Research Forest

Potential causes of basal forking in young lodgepole pine plantations – Establishment Report

Research Project # 96-06

Quick Sheet #11

March, 99

Introduction

In recent years, many silviculturists and tree nursery staff have noticed that higher proportions of out-planted lodgepole pine (*Pinus contorta)* seedling stock have developed forks at the root collar (basal forking). On the Research Forest, we have found that up to 22% of trees in early 1990's pine plantations have basally forked stems. This type of forking results in two equally competing stems growing from the same root system. From a distance, it appears as if two trees were planted in the same hole. This stem deformity, and lack of single terminal dominance, is persisting up to eight years after planting. It is unclear what causes basal forking and when it is first expressed, since this is a problem has been noticed in retrospect. There is concern that the growth loss and poor form of trees with this stem defect will disqualify them as free growing trees.

The purpose of this project is to study possible factors that may be related to the onset of basal forking in lodgepole pine plantations by closely tracking seedling stem form before and after outplanting. We will test for relationships between basal forking and nursery treatments, planting depth and simulated mechanical damages to seedlings by animals and planting.

This report provides baseline information about seedling stem form in each treatment unit, at establishment and after one growing season. Initial observations about the incidence of forking in one year old outplanted pine are summarised.

Study sites/Methods

This project was established on the Gavin Lake Block of the Research Forest, on a very moist site in the ICH mk3 biogeoclimatic subzone. The site was prepared with a Hytest Tiller to break up a grass mat and create mounds with drier and warmer plantable spots. The site was planted in spring 1998 with lodgepole pine 1-0 415B container grown stock.

The research design is a completely randomised split-plot, replicated twice. Two types of treatments were applied to the planting stock: 1) nursery treatments and 2) handling/damage sub-treatments. The treatments and rationale are explained below:

Nursery treatments

Blocks were planted with half copper root-pruned stock and half non-copper treated stock to test possible effects of chemical root pruning on the form of container grown nursery stock. There is some speculation that chemical root pruning may affect tissue differentiation at the root collar. The adoption of copper treated

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seedlings as the preferred type of container grown pine stock coincides with the awareness of increased forking in pine plantations.

Handling/Damage Treatments

Within the copper treated and non-copper treated blocks, five treatments were randomly applied at the time of planting:

Deep - Seedlings were planted to a depth of two finger widths above the root collar so that the laterals were partially buried. Deep planting was standard practice in the past. If lateral branches were buried at the time of planting, they might root and develop their own apical dominance. This is not common in lodgepole pine, but is possible under moist and ideal conditions.

Maim - Seedlings were scarred at the base of their stem by bending and scratching the stem to expose the cambium. This was intended to simulate mechanical damages that could occur during handling and planting. The assumption is that stem wounding might stimulate air layering and, in a moist environment, permit root formation and a competing lateral branch.

Terminal clipped - Seedlings had their terminal bud clipped off. This was intended to simulate small mammal (hare and vole) browsing and planting damage. Small mammal damage is common in young pine plantations on the Research Forest. This treatment also mimics planting and handling damage that occurs when terminal buds have started to flush and are easily knocked off. The assumption is that if terminals are removed, during the first year after planting, competing laterals may cause basal forking.

Edge - Seedlings that were located along the outside edge row of growing tables in the nursery were selected for this treatment. It was noticed that edge trees had quite different form from those grown on the interior of growing tables. Edge trees were observed to be shorter, with deeper purple and yellow pigmentation, better developed outside laterals, and larger root collar diameter. In general they appeared less balanced, with reduced inside laterals and very well developed outside laterals that grow out at 90 degrees and then turn up, perhaps into competing leaders.

Control - No treatment.

Monitoring

Seedlings were assessed for condition and overall vigour, damage, growth form, and height and diameter, two weeks after planting and at the end of the first growing season. This report will focus on stem form, which was assessed using the following categories:

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- leader dominant
- basal fork – dominant shoot
- basal fork – no dominant shoot
- fork above base – dominant shoot
- fork above base – no dominant shoot
- other (crook, bend, leaning, etc.)

Stem form, particularly in pine, is not well defined in the first growing season after planting, since there has often not been enough time for terminal dominance to be established among competing shoots. It is important to clarify our definition of 'forking' in this early stage of growth -- stems were assessed as 'forked' if there was no clearly single terminal shoot (e.g. leader absent/competing laterals present or a leader present/single competing lateral).

Forked seedlings were further assessed to see if there was a dominant (taller) competing shoot that would likely become a leader in the next growing season. Dominant competing lateral branches were not assessed as 'leaders' since it will take at least another growing season for us to be sure that they will become main terminal shoots. We are interested in tracking stem form over time to see how long it takes for a single leader to be established and if any of the above initial growth forms are linked to persistent basal forking.

Results and Discussion

Condition

Sixty-five percent of the seedlings were in good condition and 29% were in fair condition after planting. By the end of the first growing season, the proportion of seedlings with good vigour had dropped to 44% and more than 50% of the seedlings were assessed as fair or poor. The decline in seedling condition was due to chlorosis (30%), vole and hare browsing (8%), and vegetation competition and trampling (3%). There was 2% mortality in the first year.

Fourteen percent of the total sample was culled for the purpose of data analysis. Seedlings with wildlife browse were culled, since the damage closely simulated the 'terminal clipped' treatment, which confounded the sampling design. Trampled and dead seedlings were also culled.

