Converting Multistoried Brush-fields to Coniferous Plantations: Effects of Treatments on Soil Nutrients – Project No. 2.06

INTRODUCTION

A study was initiated in 1986 in the Kalum Forest District of the Prince Rupert Forest Region to compare the effectiveness of various treatments for converting alder stands growing on coastal alluvial sites to conifer plantations. One of the objectives of the study was to assess the impact of the treatments on soil chemical properties. The results reported here reflect changes in soil nutrient concentrations one year following treatments.

METHODS

The study uses a completely randomized design with three replications of nine conversion treatments, plus control. Study plots are 0.5 ha in size except those with prescribed burning – they are 1 ha in size. At the time of the most recent soil sampling, three of the treatments had not been completed. Consequently, results of only seven (six plus control) treatments are reported here:

1. control
2. blading (blade)
3. blading followed by seeding with grasses and clover (blade/seed)
4. broadcast burn (burn)
5. girdling of alder (girdle)
6. spraying of understory followed by blading (spray/blade)
7. hack and squirt treatment of alder followed by spraying of the understory.

Soils were sampled before treatment and one year after treatment and analysed for concentrations of total and mineralizable nitrogen, total sulfur, available phosphorus, extractable potassium, calcium, magnesium, and pH.

RESULTS AND DISCUSSION

Percent changes in contents of nitrogen and extractable cations in the 0-15 cm soil layer are shown in Figures 1 and 2 respectively, comparing controls to alder treatments (average of girdle and hsq/spray), broadcast burn, and blading treatments (average of blade, blade/seed, and spray/blade).

Treatments involving blading resulted in substantial reductions in soil nutrient content, particularly in the 0-15 cm layer. Since soil organic matter and nutrients are most concentrated near the soil surface, and blading displaced or removed 10-15 cm of soil, this result was anticipated.

Differences in responses to blade, spray/blade, and blade/seed treatments were generally small and not statistically significant. However, this may change over time if a significant component of clover persists in the blade/seed treatment and actively fixes nitrogen.
Pre-treatment levels of total and mineralizable nitrogen decreased following blading by up to 49% in the 0-15 cm soil layer. Levels of available phosphorus and potassium declined by greater than 50%, while reductions in extractable calcium and magnesium ranged from 15 to 29%.

Broadcast burning also resulted in significant losses of nitrogen and other nutrients from the soil, however decreases were generally not as severe as those associated with blading. Total and mineralizable nitrogen, sulfur, potassium, calcium, and magnesium declined in the 0-15 cm soil layer by 20 to 25% on average.

In addition to soil nutrient losses, nutrients were also removed in vegetation from bladed and broadcast burned plots. Feller and Blackwell (1989) estimated the nutrient content of vegetation on six study plots before and after broadcast burning. They estimated that 295 kg/ha of nitrogen (5% of the total site nitrogen) was lost on average from vegetation as a result of burning. Since blading resulted in close to 100% removal of above-ground biomass, losses of vegetation nitrogen from bladed plots averaged over 500 kg/ha, or approximately 9% of the total site nitrogen.

Changes in soil nutrient levels following girdling and hack and squirt/spray treatments were generally similar to those observed in controls, with the exception of potassium. Leaching and migration of nutrients associated with heavy rainfall and groundwater movement are a common feature in these floodplain soils, resulting in periodic fluctuations in the levels of soil nutrients, unrelated to silvicultural activities. There were, however, significant decreases in soil potassium averaging 25% following these treatments.

CONCLUSION

From the point of view of nutrient conservation, treatments involving blading are least desirable. These are highly productive ecosystems, and probably relatively resilient with respect to disturbances causing minor nutrient losses. However, the magnitude of soil organic matter and nutrient losses associated with blading is potentially seriously degrading. Not only is the nutrient content of the soil reduced, but also the ability of the soil to store nutrients.

Since soil nutrient levels are likely to continue to change overtime in response to the treatments, soils will be resampled in 1992, five years after treatment.

REFERENCES


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