

FIELD TRIAL OF TIME-OF-PLANTING FERTILIZERS

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EXECUTIVE SUMMARY

During the 2001 growing season Brinkman & Associates Reforestation Ltd. contracted the MOF Surrey Nursery to undertake field trials of 7 time-of-planting fertilization treatments. The treatments tested were:

- No Fertilization
- Nutripak 16 gram 25-9-9
- Spectrum Pacific "Teabag" 16 gram 25-9-9
- Agriform Tablets
- 15 ml Fish Based Fertilizer
- 30 ml Fish Based Fertilizer
- 60 ml Fish Based Fertilizer

First year results from the trial show striking differences between the treatments:

- The three treatment levels of the fish based fertilizer, and the Agriform Tablets, showed clearly positive results, with trees showing decreased signs of planting shock, increased height & calliper growth, and an extended growing season. The best results were achieved with the 30 & 60 ml fish based fertilizer treatments. All treatments showed enhanced root growth, but some root asymmetry was noted with the Agriform Tablet
- The Nutripak treated trees showed reduced planting shock, and somewhat increased growth rates for both the top and roots, as compared with the control, but also some increase in mortality.
- The trees treated with the Spectrum Pacific product showed very high levels of mortality, highly asymmetrical root growth in surviving trees, and no growth enhancement

Ongoing performance of the trees will be important in determining the optimal treatment, and the trial will be monitored through the second year.

INTRODUCTION

Time-of-planting fertilization is an important tool in the silviculture forester's toolkit, with the potential to:

- Reduce planting shock
- Increase growth of planted trees during the first and second years after planting
- Reduce establishment brushing requirements
- Speed achievement of FG status

The sum of these effects can potentially significantly reduce the costs of establishing a FG plantation. However, a number of issues have arisen around time-of-planting fertilization during the past 2 – 3 years, including:

- Potential evidence of negative effects on planter health from some products. Levels of certain heavy metals such as Cadmium were a concern.
- Application of some products appears to have resulted in increased mortality under some conditions. Contributing factors have included placement of fertilizer products in contact with tree roots, and periods of moisture deficit.
- Some of the products appear not to have provided the full growth benefits expected.
- Longevity of the fertilizer effect appears to vary from product to product.

Recognizing these concerns, Brinkman & Associates has been conducting ongoing research on a variety of fertilizer related issues. In the course of this research, a proprietary fish based product was identified which appeared to have potential as a time-of-planting fertilizer. In order to determine the efficacy of this product, Brinkman & Associates contracted with the MOF Surrey Nursery to conduct a trial of the fish based product, compared to untreated controls, and a number of other conventional products currently on the market. This report details the results of the first year of that trial.

TRIAL DESIGN

The trial was designed to take advantage of the highly uniform growing conditions available in the Surrey Nursery trial beds. The trial as designed consisted of 7 rows of 50 trees each, each row receiving one fertilization treatment. Trees planted were all from a single low elevation south coast Douglas Fir seedlot (seedlot 6513), grown as 1+0 PSB 410. The treatments were randomly assigned to the rows, and consisted of:

- No Fertilization
- Nutripak 16 gram 25-9-9
The Nutripak is a proprietary product consisting of conventional fertilizer in a plastic package with calibrated micropores which release the fertilizer over time
- Spectrum Pacific "Teabag" 16 gram 25-9-9
The Spectrum Pacific product consists of coated slow release fertilizers in a paper based teabag
- Agriform Tablets
Agriform Tablets are a proprietary fertilizer blend in a compressed tablet form.
- 15 ml Fish Based Fertilizer
- 30 ml Fish Based Fertilizer
- 60 ml Fish Based Fertilizer

Each treatment was undertaken in the same manner:

- Trees were planted at approximately 1 foot spacing.
- An 8 cm dibble hole was made 3 cm from the plug on the south side of the tree
- The fertilizer product was placed in the dibble hole, and covered.

