

Silvicultural Control of Damage by
Spruce Weevil *Pissodes strobi* Peck
(Coleoptera: Curculionidae) in the
Central Interior of British Columbia

Establishment Report

by

Russel D. Cozens

Prince George Forest Region
British Columbia Forest Service
British Columbia Ministry of Forests and Lands

Forest Service Internal Report PM-PG-6
February 1987

NOT FOR PUBLICATION

The contents of this report may not be
cited in whole or in part without the
written approval of the Regional Director,
Ministry of Forests and Lands, 1011 - 4th Ave.,
Prince George, B.C., V2L 3H9

TABLE OF CONTENTS

Title Page	i
Table of Contents	ii
List of Figures	iii
Abstract	1
Introduction	2
Methods	5
Discussion	10
Acknowledgement	14
References	15

LIST OF FIGURES

Figure		Page
1	General location of study plots.	6
2	Location of study plots in interior spruce plantations.	7
3	Plot design for the investigation of silvicultural control of spruce weevil.	9
4	Side view of alternate brushed strips in immature interior spruce stand showing effect of strip brushing on the interception of sunlight and its potential insolation.	11

Silvicultural Control of Damage by Spruce Weevil
Pissodes strobi Peck (Coleoptera: Curculionidae) in the
Central Interior of British Columbia

Establishment Report

Russel D. Cozens

British Columbia Forest Service, Prince George Forest Region
Prince George, British Columbia, Canada V2L 3H9

ABSTRACT

The spruce plantations of the Central Interior of British Columbia are threatened by the spruce weevil. Since the planting of alternate species is not a viable option, and the use of chemical pesticides in a large scale is unlikely, weevil control through silvicultural methods may provide the best alternative. In the long term, this study investigates the manipulation of a naturally-occurring deciduous overstory as a method of weevil control in spruce plantations. The effect of the overstory upon the dynamics of the weevil populations and the vigour of the spruce stand will be examined. This report describes the establishment phase of the control study.

INTRODUCTION

Young interior spruce (*Picea glauca x engelmannii*) trees are subject to severe damage by larval feeding of the spruce weevil, *Pissodes strobi* Peck (Coleoptera: Curculionidae) (Stevenson 1967; Furniss and Carolin 1977). This damage manifests itself as multiple or crooked stems, reduced height growth and possible mortality as a result of overtopping by competing trees - both coniferous and deciduous. However, when interior spruce is grown under a natural overstory of trembling aspen (*Populus tremuloides* Michx.) and western white birch (*Betula papyrifera* Marsh. var. *commutata*), the number of weevil attacks and their success in the production of future generations may be reduced significantly. This reduction, due to shading, has been noted in Eastern Canada and United States (Graham 1926; Sullivan 1959; Berry and Stiell 1976; Stiell and Berry 1985).

There are several possible explanations for this reduction of weevil activity in shaded spruce stands:

- 1- interference with the host selection procedure due to the large number of vertical silhouettes - few of which are spruce leaders;
- 2- limitation of the leader diameters, as a result of shading, to less than the size preferred by the attacking adult weevils;
- 3- reduction of the leader bark temperatures to levels unfavourable for host selection, mating and oviposition; and,
- 4- reduction of the heat accumulation to levels below the threshold for brood development.

These factors may act individually or together to limit the success of spruce

weevil attacks in young spruce trees growing under a deciduous overstory.

Forest managers have been concerned with the silvicultural control of white pine weevil (= spruce weevil) damage to eastern white pine (*Pinus strobus* L.) through silvicultural methods for at least 60 years. Peirson (1922) discussed the planting of a deciduous species several years prior to the establishment of the desired white pine plantation, but dismissed this as impractical. Both Graham (1926) and MacAloney (1932) recommended mixed species plantations and manipulation of the deciduous overstory as a means toward controlling white pine weevil damage. More recently, the control of insolation by the cutting and planting of strips in a mature forest has been somewhat successful in limiting attacks upon eastern white pine (Berry and Stiell 1976; Stiell and Berry 1985).

