

**METALOSATE<sup>®</sup> TRIAL ON BUD FORMATION IN NORDMANN FIR**

**Winnie W. Olsen  
Brenntag Nordic Agro  
Denmark**

**Abstract**

Denmark has a big production of Christmas trees. During the last ten years the production has increased each year. Together with the increase new problems have emerged. One of the problems is red needles on the new shoots in the summer. A trial with different treatments of calcium, boron and zinc showed that the red needles might be due to short periods of calcium deficiency. In other crops the phenomena is called tipburn. The trial showed a significant reduction in the number of trees with red needles and a reduction in severity of the attack.



**Figure 1.** Nordmann Fir 3/0

Another trial with nursery stock of Nordmann fir showed that the number of buds on 2-year-old trees could be increased with zinc and boron in the spring before stretching. The same trial with 3-year-old trees was not significant.

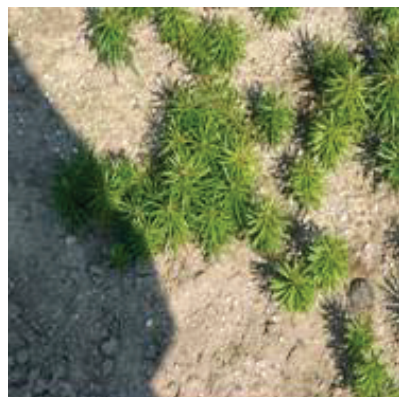
These trials indicate that the correct timing and dosage of Metalosate products could be the solution to some of the problems in the Christmas tree production in Denmark. The trials will be repeated in 2004.

**Purpose**

The purpose with the trial was to see how Nordmann fir trees react to treatments with zinc and boron; especially the bud development. Furthermore the capabilities of latex to work as a spreader were investigated.

**Trial Plan**

The trees were treated on the 11th of June 2003 in full sunshine at 22°C (72°F). The trial was finished on the 7th of August 2003. The treatments were done on 1/0 against 2/0 and 2/0 against 3/0. In this report these trees will be called 2/0 and 3/0.



**Figure 2.** Nordmann Fir 2/0

2/0 trees were covered with mesh immediately after treatment. 3/0 trees were not covered with mesh.

There was one plot per treatment therefore it was not possible to see if variances in the soil influenced the results.

### Treatments

1. Untreated.
2. 0.5 litre/hectare (6.8 fluid ounces/acre) Metalosate Zinc.
3. 0.4 litre/hectare (5.5 fluid ounces/acre) Metalosate Boron.
4. 0.1 litre/hectare (1.4 fluid ounces/acre) Metalosate Boron plus 0.25 litre/hectare (3.4 fluid ounces/acre) Metalosate Zinc.
5. 0.3 litre/hectare (4.1 fluid ounces/acre) Metalosate Boron plus 0.75 litre/hectare (10.3 fluid ounces/acre) Metalosate Zinc.
6. 0.5 litre/hectare (6.8 fluid ounces/acre) Metalosate Boron plus 1.25 litre/hectare (17.1 fluid ounces/acre) Metalosate Zinc.
7. 0.2 litre/hectare (2.7 fluid ounces/acre) Metalosate Boron plus 0.5 litre/hectare (6.8 fluid ounces/acre) Metalosate Zinc plus 5 litres/hectare (68.4 fluid ounces/acre) latex.
8. 0.4 litre/hectare (5.5 fluid ounces/acre) Metalosate Boron plus 1 litre/hectare (13.7 fluid ounces/acre) Metalosate Zinc plus 5 litres/hectare (68.4 fluid ounces/acre) Latex

### Results

<b>Table 1</b>		
<b>Number of Buds on 2/0 Nordmann Fir</b>		
<b>Treatment</b>	<b>ANOVA Result p-value</b>	<b>Mean Number of Buds</b>
1		2.700
2	0.023*	3.100
3	0.030*	3.075
4	0.000**	3.350
5	0.010*	3.100
6	0.017*	3.075
7	0.000***	3.450
8	0.003**	3.200

\* Significant difference 95% level

<b>Treatment</b>	<b>ANOVA Result p-value</b>	<b>Mean Number of Buds</b>
1		3.622
2	0.591 ns	3.533
3	0.126 ns	3.889
4	0.040*	3.267
5	0.207 ns	3.844
6	1.000 ns	3.622
7	0.156 ns	3.867
8	0.391 ns	3.778

