Research Forest

Alternative establishment prescription for control of spruce weevil damage: Year 8 growth and performance

Research Project # 93-03

March, 2000

Quick Sheet #16

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Introduction

This report summarises 8-year old interior spruce tree growth and performance in a project designed to test the effectiveness of a mixed species clump planting prescription in reducing white pine weevil attack and damage to young plantations. The growth and performance of interior spruce planted in clumps with lodgepole pine is compared to a regular prescription of evenly mixed and uniformly spaced spruce and pine. This project was established in 1993 on two blocks in the ICHmk3 05 site series, on the Gavin Lake block of the Research Forest.

Background on the project can be found in Quicksheet # 2[1], which details the planting prescription and rationale. Quicksheet #7[2] provides a summary of the management history of the sites, and tree growth and performance in each planting regime, five years after the establishment of this project.

The focus of this analysis is the growth response of spruce. The overall condition of pine is summarised.

[1] Day, K. 1995. Control of spruce weevil damage by introduction of alternate commercial species. Quick Sheet #2. UBC/Alex Fraser Research Forest. Unpublished.

[2] Hayward, J. and C. Trethewey. 1999. Alternative establishment prescription for control of spruce weevil damage: Five year growth and performance. Quick Sheet #7. UBC/Alex Fraser Research Forest. Unpublished.

Methods

Site Preparation

Both sites are inherited backlog blocks from early 1970's logging. In 1991 they were found NSR and dominated by willow, alder and cottonwood. Aggressive site preparation was prescribed in 1992 in an effort to restore these sites to conifer production. A brush blade and crawler tractor was used to remove and pile all vegetation on the blocks. This resulted in removing most of the humus and some soil compaction.

Planting and Stand Tending Prescriptions

The blocks were planted in 1993 and manually brushed in 1997. Two stand establishment prescriptions were implemented on each block:

Regular spacing

An even mixture of interior spruce and lodgepole pine were planted at 1800 stems per hectare and a 2.5 meter target inter-tree distance. All competing vegetation was brushed throughout the treatment area.

Clumped spacing

Seven-tree clumps were planted at 300 clumps per hectare and 2100 stems per hectare. Each clump consisted of 4 lodgepole pine and 3 interior spruce. The pine were mostly planted on the south side of the clumps to provide shade to the spruce. Clumps were spaced 5.7 meters apart and the target within-clump inter-tree distance was 1.0 meter. Manual brushing was prescribed only within the clumps and deciduous tree and brush species were retained between clumps.

Field Measurements

One hundred spruce sample trees were systematically chosen on random transects

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throughout each treatment unit on each block. Measurements of spruce growth (basal diameter and height), health, and weevil attack status are being monitored over time.

Data Analysis

An ANOVA (α=0.05) was used to test for significant differences in growth between treatment regimes.

Assumptions:

- The regularly spaced trees were growing independently of each other in this early stage in plantation development.
- In the clump-planted treatment, individual clumps grew independently of each other but trees within each clump were not growing independently, due to the very close spacing.
- growing conditions are comparable in the clumped and regularly planted unit areas.

In order to deal with within-clump dependence, the average height and diameter in each clump was used in the analysis.

Results

Condition

Spruce

There are no notable trends in the survival and condition of the trees by treatment. There was slightly higher mortality and poorer condition in the trees on block 361 compared to block 358.

Figure 1 shows the average condition of the spruce planted in both treatments on both blocks.

On average, there was 79% survival of the spruce. The main forest health problems were, chlorosis, poor vigour and mortality due to flooding, and stem defects that included crooks and multiple leaders.

There was no spruce weevil attack on any of the trees in the study at year 8.

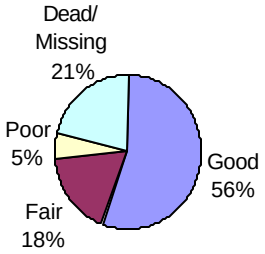

Figure 1- Average interior spruce condition at year 8.