Spruce weevil has been recognized as a serious pest of Sitka spruce (*Picea sitchensis* [Bong.] Carr.) plantations and, as such, has generated a great deal of concern. In many areas of coastal British Columbia, Sitka spruce is no longer planted due to its ultimate fate to the weevil (Taylor 1986). The potential for problems is not limited to the Coastal regions of the Province. Cozens (1984) indicated a total area of greater than 105 000 ha of predominately interior spruce plantations established in the Prince George Timber Supply Area to the end of 1984. Since that date, the figure has been increasing at an approximate annual rate of 25 000 ha.¹ As the leaders on

¹ Williams, W.C. Silviculture Officer, B.C. Forest Service, Prince George Forest Region, Prince George, B.C. personal communication.

individuals in the spruce plantations in the interior regions of British Columbia attain the physical dimensions to make them attractive to attacking adults, they too are seriously threatened. Since, in the majority of these areas, interior spruce is the only species which can be planted, effective control of the weevil to limit its damage is of paramount importance.

In 1980, McLean¹ established trials in the University of British Columbia Research Forest to investigate weevil activity in Sitka spruce grown under a red alder (*Alnus rubra* Bong.) canopy. Recent observations (unpublished) have shown that weevil attacks and subsequent brood production have been significantly reduced on the spruce trees growing in the shade of the red alder. Since establishment, 12 of 200 planted Sitka spruce trees have been attacked under the alder canopy (some were on the interface between the two treatments) whereas 48 of 200 planted trees in the open-growing area were attacked. Brood production also has been reduced in trees growing under the alder canopy: 2-5 adults emerged from the infested shaded leaders; 25-30 adults emerged from those infested leaders receiving full insolation.

Chemical and biological control methods have little chance of success in the near future. The limited availability of the adults for control by conventional insecticides, the longevity of the adults, the shroud of controversy over the environmental acceptability of chemical control and the question of the practicality of biological control methods all cloud the issue

¹ McLean, J.A. Professor, Faculty of Forestry, The University of British Columbia, Vancouver, B.C. personal communication.

of direct control (Cozens 1983). Therefore, silvicultural methods may provide the best avenue for effective control.

Brushing and weeding activities within spruce plantations currently are conducted with the goal of removing all vegetation which is competing with or overtopping the potential crop trees. In the Prince George Forest Region, this involves the cutting of trembling aspen, western white birch, cottonwood and the tall shrubs Sitka alder (*Alnus viridus* ssp. *sinuata*), mountain alder (*Alnus incana* ssp. *tenuifolia*) and willow (*Salix* spp.). While these activities may enhance the growth of spruce trees, some doubt exists as to whether or not the anticipated growth gains may be more than countered by the losses due to increased spruce weevil activity. Since interior spruce is reasonably shade tolerant, it may be possible to limit the attacks by weevils, and their resultant brood production, yet maintain acceptable tree growth by the management of an existing or modified deciduous overstory.

The purpose of this study is to examine the feasibility of spruce weevil control in the Central Interior of British Columbia through the maintenance and manipulation of such a natural deciduous overstory.

METHODS

A typical spruce plantation, located approximately 50 kilometres east of Prince George (Fig. 1 & 2), was chosen as the area in which to establish this trial. The area had been clearcut in 1969, site prepared with a broadcast