\*Decrease in number of buds

**Table 3**  
**Needle Analysis Through The Growing Season For 2/0 For Untreated, Treatment 7 And Treatment 8**

2/0	15 Jun 2003 Untreated		15 July 2003 Untreated		8 August 2003 Untreated		8 August 2003 Treatment 7		8 August 2003 Treatment 8	
	Analysis	Index	Analysis	Index	Analysis	Index	Analysis	Index	Analysis	Index
<b>N</b>	1.4	-30	1.1	3	1.4	-19	1.7	-15	1.6	-15
<b>S</b>	0.09	-23	0.08	-33	0.09	-31	0.10	-33	0.10	-32
<b>P</b>	0.19	1	0.18	0	0.26	2	0.33	9	0.29	6
<b>K</b>	0.72	-14	0.61	-12	0.78	-20	0.86	-23	0.80	-21
<b>Mg</b>	0.09	-22	0.11	17	0.09	-25	0.11	-26	0.13	-21
<b>Ca</b>	0.42	24	0.46	11	0.95	27	0.87	18	1.03	31
<b>Fe</b>	264	60	530	*	377	72	276	41	296	48
<b>Mn</b>	153	11	226	21	200	25	348	55	214	26
<b>B</b>	14	-9	12	-17	15	-22	20	-21	19	-19
<b>Cu</b>	5	-8	5	-6	5	-17	6	-20	6	-17
<b>Zn</b>	31	9	43	16	55	8	71	14	69	15
<b>Mo</b>	1		0.90		1.58		1.29		1.54	

Treatment 7: 0.2 litre/hectare (2.7 fluid ounces/acre) Metalosate Boron plus 0.5 litre/hectare (6.8 fluid ounces /acre) Metalosate Zinc plus 5 litres/hectare (68.4 fluid ounces/acre) latex.

Treatment 8: 0.4 litre/hectare (5.5 fluid ounces/acre) Metalosate Boron plus 1.0 litre/hectare (13.7 fluid ounces/acre) Metalosate Zinc plus 5 litres/hectare (68.4 gallon/acre) latex.

The trees were a nice green colour in August.

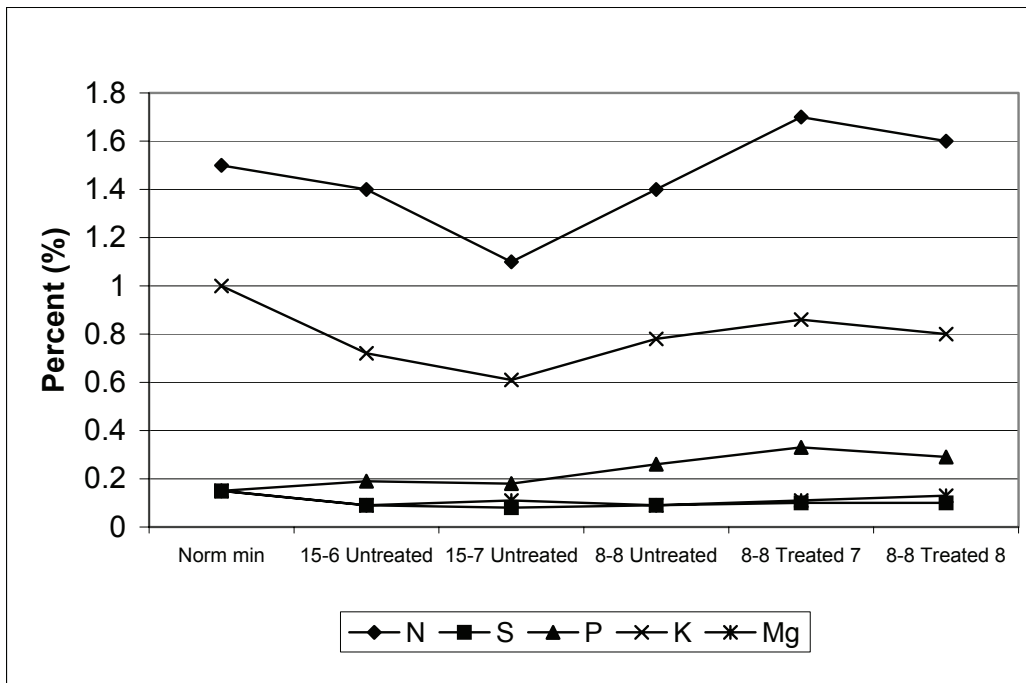
Table 4  
Needle Analyses Through The Growth Season For 3/0 Trees For Untreated, Treatment 7 And Treatment 8