Pine

There was a high incidence of stem defects in the pine. In year 8, 48% of the surveyed live stems had defects that included crooks, leans, bends, and breakage. Some of the most severe damage resulted from several freeze and thaw events in year 6 that caused breaks and severe bends to 17% of the stems from heavy snow and ice. A probable cause of many of the leaning stems is poor stability due to shallow rooting in very dense and wet soils. Five percent of the pine were infected with western gall rust.

Height

The pine had overtopped the spruce by year 3. At year 8, the pine was approximately twice the height of the spruce and is providing side shade and screening as intended.

The mean height of the spruce was significantly greater in the clump planting treatment ($p=0.039$) by 9cm and 12 cm in block 358 and 361 respectively (Figure 2). Total height on block 358 was significantly greater than that on block 361 ($p<0.0001$).

Diameter

Figure 3 shows a trend towards greater mean basal diameter in the clump planted trees, compared to the regularly planted trees. The diameters of the clump planted trees are greater than the regularly planted trees by 0.2 cm and 0.6 cm on block 358 and 361, respectively. There is some evidence that this

is due to a clump planting treatment effect (p=0.050). As with height, there is a highly significant block effect. Mean basal diameter is greater on block 358 (p<0.0001).

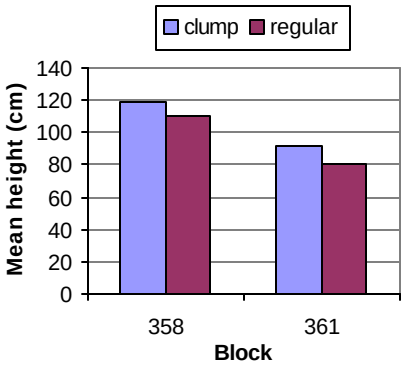

Figure 2 - Mean height of interior spruce at year 8, by treatment and block.

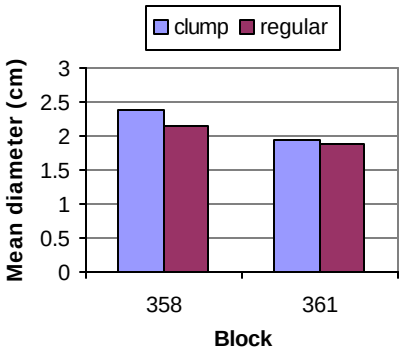

Figure 3 - Mean basal diameter of interior spruce at year 8, by treatment and block.

Discussion

The greater growth and survival on block 358 is likely due to a lower level of flooding there than on block 361, early in the growing season. Block 358 is gently sloping whereas block 361 is level and retains more water for a longer period in the spring.

The spruce trees in this trial have been monitored at two-year intervals for growth and condition since establishment in 1993. The trend of greater height and diameter in the clump planted trees was not present at establishment and was first observed in year 5. This effect has persisted and become more significant over time.

The greater height and diameter growth in the clump planted spruce was unexpected. It was anticipated that the denser vegetation in the clump planting treatment would result in reduced diameter increment but the opposite was found. At this early stage in plantation development, it appears that there is an increase in site productivity associated with the clump planting prescription. Manual brushing took place in year 5. Since the treatment effect on growth was first observed in year 5, it is unlikely that the difference in growth between treatments can be explained by differences in brushing treatments.

It is possible that the closely planted pine and spruce have created improved growing conditions (insulation and frost protection) within the clumps and/or that more rapid nutrient cycling is occurring there. It might also be possible that a beneficial belowground interaction occurs between the closely planted spruce and pine root systems.

Conclusion

Greater mean spruce basal diameter and total height were observed in the clump planting treatment compared to the regularly spaced treatment at year 8. This treatment effect is statistically and biologically significant for height and marginally so for diameter. These results were unexpected and raise questions about the cause(s) of higher spruce productivity within closely planted clumps.

We will continue to monitor this trial, over time, for differences in growth and yield and forest health between the clump and regularly spaced planting prescriptions.

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