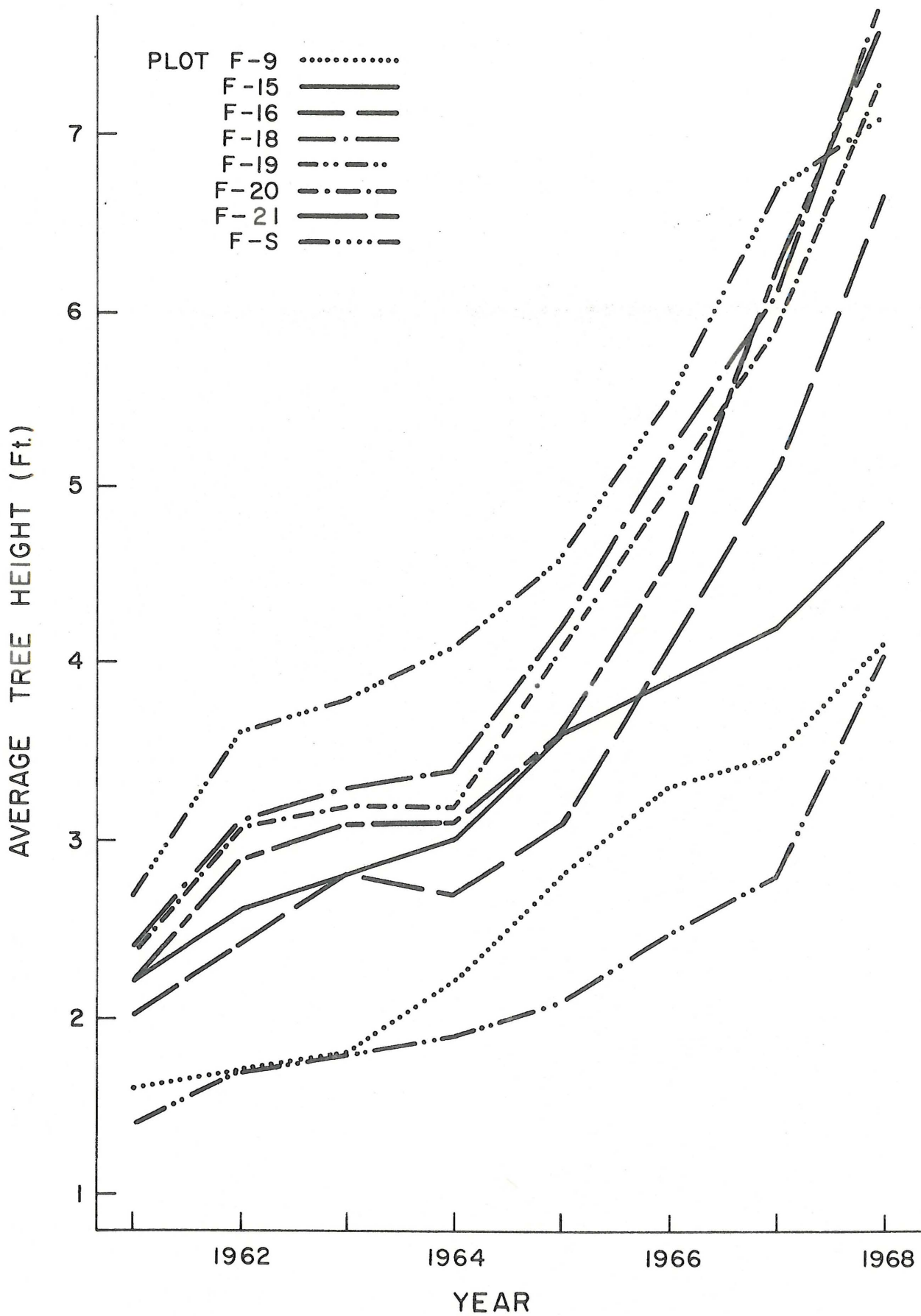


Figure 2. Average heights of spruce trees growing in eight plots at Green Timbers Nursery as of spring examination.

