GROWTH RESPONSES AND STABILITY OF RADIATA PINE CHEMICAL WEED CONTROL AND RIPPING IN PUMICE PASTURE LAND

G.J. BRUNSDEN

Forest Research Institute, Rotorua

Summary

A research trial was established on farmland near Rotorua to investigate the growth response and pattern of root development of radiata pine (*Pinus radiata*) seedlings to various chemical and mechanical site preparation regimes. After 3 years, trees that had only chemical weed control showed the best overall responses. Mechanical site preparation by ripping, with or without weedicide, resulted in poorer growth and is not recommended for this type of pasture-land soil. Wrenched 1½/0 seedlings significantly outgrew both wrenched and box pruned 1/0 seedlings. Successful establishment on pumice pasture-land sites depends on the use of high quality tree stocks properly planted and kept weed-free for several months.

INTRODUCTION

Instability in juvenile pines and other species as a result of inadequate root anchorage is a recognised disorder of planted tree crops. Tree instability, or toppling, may be related to many factors including planting stock preparation, poor handling, cultivation of the planting site, planting method, and various silvicultural practices (Chavassee 1978). Most toppled trees continue to grow, acquiring a curved stem that greatly reduces their later marketable value (Moss 1971).

Site preparation by ripping to improve soils which are naturally compacted (heavy clays, some compacted gravels, soils with hard pans), or that have been compacted by forestry operations is a widespread practice throughout this country. Its main purpose is to promote better stem and root growth (Chavassee 1978). Greatly improved survivals, faster initial growth, and more uniform tree height have been obtained on many soils, such as the gravels of Canterbury and the clays of Otago, as a result of ripping.

On some sites it is the nature of the soil, including texture, structure, and organic content that predisposes trees to toppling. For example, soils of high fertility may cause trees to develop an abundance of early top growth at the expense of horizontal and vertical root penetration, a combination likely to result in toppling.

In 1976 a research trial was established to investigate the stem, root and stability response of young radiata pines to chemical and mechanical site preparation regimes when applied to a farmland site.

METHOD

Trial site

One-third of a hectare of uniform, grazed pumice pasture-land 15 kilometres south of Rotorua was selected for the trial site.

The soil type (Rijkse 1979) was Ngakuru sandy loam (commonly yellow-brown loam). The top 0 - 16 cm was black sandy loam, friable, weakly developed block structure (compacted), many Taupo lapilli, sharp boundary. The lower 16 - 56 cm was yellowish-brown greasy sand loam, friable, weakly developed blocky structure, distinct boundary.

Scrub Weeds and Forestry

Pasture grass and weed species on the site were white clover (*Trifolium repens*), browntop (*Agrostis tenuis*), ryegrass (*Lolium perenne*), yarrow (*Archillea millefolium*), sorrel (*Rumex acetosa*), with minor infestations of couch (*Agropyron repens*), cocksfoot (*Dactylis glomerata*), nodding thistle (*Carduus nutans*), and sweet vernal (*Anthoxanthum odoratum*).

Site preparation

In August 1976, 2 weeks prior to planting, the following preparation methods were applied in parallel lines 2 m apart and 100 m in length :

- (i) Ripping the soil using a single agricultural tine to a depth of 40 - 50 cm. Two passes were needed to achieve full depth on each line.
- (ii) Ripping as for (i) plus a pre-plant knapsack strip spray using 4 kg/ha simazine and 0.6 kg/ha paraquat; swath width 80 cm centered over rip.
- (iii) Weedicide spraying only as in (ii).
- (iv) Untreated control.

Tree stocks

Three types of radiata pine seedlings (ex Forest Research Institute nursery) were used for the experiment:

1. 1/0 box-pruned stock conditioned by a combination of undercutting and four-sided lateral root pruning.
2. 1/0 normal wrenched stock; (conditioned by undercutting, lateral
3. 1½/0 normal wrenched stock; (pruning and wrenching.

Design

A total of 30 blocks were laid out. Each block had two lines of each site preparation method. Within blocks, stock types were randomly planted 10 per line at 1 m intervals using a garden spade. For each of the 12 treatments (four site x three tree) 200 trees were planted, 2400 plants in total.

Assessments

Survival and tree health were recorded at three-monthly intervals. Main stem height and diameter of each tree was measured shortly after planting, then annually every winter.

