FUTURE FORESTS RESEARCH

RADIATA MANAGEMENT TECHNICAL NOTE Site Productivity

Number: RSPTN-007
Date: September 2011

Effect of Boron Fertiliser on Tree Growth

Summary

At a site with high rainfall and clay soil in Tungrove Forest, application of boron (B) fertiliser increased soil and foliar B concentrations, but had no effect on tree growth. Weed control (WC) and genotype were two main factors affecting tree growth. Significant interactions were also found between B and WC, and between genotype and WC.

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INTRODUCTION AND METHODS

The effect of B fertiliser on tree growth, nutritional status and wood characteristics is being investigated at four sites across the country. This note updates results for 2008 at one site (Tungrove Forest) with high rainfall and high growth rates. The trial was established in 2002.

This trial has a factorial design with four B fertiliser rates (0, 8, 16 and 32 kg B ha^{-1}), two weed controls (± WC, three applications in 2003, 04 and 06) and six radiata pine genotypes. This update covers major results from the following studies:

- Foliage sampling for determination of 100 fascicle dry weight and nutrient concentration (C, N, P, K, Ca, Mg, B, Cu, Zn, S, Fe, Mn, Al, and Na).
- Winter measurement of tree height and root collar diameter of individual trees in all plots (age 6 years).
- Soil sampling of 0-10 and 10-20 cm depths for determination of B and weed control effects on soil B (hot-water-soluble B – HWSB).

The data were analysed using the GLM procedure in SAS for the effect of:

- Boron, weed control and their interaction on foliar nutrient concentrations and fascicle weight, and soil HWS B.
- B, weed control, genotype and their interactions on tree height, Dbh and volume ($\pi r^2 h/3$). Covariates were initial height, diameter and volume.

RESULTS

Effect on foliar nutrients, soil HWSB (0-20 cm) and fascicle weight

Boron addition had a significant effect on foliar B (Fig. 1) and soil HWSB. In 2008 concentrations of foliar B increased from 14.5 µg/g at B0 to 19.5 at B32 while soil HWSB increased from 1.7 µg/g (B0) to 3.8 (B32). Boron treatments had no significant effect on other foliar nutrients and fascicle weight (data not shown). Foliar B concentration generally decreased with time, especially at higher rates of B application (Fig. 1).

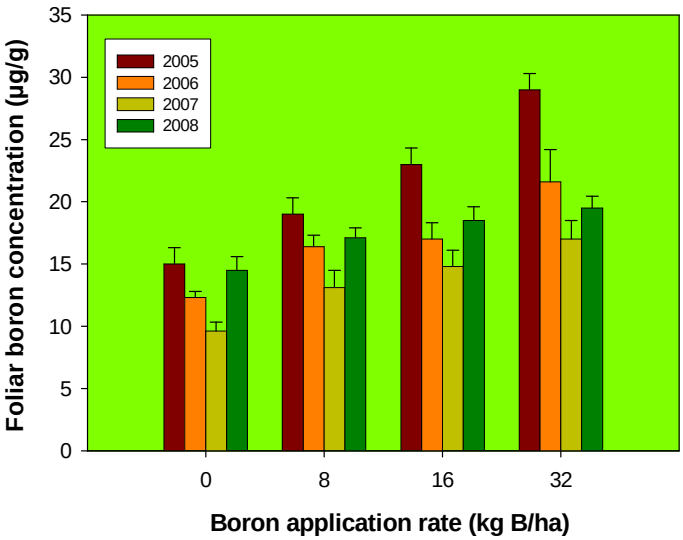

Figure 1: Effect of B fertiliser on foliar B concentrations. On all graphs: T = Standard error

Weed Control had significant effects (P<0.05) on some foliar nutrient concentrations and fascicle weight. Weed control decreased foliar P, Mg, Ca, Fe, Mn and Zn concentrations due to growth dilution. In 2008 the fascicle weight (mg/fascicle) increased from 53.9 without weed control to 68.1 with weed control (Fig. 2).

Boron×weed control interactions were not significant for foliar nutrient concentrations or fascicle weight.