3/0	15 June 2003 Untreated		15 July 2003 Untreated		8 August 2003 Untreated		8 August 2003 Treatment 7		8 August 2003 Treatment 8	
	Analysis	Index	Analysis	Index	Analysis	Index	Analysis	Index	Analysis	Index
<b>N</b>	1.1	-53	0.5	-25	0.9	-22	0.9	-26	1.1	-22
<b>S</b>	0.07	-27	0.04	-30	0.05	-32	0.05	-36	0.07	-35
<b>P</b>	0.18	-3	0.11	-5	0.18	-2	0.19	-3	0.23	0
<b>K</b>	0.58	-26	0.24	-22	0.35	-19	0.46	-20	0.55	-22
<b>Mg</b>	0.08	-23	0.06	-6	0.08	-17	0.09	-19	0.10	-21
<b>Ca</b>	0.49	35	0.33	12	0.87	33	0.82	26	0.94	30
<b>Fe</b>	359	99	933	*	359	76	457	99	440	91
<b>Mn</b>	62	-2	104	11	67	3	77	2	94	2
<b>B</b>	15	-6	10	-6	17	-9	21	-7	20	-12
<b>Cu</b>	5	-4	4	2	4	-10	4	-13	4	-15
<b>Zn</b>	31	10	30	14	28	0	30	-2	45	4
<b>Mo</b>	1		0.99		1.17		1.30		1.20	

Treatment 7: 0.2 litre/hectare (2.7 fluid ounces/acre) Metalosate Boron plus 0.5 litre/hectare (6.8 fluid ounces/acre) Metalosate Zinc plus 5 litres/hectare (68.4 fluid ounces/acre) latex.

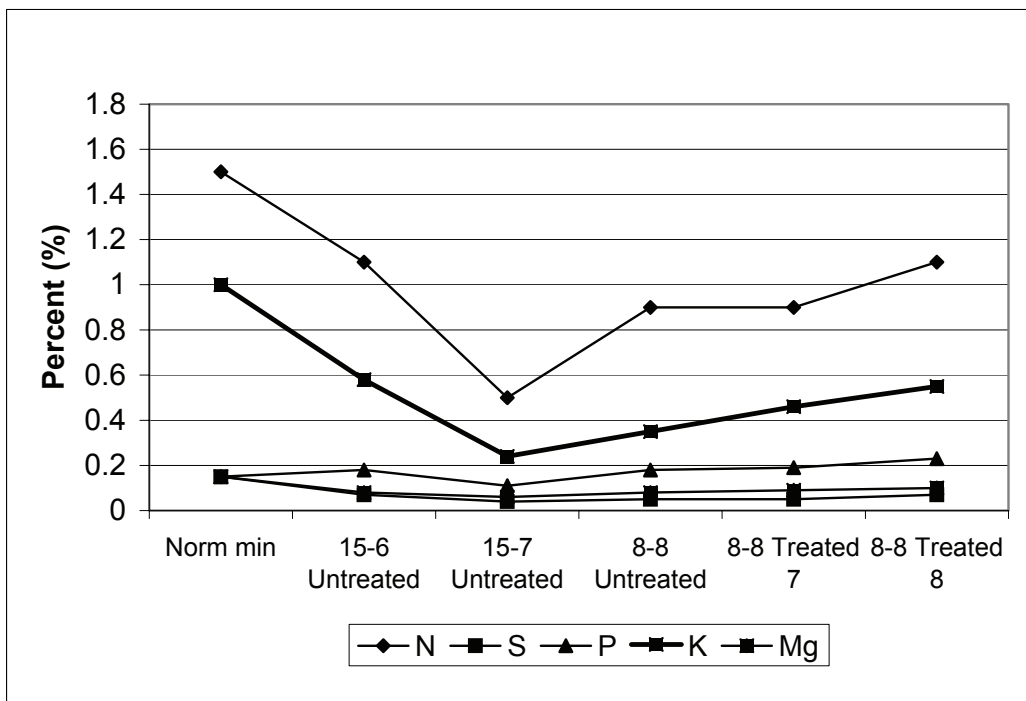
Treatment 8: 0.4 litre/hectare (5.5 fluid ounces/acre) Metalosate Boron plus 1.0 litre/hectare (13.7 fluid ounces/acre) Metalosate Zinc plus 5 litres/hectare (68.4 fluid ounces/acre) latex.