In addition to the treatments detailed above, three additional rows of trees were planted, with the fish fertilizer in 15, 30 and 60 ml quantities placed directly in the planting hole.

At the time of planting, in late May, all trees were measured for height, percentage bud set, and condition. After planting, all treatments were watered at regular intervals.

Subsequent measurements of height, bud set, and mortality were made at monthly intervals. During the Sept 20 2001 measurement, when almost all of the trees had set bud, root collar caliper measurements were also made. Subsequently, on Oct 11 2001, 10 trees from each treatment were dug up, and root form and development evaluated.

TRIAL RESULTS

1. Survival

Of the ten treatments undertaken (the seven different fertilization regimes, plus the three treatments with fish fertilizer directly in the planting hole), four showed significant mortality:

- The 15, 30 & 60ml treatments where the fish based fertilizer was applied in the planting hole showed 100% mortality
- The Spectrum Pacific teabag showed 84% mortality.

The cause of mortality in the case of the fish based fertilizer treatments was clearly the placement of the product in the planting hole, since mortality was statistically insignificant (2.6%) when the fish based fertilizer was installed beside the planting hole, in the same manner as the other fertilizers.

The cause of mortality with the Spectrum Pacific product was not clear. When the product was excavated during mid October, it appeared that very little if any fertilizer remained in the slow release prills, possibly indicating that the fertilizer released too quickly. This possibility was supported by the fact that the remaining living trees showed extensive root mortality on the side toward the fertilizer, with root growth strongly biased away from the fertilizer pack.

One additional product, the Nutripak, showed mortality higher than the control, at about 20%. The cause of this mortality was not clear, as the living trees did not show signs of root mortality or bias away from the fertilizer product

Most of the mortality occurred in the month after planting, with occasional further mortality in the following months. No mortality occurred in the untreated control, and mortality with the Agriform tablets and with the fish based fertilizer installed beside the tree was not statistically significant

2. Foliage Condition

In the surviving trees, the untreated control trees showed significant chlorosis, typical of planting shock. A few of the trees treated with the Nutripak and the Agriform Tablet also showed chlorosis to a lesser degree, but most of the trees in these treatments showed no chlorosis or other negative effects. The trees treated with the 15, 30 & 60 ml amounts of the fish based fertilizer and the surviving trees treated with the Spectrum Pacific product showed no chlorosis or other adverse effects

3. Height Growth

Variations in total height increment over the growing season between the various products were dramatic. Chart 1 shows the relative increment between the various treatments.