Three years after planting the root systems of 20 trees per treatment x tree stock combination were excavated to study rooting configuration and development.

RESULTS

Survival

There were no significant differences between any treatments, site preparation, or tree stock type. Survival was higher than 98% for all treatments.

Height growth (Fig. 1)

Increment after 3 years was by far the best for the weedicide site preparation and worst for the ripping-only treatment (Fig. 1A). There was no difference in height growth between ripped and weedicide lines and the control lines.

The 1½/0 wrenched trees, larger at planting, significantly (5% level) outperformed both the 1/0 stock types (Fig. 1B). There was no significant difference between the 1/0 stock types.

Bulk (Fig. 2)

$$\frac{(\text{Mean height})}{100} \times (\text{diameter})^2 = \text{bulk index}$$

provides a measure of overall tree growth performance.

Mean bulk index of trees on weedicide-sprayed-only lines was twice that of trees on ripped lines, whether sprayed or not (Fig. 2A and Fig. 3). Even the bulk index of trees on control lines was 80% greater than on the ripped.

Bulk index differences between tree stocks (Fig. 2B) was in favour of the 1½/0 seedlings and again there was little difference between the two 1/0 conditioning types.

Fig. 1 Effect of site preparation method and tree stock type on 3 year height increment of radiata pine.

Fig. 2 Effect of site preparation method and the stock type on 3 year bulk index of radiata pine.

$$\text{BULK} = \frac{(\text{HEIGHT}) \times (\text{DIAMETER})^2}{100}$$

Scrub Weeds and Forestry

Root development

Both the lateral and taproot development were very good for all treatments. However, root systems in the ripped lines were slightly poorer. Here lateral roots tended to be aligned along rips and root penetration outside the rip zone was weak. Glazing of the rip walls by the tine has more than likely been the cause of this feature.

Of the tree stocks the 1½/0 trees had the slightly poorer root form. There was no evidence of tree instability at the time of the assessment.

Fig. 3
Growth differences between trees planted on an uncompacted pumice pastureland site. Weedicide treated lines (left) compared with a ripping and weedicide treatment (right).

DISCUSSION AND CONCLUSIONS

The poorer growth performance of trees planted on the ripped lines in this trial indicates that ripping soils of this structure is not advisable.

Seedlings planted into an unripped fertile topsoil have immediate access to plant nutrients accumulated in the course of pasture-land management. It was observed that cultivation by ripping tended to push aside the topsoil so that trees planted on rips were established predominantly in the subsoil, an area where nutrients may be less available and subsequent growth slower.

The absence of toppling and the root excavation findings indicate that on fertile pumice pasture-land sites good root form and tree stability can be achieved simply by careful and proper planting. There was no evidence from this trial that ripping improved root growth.

Preest (1977) found that weed control of young Douglas fir (*Pseudotsuga menziesii*) resulted immediately in increased growth and had a highly significant positive effect for several years following. Results here clearly confirm this for radiata pine. Although effective chemical weed control was achieved for a period of only 4 months it was found to significantly improve height increment (15%) and bulk (23%) when compared with the untreated control.

The older and somewhat larger wrenched 1½/0 seedlings significantly outperformed both wrenched and box pruned 1/0 seedling in terms of height increment (11%) and bulk (32%).

These results show that the most important requirements for the successful establishment of trees on uncompacted pumiceland sites are the use of high quality, well conditioned tree stocks, proper and careful planting, and good weed control for several months after planting.

Scrub Weeds and Forestry

ACKNOWLEDGMENTS

The co-operation and assistance of the owners, Messrs A. Ford and B. Plumridge, of Highlands Station Farm are gratefully acknowledged.

REFERENCES

- Chavasse, C.G.R., 1978. The root form and stability of planted trees with special reference to nursery and establishment practice. Paper presented at Symposium on Root Form of Planted Trees Victoria, B.C., Canada, May 16 - 19, 1978.
- Moss, A., 1971. An investigation of basal sweep of lodgepole and shore pines in Great Britain. *Forestry* 44: 43-65.
- Preest, D.S., 1977. Long-term growth response of Douglas fir to weed control. *N.Z. J. For. Sci.*, 7(3): 329-32.
- Rijkse, W.C., 1979. Soils of Rotorua Lakes District, North Island, New Zealand. Department of Scientific and Industrial Research, N.Z. Soil Bureau, *N.Z. Soil Survey Report* 43.