The trees were light green in August.



**Figure 1.** Nordmann Fir 2/0 Content of Macronutrients

There was a general decrease in the content of nutrients through the growing season. When active growth stopped, the level of nutrient increased again. The content of both K and Mg were below the minimum range in the period.

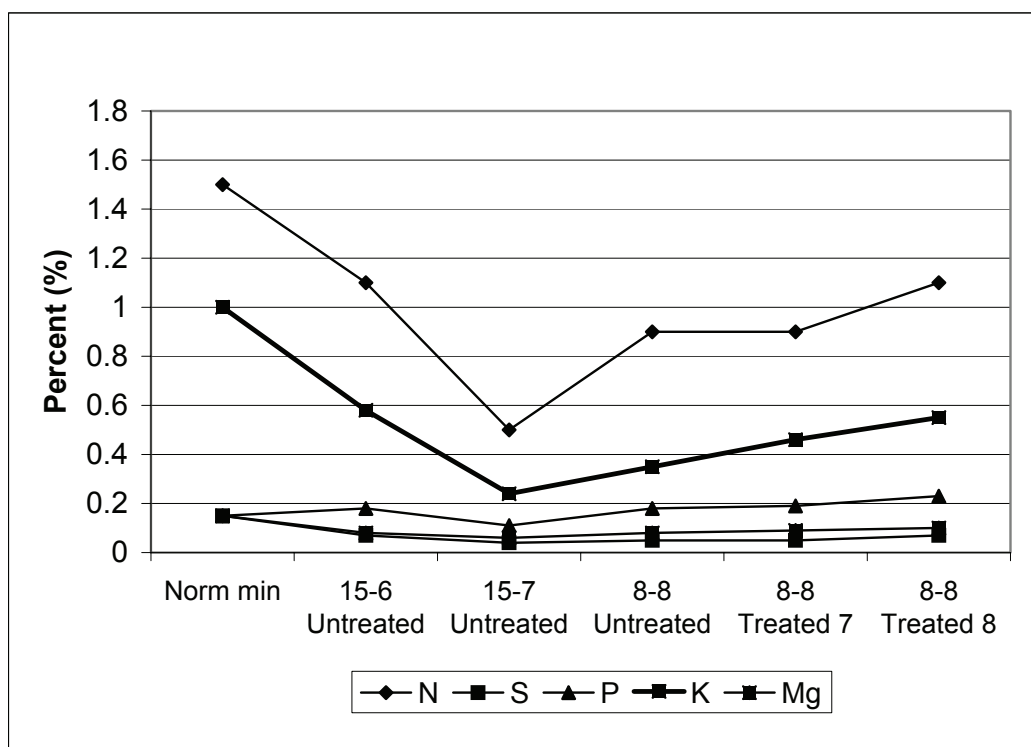


**Figure 2.** Nordmann Fir 3/0 content of Macronutrients.

If 2/0 and 3/0 are compared, it can be seen that the level of nutrient in 3/0 in general was much lower than the level in 2/0. Except for phosphorus, all the nutrients were below the minimum range. The reduction in the nutrient levels from 2/0 to 3/0 were about 30% for N, 50% for S, 20-40% for P, 20-60% for K and 10-25% for Mg.

