Research Forest

Slow Release Time-of-Planting Fertiliser for Restoration of Degraded Sites – 3 Year Results

Research Project # 94-11

Quick Sheet #9

March, 99

Introduction

This trial was established to test the effects of RTI BIO PAK, bio-enriched 16-16-8 (NPK) time-of-planting fertiliser, on lodgepole pine seedling growth in the restoration of degraded sites on the Gavin Lake Block of the Alex Fraser Research Forest. Reforestation Technologies International (RTI) supplied fertiliser packets (teabags) which are developed for reforesting harsh, moisture and nutrient deficient sites such as old roads and landings. BIO PAK fertiliser packets contain polymer coated granules designed to release nutrients only when soil is moist and warm, and therefore reduce nutrient loss from leaching when growing conditions are less optimal. Reforestation of harsh sites may be improved through time-of-planting fertilisation that effectively distributes nutrients to the plant during initial growing seasons. Both short and long-term effects of this method of fertilisation are of interest in this study. This report summarises results during the first three growing seasons after fertilisation.

Site History/Methods

The trial was established on road and landing areas within opening 93A041-314 that was created by trespass logging operations in 1992. The sites were left with a severely compacted and degraded soil structure and nutrient capital. Restoration efforts included re-contouring and shallow ripping, to a depth of 25 cm, with an excavator rake in summer 1995. The area was spring planted in 1996 with 1+0 PCT 415D lodgepole pine stock at a density of 1600 stems per hectare. The predominant soils on these sites are fine textured silt loam Eutric Brunisols. Critical site factors include a shallow rooting depth, drought, and grass competition. Replicates were established on two landings and one roadbed:

Replicate 1: SBSdw1 01 – mesic relatively flat landing

Replicate 2: SBS dw1 01 – mesic relatively flat landing

Replicate 3: SBS dw1 01 – mesic colder north facing sloping road

120 control and 120 treatment sample seedlings were established on transects throughout each replicate site. Of those, 20 control and 20 treatment seedlings were randomly selected for destructive excavation, over time, to assess root growth and breakdown of the fertiliser granules.

Sample seedlings were assessed for condition and growth at establishment and annually for the first three growing seasons.

Results

Condition

Ninety-five percent of the total seedlings were in good condition after the first growing season. There was no noticeable difference in vigour between replicates.

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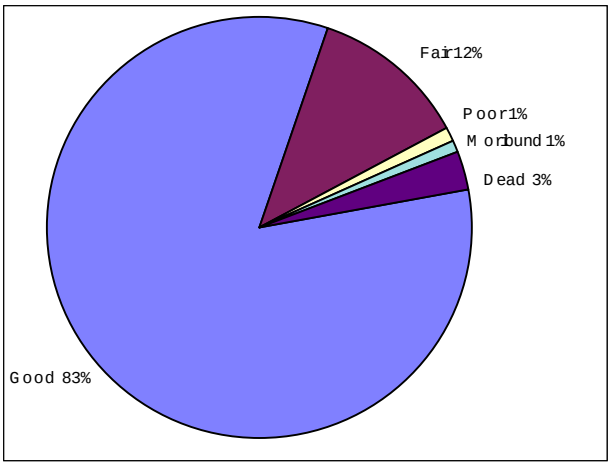

Figure 1) Overall seedling condition after two growing seasons. N=690

Seedling condition was still good after two growing seasons (Figure 1), however there was some damage to seedlings as a result of wildlife browsing and cattle trampling. This damage affected less than 5% of the seedlings on all replicates, and was more concentrated on replicate 3.

In year 3 there was considerable animal damage on replicate 3 which led to higher mortality and significantly lower overall vigour than found in replicate 1 and 2 (Figure 2).

The majority of damage was noted as stem scarring caused by cattle and small mammals, particularly vole. After the third growing season, 17% of the seedlings on replicate 2, and 30% of the seedlings on replicate 3, were noted as damaged and unsuitable as samples for monitoring fertiliser effect. Replicate 1 was unscathed by these damaging agents and maintained the best overall seedling vigour.

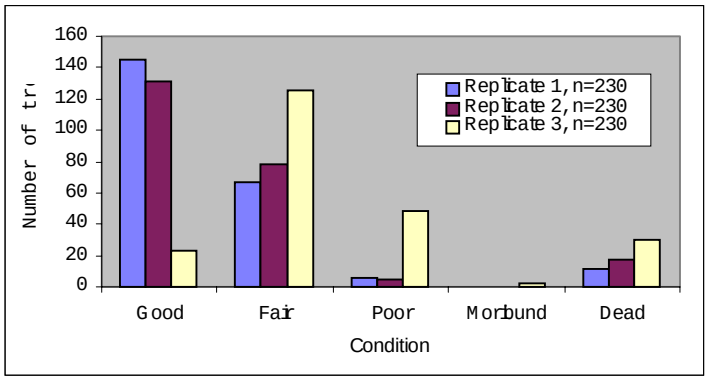

Figure 2) Seedling condition by replicate after three growing seasons. N=690

Seedlings that were not damaged by cattle or wildlife were analysed to see if fertilising affected survival or condition. There was not a significant difference, in any year of the trial, in either survival or overall conditions between fertilised and control seedlings (at $p < 0.01$ chi-square level).