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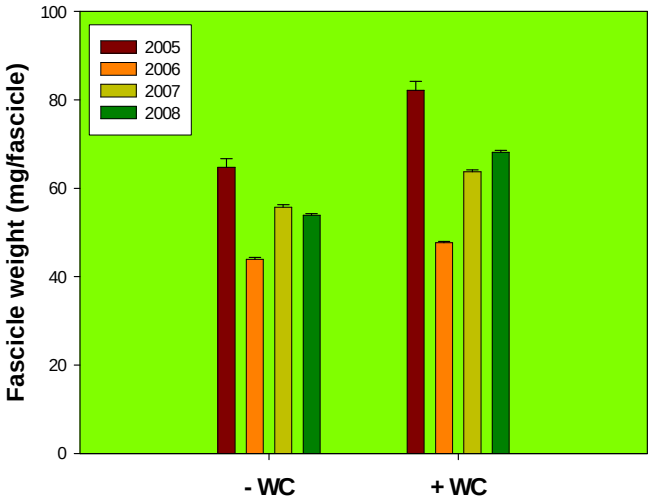

Figure 2: Effect of weed control on fascicle dry weight

Foliar nutrient concentrations in the control plots

In the control plots (B0 with no weed control), the mean foliar nutrient concentrations in 2008 were generally satisfactory, except for foliar N, which was low.

	N	P	K	Ca	Mg	B	Cu	Zn	K/Mg
			%				ppm		
Mean	1.13	0.14	0.46	0.20	0.12	14	3.9	31	4.0
Stdev	0.07	0.02	0.14	0.05	0.03	3.2	0.4	6.9	1.7

Tree growth (age 6 years)

The Boron main effect was not significant on any growth parameter in 2008 although tree growth appeared to be better in the plots with 8 kg B/ha (Fig. 3).

Weed control significantly (P<0.01) improved tree height, DBH and volume in 2008. Tree DBH increased from 12.6 cm without weed control to 15.1 cm with weed control (Fig. 4).

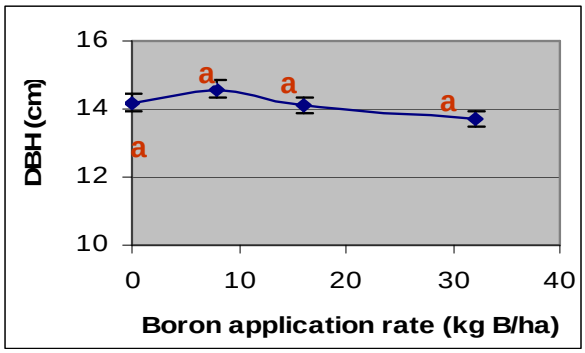

Figure 3: Effect of B fertiliser on tree DBH

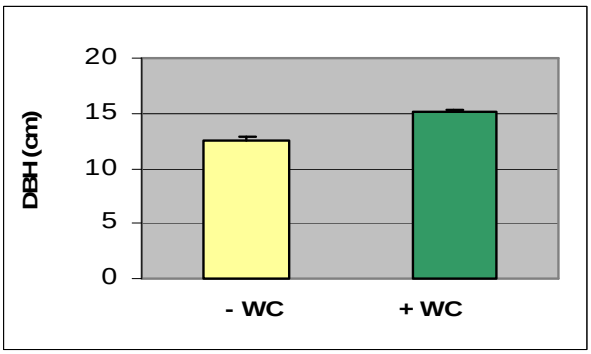

Fig.4 Effect of weed control on tree DBH

Genotype had significant (P<0.01) effects on all growth parameters in 2008. Genotypes 4 and 8 performed significantly better than other genotypes. These had a DBH of 16.5 and 15.3 cm, and a height of 8.63 and 8.26 m, respectively. Genotype 3 had the smallest size, with a DBH of 10.6 cm and a height of 6.75 m (Fig. 5).