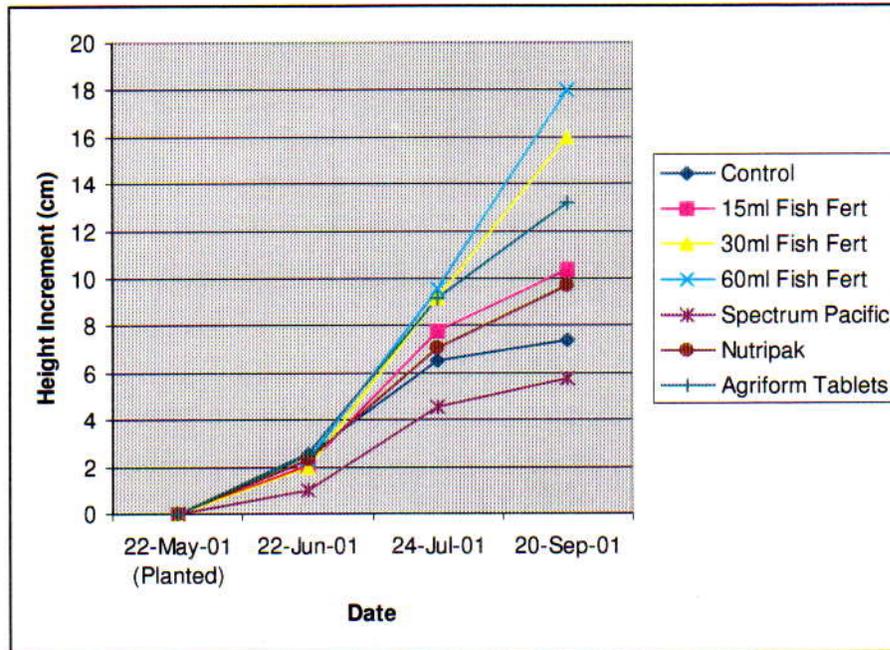


Chart 1 : Height Increment for all Treatments

The stand-out products, in terms of total height, were clearly the 30 and 60 ml doses of the fish based fertilizer, and the Agriform Tablets, with the fish based fertilizer significantly outperforming all other products. The Nutripak and 15ml dosage of the fish based fertilizer performed similarly. The very poor performance of the Spectrum Pacific product was probably associated with the loss of a significant portion of the tree roots.

Growth rates for all treatments except the Spectrum Pacific were very similar during the first month, probably reflecting a combination of normal planting shock and utilization of the remaining fertilizer stored in the plug.

The other effect noted was the extension of the maximum growth rate later into the growing season. This effect was noted for all of the fertilizer products to some degree, as compared with the control, but was particularly significant in the case of the higher doses of the fish based fertilizers. This trial took place on an irrigated site with no significant moisture deficit. It is possible that the effect would have been less pronounced on a site with significant late summer moisture deficit.

4. Calliper Growth

Trial results in terms of stem caliper followed a similar pattern to that noted for tree height, except that the Spectrum Pacific product outperformed the Control. As Chart 2 shows, the range of calipers was significant:

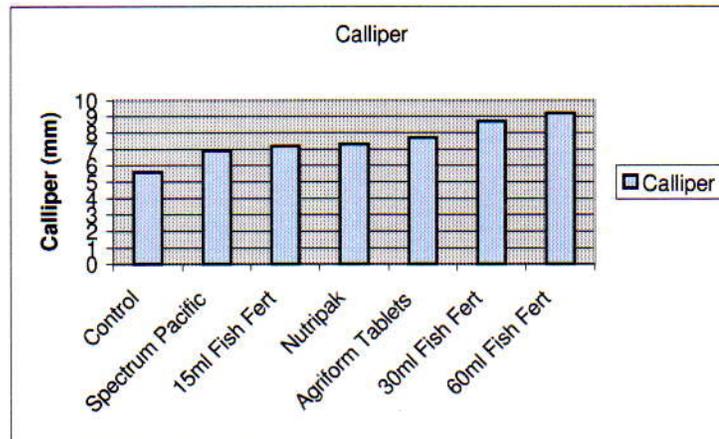


Chart 2 : Stem Root Collar Caliper by Treatment

Height to Caliper ratio was significantly less for all of the fertilization treatments as compared to the control, with the control at about 60, and the fertilized stems between 44 and 50. No significant difference was found between the various fertilizer types.

5. Bud Set

All of the fertilizer products except the Spectrum Pacific product showed significant delay in bud set as compared with the Control. This would be expected, based on the extended growing period noted for the fertilized trees.