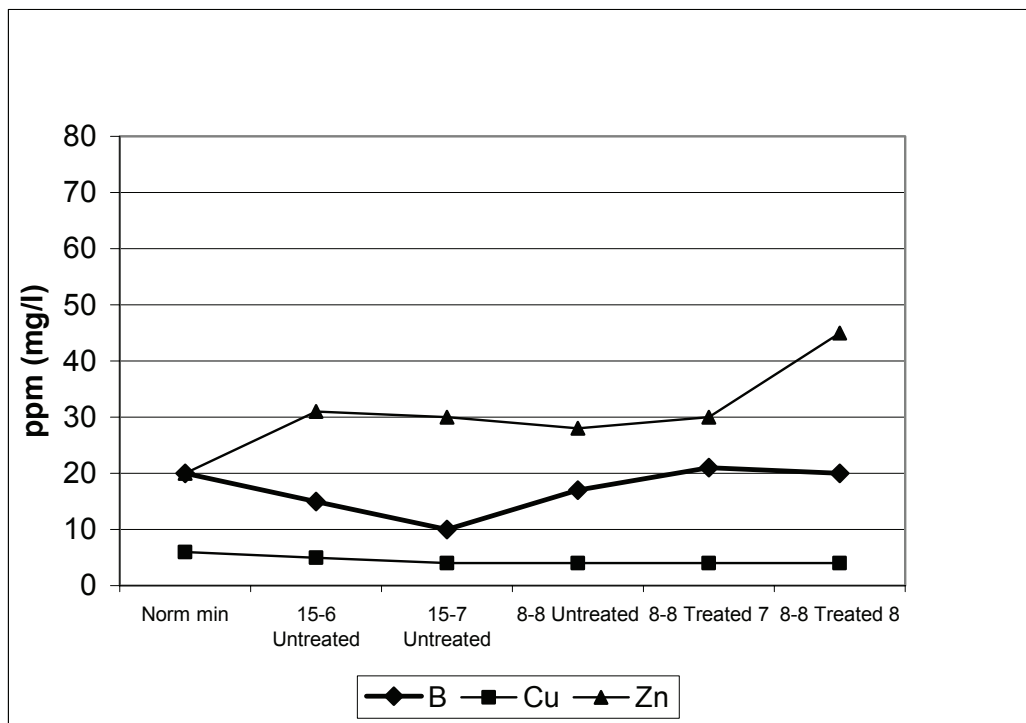
It can be seen in Table 5 that the 2/0 trees in general had a better nutritional status during the growth (June to July) than the 3/0 trees. In August there was not the big difference in the indexes for 2/0 or 3/0. The difference in August was that 3/0 in general was light green while 2/0 was nicely dark green. The macronutrients in 3/0 may have been too low from the beginning of the season.

Index Untreated	Nordmann 2/0			Nordmann 3/0		
	15 Jun	15 Jul	8 Aug	15 Jun	15 Jul	8 Aug
<b>N</b>	-30	3	-19	-53	-25	-22
<b>S</b>	-23	-33	-31	-27	-30	-32
<b>P</b>	1	0	2	-3	-5	-2
<b>K</b>	-14	-12	-20	-26	-22	-19
<b>Mg</b>	-22	17	-25	-23	-6	-17



**Figure 3.** Nordmann Fir 3/0 Content of Macronutrients

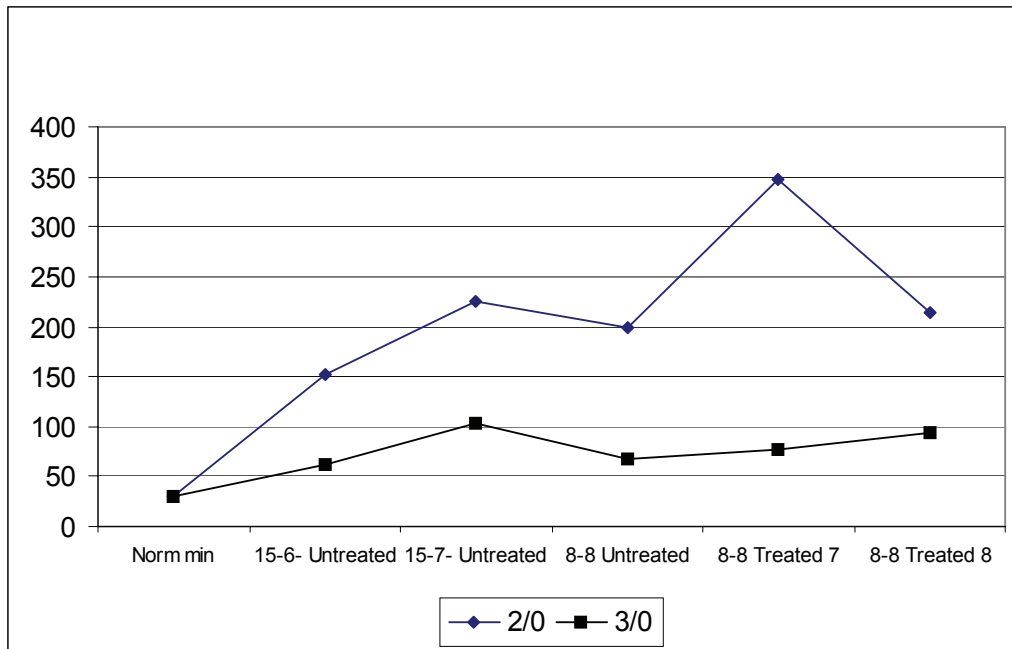
The contents of boron and zinc were higher in treatment 7 and 8 than in the untreated. The content of zinc increased over time in the untreated trees, which was unexpected. Copper and boron were too low in general over the whole period.