Height

Twenty-nine percent of the original sample seedlings were culled (due to damage, mortality and destructive sampling) for the purpose of analysing growth data. We found no significant difference in mean height between treated and control seedlings after the first growing season. By the end of the second growing season, fertilised seedlings were taller than non-fertilised seedlings in all replicates. This treatment effect was found to be significant in replicates 1 and 2 ($p<0.05$) (Figure 3).

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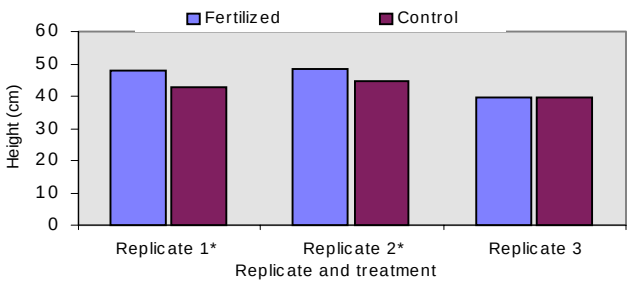

Figure 3) Year 2 mean seedling height by treatment and replicate *=sig. P<0.05

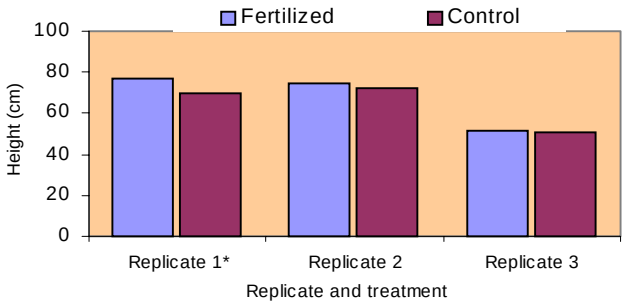

Figure 4) Year 3 mean seedling height by treatment and replicate. *=sig.

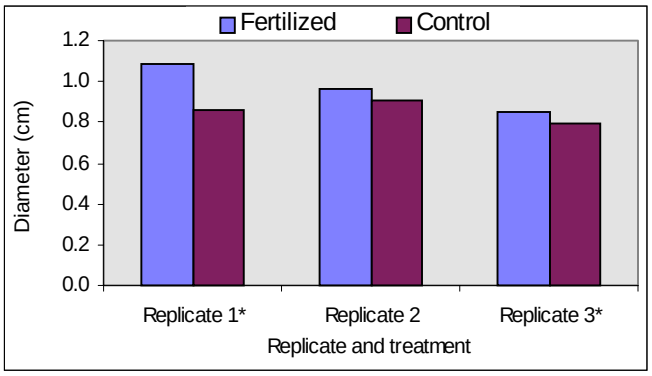

Figure 5) Mean seedling diameter, by replicate and treatment, after three growing seasons. *=sig. p<0.05

Height growth on replicates 1 and 2 was significantly better than on the cooler north-facing replicate 3 site.

Fertilized seedlings were still taller in all replicates at the end of the third growing season but the treatment response was only found to be significant in replicate 1 (Figure 4).

Diameter

At the end of the first growing season the mean diameter of fertilised seedlings was significantly greater ($p<0.05$) on replicate 1, but no other trend was established. By the second year of growth, fertilised seedlings in all replicates had significantly greater diameter increment than the untreated seedlings. This trend was still present in year 3 though not significant for replicate 2 seedlings (Figure 5).

Discussion

The better growth of fertilised seedlings demonstrates the potential advantage to applying a slow release fertiliser at the time of plantation establishment. The greater growth that was observed on fertilised seedlings in the second year continued into the third year, although this trend was not found to be significant in all replicates. While we observed significant growth increases due to fertilisation, the additional robustness of the seedlings did not

improve their overall survival. The increased seedling diameter and height of fertilised seedlings might, however, make them more likely to survive on brushy sites where snow press is a problem.

The most consistent fertiliser effect was found on replicate 1 which was least impacted by damage agents. Cattle trampling and herbivory were heavy in year 3 on replicates 2 and 3, which might have affected growth analyses despite our efforts to cull damaged seedlings from the sample.

Replicate 3 was located on a colder site, which may explain the reduced fertiliser effect found there. On all three sites, the very dry season in 1998 may have reduced fertiliser effectiveness. It is possible that drought conditions combined with colder soils hampered fertiliser release more on replicate 3 than the other two replicates. We expected the fertiliser to be released over 12 months, however in dry, cold soils it can take longer (RTI 1998). We monitored fertiliser breakdown and, at the end of year 3, observed that 60% of the polymer-coated granules that we sampled still contained some unreleased fertiliser. Fertiliser release has taken place slowly over 3 years and will continue to do so for at least another year.

A final observation of factors that may have effected the seedling growth response to fertiliser was the increased flush of competing vegetation (primarily grasses) around the base of the treated seedlings in the spring. Grass competition may have impeded net benefit to seedling growth.

Conclusion

The short-term results of this trial point to the effectiveness of BIO-PAKS fertiliser when applied at time-of-planting for seedling height and diameter growth on degraded sites. Long term monitoring of the trial will continue to evaluate seedling growth to determine how and if observed treatment effects are sustained into the future seedling crop.

Funding

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