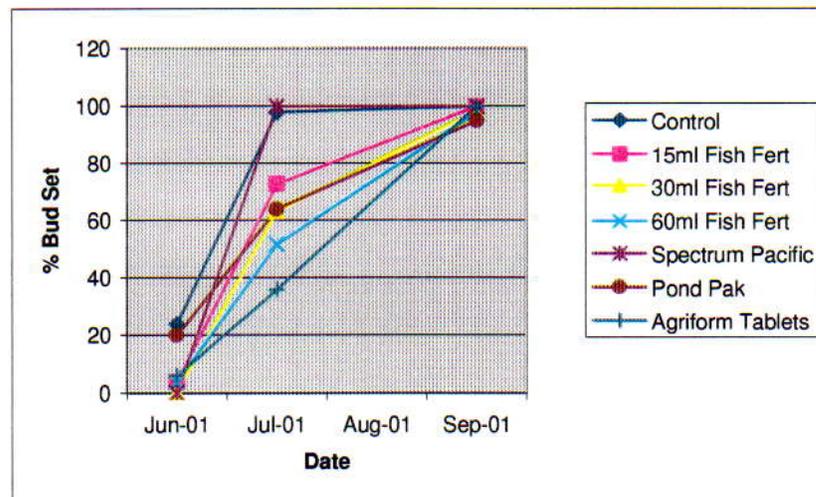


Chart 3 : % Bud Set by Treatment

In the 30 & 60 ml fish based fertilizer treatments, a second flush was noted on some of the trees after an initial bud set.

Root Form & Fertilizer Condition

The last 10 trees in each treatment (#41-50) were dug up on Oct 12 2001. All excavated trees were assessed for root form, and for the condition of the remaining fertilizer product, where evident.

- The untreated control trees showed symmetrical root release, with some bias toward root growth from the bottom of the plug. Root volumes were moderate

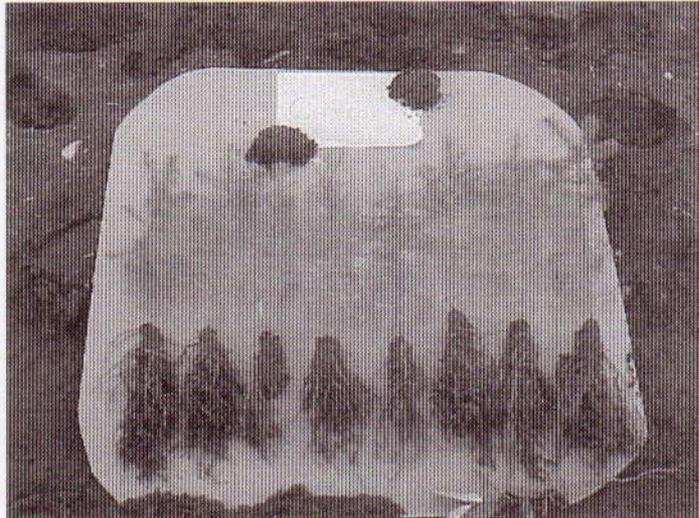


Photo 1 : Control

- The surviving trees with Spectrum Pacific teabags showed root development strongly biased away from the fertilizer. Root mortality appeared to have occurred on the south side of the plug, next to the fertilizer product. Examination of the remnants of the fertilizer product showed only broken fragments of the fertilizer coating, with little if any fertilizer remaining.



Photo 2 : Spectrum Pacific Teabag

- The trees treated with Nutripaks showed more total root volume than the control trees, with little or no bias away from the fertilizer product. Compared with the control, somewhat more of the root growth occurred from the middle and top of the plug. Most of the fertilizer appeared to still be in the bag, suggesting that fertilizer release had not been as great as with the other products. Ongoing fertilization effects in Year 2 are expected.



Photo 3 : Nutripak

- The trees treated with Agriform Tablets showed much more root volume than the Control trees, but some tendency for roots to develop away from the tablet. The tablet appeared to still contain a fair amount of fertilizer, which may be available in year 2



Photo 4 : Agriform Tablet

- The trees treated with 15ml of Fish Based Fertilizer showed root growth similar to the Agriform tablets, but root growth was much more symmetrical. No assessment of remaining fertilization potential could be made for any of the fish based fertilizer treatments