Stem Form

The number of seedlings with basal forks, regardless of treatment, increased from 6% to 13% in the time between planting and the end of the first growing season (Figure 1). We did not observe any trends in the occurrence of basal forking in the pine seedlings due to copper root pruning treatment. Both copper-treated and non copper-treated seedlings had a similar frequency of basal forking in year 0 and year 1 (Table 1).

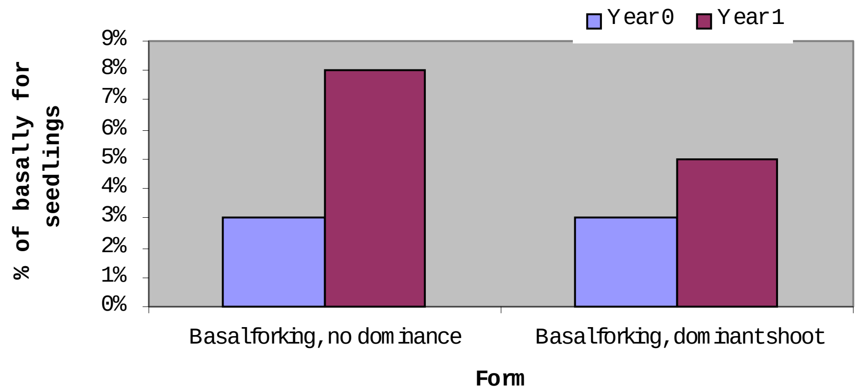

Figure 1) **Percentage of lodgepole pine seedlings with a basal forking at time of planting and after one growing season.**

Table 1. **Basal forking incidence in lodgepole pine grown with and without copper-treatment.**

	Treatment	n	Basal forking, No dominance	Basal forking, Dominant shoot	Total
YEAR 0	Copper-Treated	224	2%	1%	3%
	Non-Copper	258	1%	2%	3%
YEAR 1	Copper-Treated	224	4%	3%	7%
	Non-Copper	258	4%	2%	6%

As there were no observed differences between seedlings grown with and without copper-treatment, the samples were pooled for reporting on basal forking for each damage/handling treatment.

The incidence of basal forking increased in all treatments, and the control, during the first growing season after planting (Figure 2).

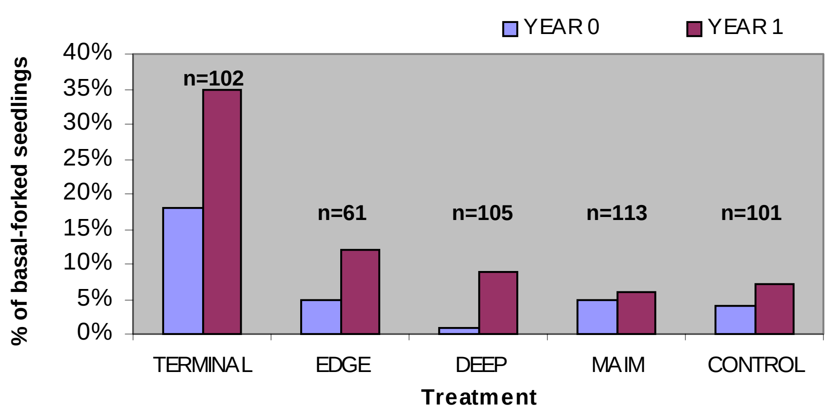

Figure 2) **Percent incidence of basal forking in lodgepole pine, by treatment, after one growing season.**

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It should be noted that the effect of the 'terminal clipped' treatment on stem form is expressed sooner than that on other treatments, since it causes an immediate forked form if the lateral branches are taller than the clipped apical shoot. This is shown by the higher incidence of forking in these treatment trees at year 0. After one growing season, the highest incidence of basal-forking (35%) was still found in seedlings that had their terminal leaders clipped. Only half of those seedlings that were forked had a dominant competing lateral branch.

Basal forking increased in 'edge' seedlings from 5% at establishment, to 12% at the end of year 1. The majority of forked stems in the 'edge' treatment had a dominant competing lateral branch.

The 'deep', 'maim', and 'control' seedlings had less than a 10% incidence of basal forking by the end of the first year.

There was no significant incidence of forking above the root collar in any treatment, as would be expected at this early stage in seedling establishment.

The stem form results so far presented are from the sample that had all animal-browsed seedlings removed. Of those seedlings that were browsed by hare or vole, 14% had basal forks and half of those had a growing shoot that was starting to exhibit dominance.

Conclusion

Thirteen percent of the seedlings demonstrated some form of basal forking after one year. The incidence of basal forking increased throughout the first growing season. We found no relationship between forking and copper treating, one year after planting. The 'terminal clipped' treatment emulates leader browsing by wildlife and, not surprisingly, had the greatest tendency to lead to basal forking in the first year. We will continue to track how long the higher incidence of forking in this treatment persists.

Damage from hare and vole browse was high, and although this study was not designed to examine such browse directly, it will be of interest to track the form of seedlings with this type of damage. High small mammal populations and incidence of related damage to newly planted seedlings might turn out to be a factor causing basal forking in pine.

We will continue to monitor and test for relationships between these treatments and the incidence and persistence of basal forking, in this trial and in other plantations on the Research Forest. Future studies will quantify the impact of this problem on pine plantation growth and yield and stocking.

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