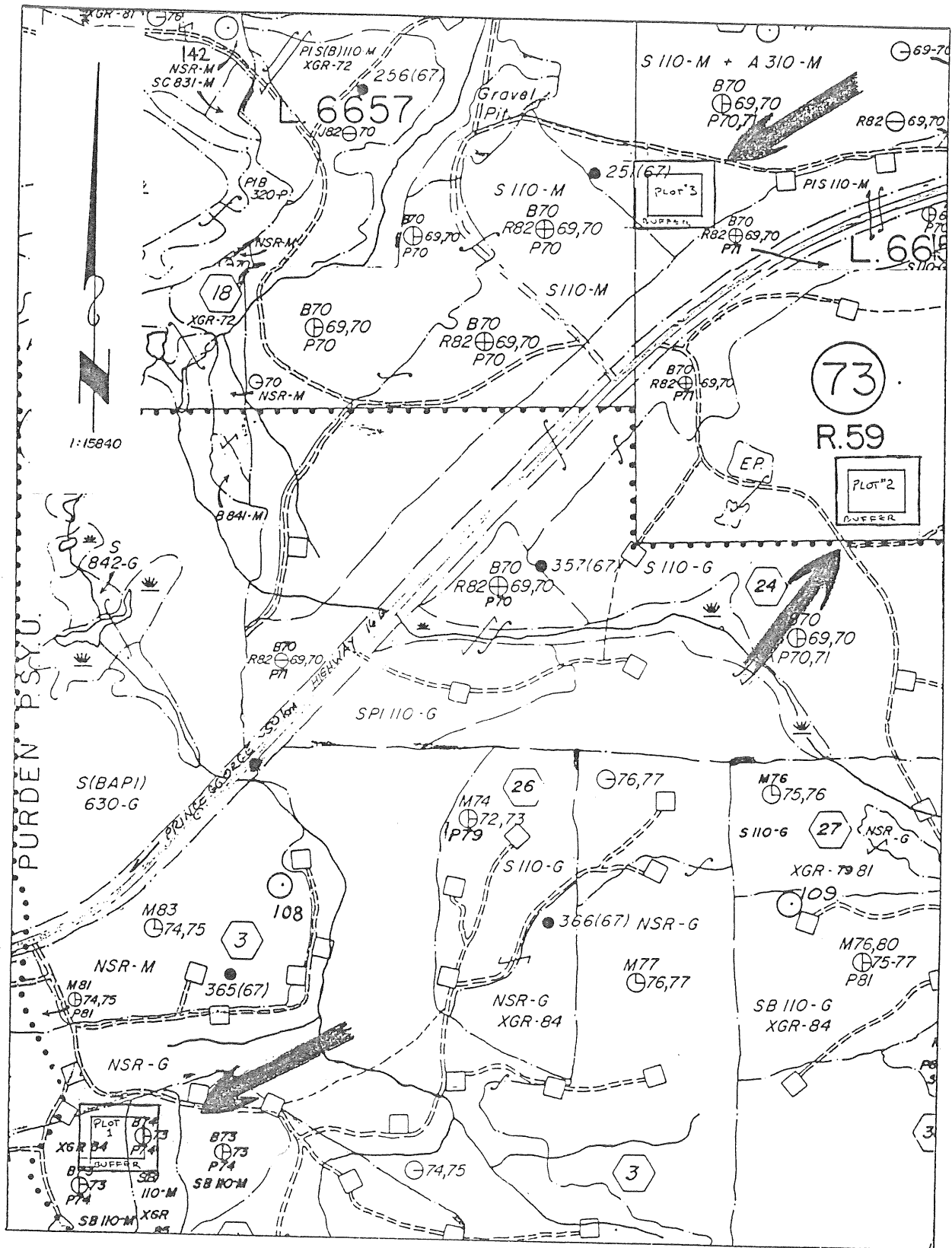


Figure 2- Location of study plots in interior spruce plantations.

burn in 1970 and planted in 1971 with 2+1 bareroot interior spruce seedlings. A survey of this area in 1983 (Cozens 1984) indicated that an active spruce weevil population was present. Subsequent subjective inspections confirmed that population pressures would come to bear upon the plots.

Three replications of each plot were established in the area. Each plot (Fig. 3) was designed to investigate weevil activity in:

- 1- a 'normal' undisturbed plantation, with a representative, relatively continuous deciduous overstory;
- 2- a totally treated (brushed) plantation, with no overstory; and,
- 3- a plantation consisting of alternate treated and natural strips in an east-west orientation such that the crop trees in brushed strips are in the shade created by the natural (unbrushed) strips.

Brushed and unbrushed strips were oriented in an east-west direction to provide maximum shading to the brushed spruce trees when the sun angle is at its maximum. A maximum angle of 58.5° was calculated to occur at noon on 21 June at the study site (Anon. 1965). The sun angle one hour before and after the noontime maximum was determined to be 55° ; this angle was used in the strip width calculations.

Analysis of the Site Index Curves (Hegyi et al. 1979) for 16-year old aspen, western white birch and interior spruce on medium sites indicated a spruce height (mid-range) of 4.2 metres (m) and a deciduous component height (mid-range) of 10.8 m. Site inspections showed the deciduous cover to be relatively close to the 10.8 m prediction, but the spruce was closer to an