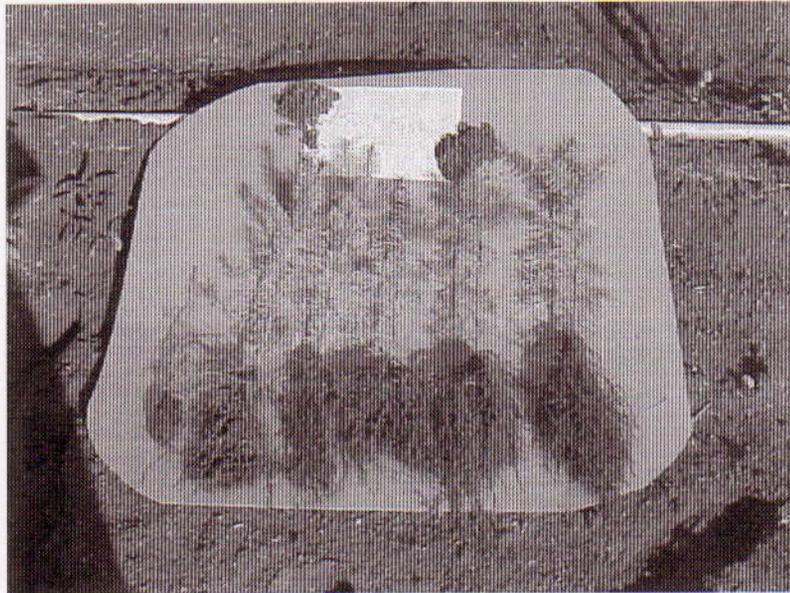


Photo 5 : 15 ml Fish Based Fertilizer

- The trees treated with 30 and 60ml of Fish Based Fertilizer showed excellent root release in all directions, with roots originating evenly from all parts of the plug. Total root mass was similar to that of the Agriform Tablets. No difference was noted between 30 & 60ml treatments.

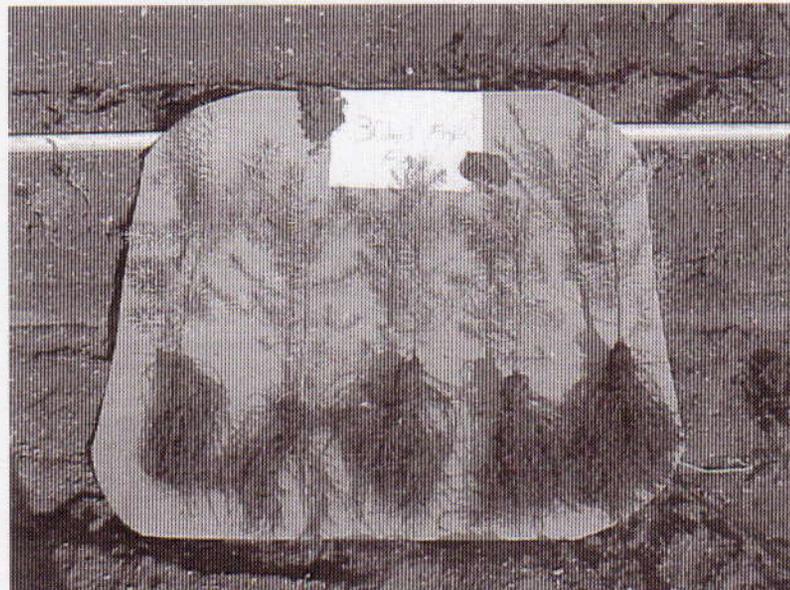


Photo 6 : 30ml Fish Based Fertilizer

SUMMARY

Based on the results of this trial, the fish based fertilizers appear to provide superior first year growth results in planted trees when applied in the correct position and amount. The Agriform Tablet also appeared to provide excellent results. The Nutripak product was potentially associated with some mortality, and did not provide as much of a first year boost as the other products, although it had clearly eliminated chlorosis and other superficial signs of planting shock. The Spectrum Pacific Teabag product caused extensive mortality, poor root form, and did not assist growth.

Both the Agriform Tablet and the Nutripak appear likely to continue to provide fertilization benefits in the second year of growth. The fish based fertilizers could not be evaluated in this regard, and the Spectrum Pacific product appeared to have no further fertilization value. The remaining 40 trees in each treatment will be maintained through a second year to evaluate ongoing growth effects.