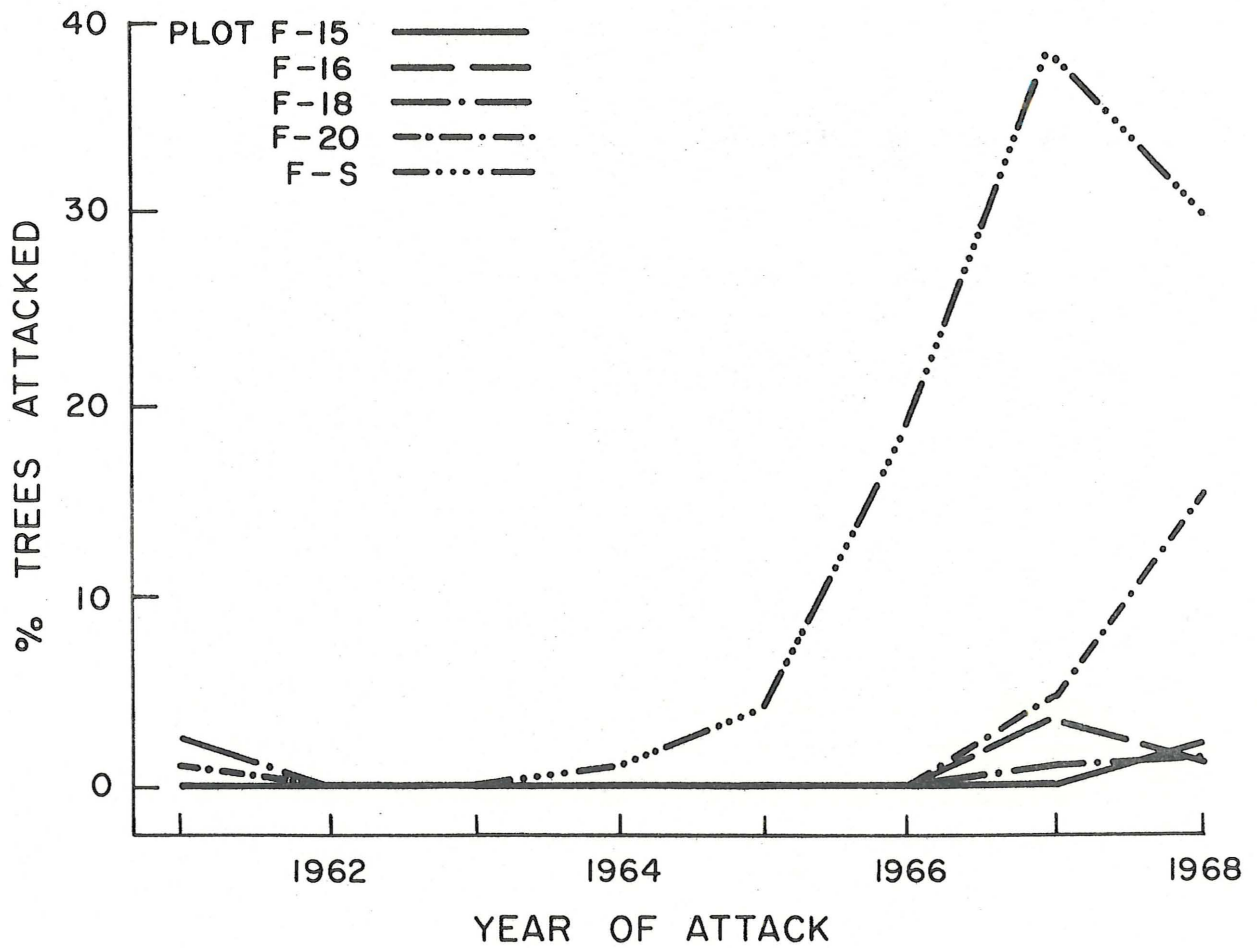


Figure 3. Per cent spruce trees attacked by spruce weevil at Green Timbers Nursery. Three of eight plots had no attack.

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