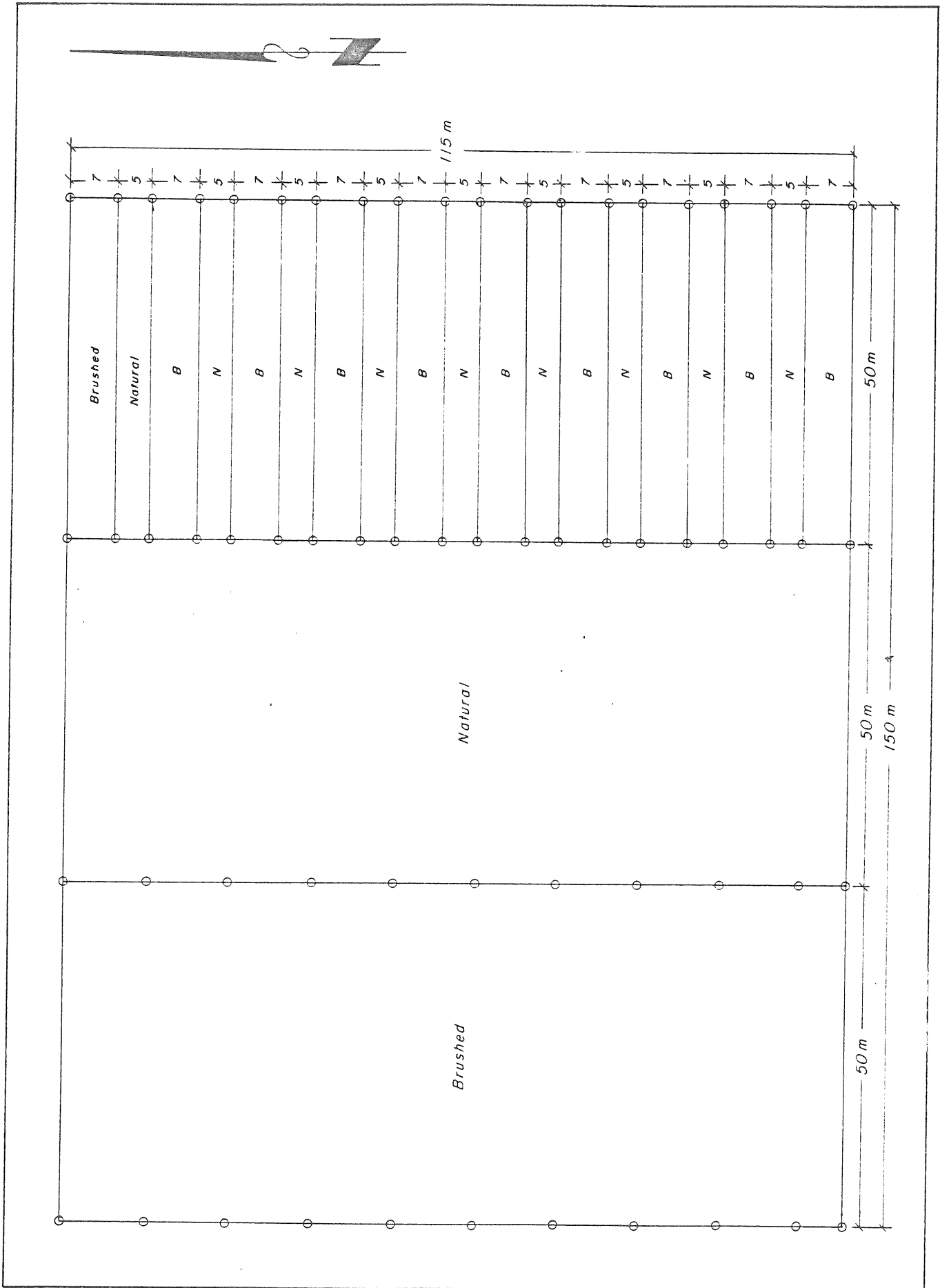


Figure 3- Plot design for the investigation of silvicultural control of spruce weevil.

average height of three metres. Thus, a deciduous height of 10.8 m and a spruce height of three metres, in conjunction with a sun angle of 55° , resulted in a strip spacing regime of five metres unbrushed and seven metres brushed (Fig. 4).

Plot layout and initial brushing took place in November of 1985. Further brushing will be conducted as required to ensure that no deciduous species will be a shading factor within the brushed areas. Chemical brushing was dismissed in favour of mechanical (hand) methods to maintain the experimental area chemical-free and thereby remove one possible variable from the analysis. A stem map of the replicates was completed in April 1986, and all spruce trees were permanently identified with numbered metal tags. The past occurrence of weevil attacks was recorded to provide the history of weevil activity within the stand and to develop an approximation of population pressures upon the stand. Also, total height and 1985 leader growth was measured and recorded for each tree.