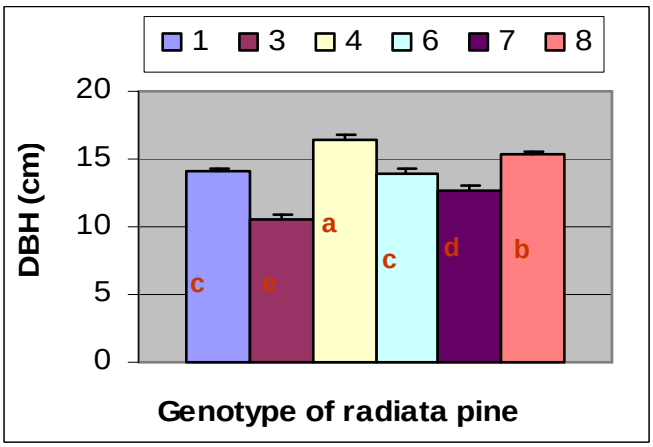

Figure 5: Effect of genotype on tree DBH

Boron x weed control interactions were significant (P<0.05) for tree DBH. With weed control there was no significant difference among B treatments for tree DBH. Without weed control, however, the tree DBH increased at B8 when compared to B0 (Fig. 6). B32 appeared to reduce tree DBH.

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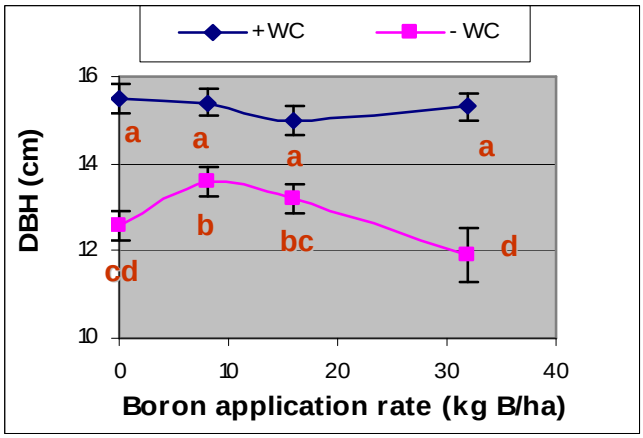

Figure 6: Interactive effect of B and WC on tree DBH

Weed control x genotype interactions were significant (P<0.05) for tree volume. Greater volume increments in response to B were found for genotypes 1, 4 and 8, which were 236, 308 and 185 cm^3 respectively (Fig. 7), than the remaining genotypes.

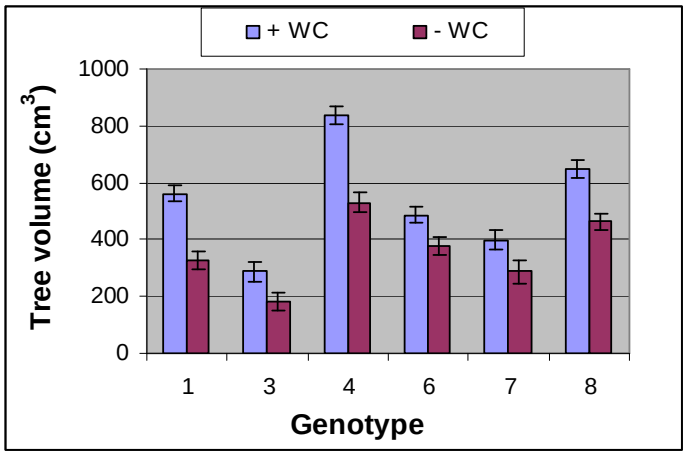

Figure 7: Interactive effect of genotype and weed control on tree volume

CONCLUSIONS

- **Boron** fertiliser increased soil hot-water-soluble B and foliar B concentrations, but had no effect on other foliar nutrients and fascicle weight 6 years after application. B fertiliser appeared to have less residual effect in this Awarua clay soil than other soils in the B trials.

- **Boron** main effects were not significant for any tree growth parameter. The lack of B effect was associated with the satisfactory foliar B concentration in most years in the control plots at this site. However, lower rates of B improved tree growth in the plots without weed control.

- **Weed control** significantly increased tree growth and fascicle weight. This is likely to be due to the improved availability of soil nutrients and moisture.

- **Genotypes** 4 and 8 had the best growth while genotype 3 had the poorest growth.

- There were **significant interactions** between boron and weed control, and between genotype and weed control. This has some management implications. Without weed control, a low rate of B fertiliser may improve tree growth. Weed control may be necessary to achieve the growth potential of genotypes more sensitive to soil moisture or nutrient limitations.

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