DISCUSSION

The control of spruce weevil by manipulation of a deciduous overstory will only be considered a practical solution to the potential problem if additional work is minimized. In the study area, which is typical of the conditions in the Central Interior of the Province of British Columbia, it is anticipated that spruce will grow well under a naturally established aspen and birch overstory. Since the crowns of these species are less dense than those of red alder, there should not be a need to thin the overstory to permit sunlight to

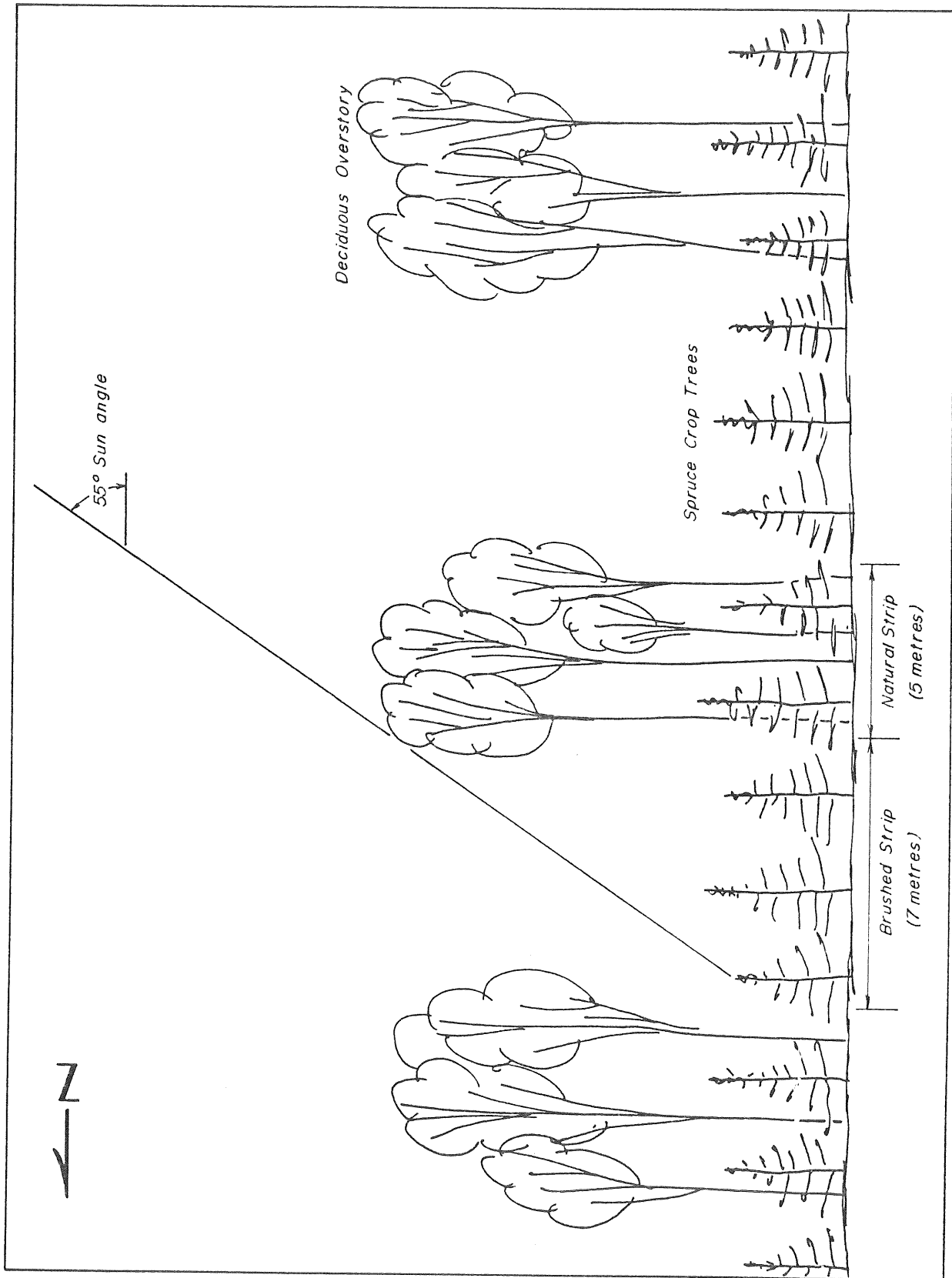


Figure 4- Side view of alternate brushed strips in immature interior spruce stand showing effect of strip brushing on the interception of sunlight and its potential insolation.

reach the spruce crop trees. The alternating brushed and natural strips are proposed as a method of limiting weevil attacks while allowing maximum sunlight to reach the spruce trees. With this spacing it is anticipated that weevil activity will be limited by the reduced insolation; however, filtered sunlight will be adequate to achieve optimum spruce growth. Such an approach may be necessary in areas of very heavy brush or deciduous cover.

Annual measurements, to be taken after October of each year are, for each tree:

- 1- total tree height,
- 2- current years' leader growth,
- 3- weevil status (Y/N),

and, on weevilled trees only:

- 4- number of weevil exit holes (as safely can be measured), and,
- 5- height of branch whorl below weevil attack(s).

These data will be analyzed to provide rates of weevilling in the different treatments (brushed, unbrushed, brushed with side shade, strip brushed).

Successful brood production can be equated to the number of exit holes and then related to the treatments. This information will be stored on computer and referenced to a digitized stand map for each of the three plots.

Within each replicate, the following information will be recorded hourly, by way of electronic datalogging equipment, between 1 May and 15 October.

- duff temperature, on north side, adjacent to the base of a spruce tree in:
 - unbrushed - average growth situation
 - brushed - average growth situation

REFERENCES

- Anonymous. 1965. *Finding the sun's true bearing*. Civil Aviation Branch, Department of Transport. Ottawa. 112p.
- Berry, A.B. and W.M. Stiell. 1976. Control of white pine weevil damage through manipulation of stand climate: preliminary results. Can. Dep. Environ. Can. For. Serv. Petawawa Forest Expt. Stn. Inf. Rep. PS-S-61. 8p.
- Cozens, R.D. 1983. The spruce weevil, *Pissodes strobi* Peck (Coleoptera: Curculionidae) A review of its biology, damage and control techniques with reference to the Prince George Timber Supply. British Columbia Ministry of Forests. Forest Service Internal Report PM-PG-3. 71 p.
- Cozens, R.D. 1984. Insect and disease risk factors in established interior spruce plantations. The University of British Columbia. M.F. Thesis. 78p.
- Furniss, R.L. and V.M. Carolin. 1977. *Western Forest Insects*. U.S.D.A. Forest Service Misc. Publ. 1339. 651p.
- Graham, S.A. 1926. Biology and control of the white-pine weevil, *Pissodes strobi* Peck. Cornell University Agricultural Experiment Station. Ithica, New York 32 p.
- Hegyi, F., J. Jelinek and D.B. Carpenter. 1979. Site index equations and curves for the major tree species in British Columbia. Inventory Branch. Ministry of Forests. Province of British Columbia. Forest Inventory Report No. 1. 53 p.
- MacAloney, H.J. 1932. The white-pine weevil. United States Department of Agriculture. Circular No. 221. 30p.
- McMullen, L.H. 1976. Spruce weevil damage - ecological basis and hazard rating for Vancouver Island. Environment Canada. Forestry Service. Pacific Forestr Research Centre. Information Report BC-X-141. 7p.
- Peirson, H.B. 1922. Control of the white-pine weevil by forest management. Harvard Forest Bulletin No. 5. Harvard Forest, Petersham, Mass. 42p.
- Stevenson, R.E. 1967. Notes on the biology of Engelmann spruce weevil *Pissodes engelmanni* (Curculionidae: Coleoptera) and its parasites and predators. Can. Ent. 99:201-13.

- Stiell, W.M. and A.B. Berry. 1985. Limiting white pine weevil attacks by side shade. For. Chron. 61:1(5-9).
- Sullivan, C.R. 1959. The effect of light and temperature on the behaviour of adults of the white pine weevil, *Pissodes strobi* Peck. Can. Ent 91:213-232.
- Taylor, S.P. 1986. Forest insect and disease impacts in timber supply areas. British Columbia Ministry of Forests. Protection Branch. Victoria, B.C. Pest Management Report No. 6. 254 p.