**Figure 4.** Nordmann Fir 3/0 Boron, Copper and Zinc.

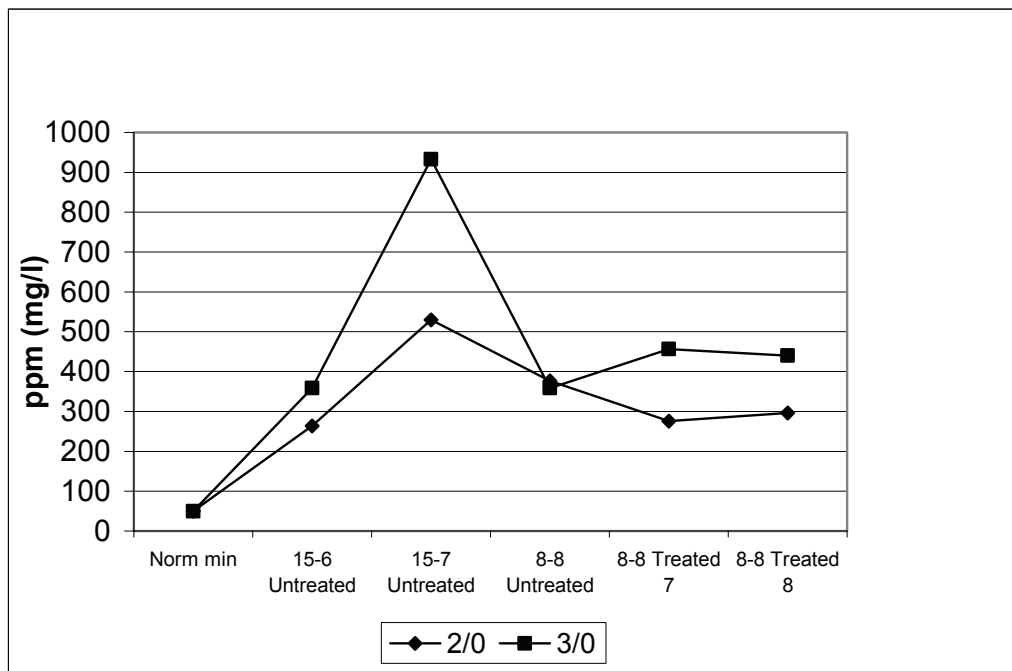
The highest dosage of 0.4 litre/hectare (5.5 fluid ounces/acre) of Metalosate Boron and 1 litre/hectare (13.7 fluid ounces/acre) Metalosate Zinc increased the content of zinc and boron in the needles. The content of boron decreased from June to July but increased in August. The content of zinc was the same from June to August in the untreated. Copper and boron were too low in general over the whole period.





**Figure 5.** Nordmann Fir 2/0 and 3/0 Manganese

2/0 contained more manganese in general than 3/0. The content increased from June to July and decreased from July to August. In general the manganese content was within the optimal range of 50-200 ppm.



**Figure 6.** Nordman Fir 2/0 and 3/0 Iron

The iron content increased dramatically in the beginning of the season in both 2/0 and 3/0. In August the content had decreased but the content was still very much above the optimal range of 50-200 ppm for both 2/0 and 3/0.

## Discussion

The statistical analysis showed that there was a significant effect of the treatments on 2/0 but not on 3/0. The treatment 7 (0.2 litre/hectare (2.7 fluid ounces/acre) Metalosate Boron plus 0.5 litre/hectare (6.8 fluid ounces/acre) Metalosate Zinc plus 5 litres/hectare (68.4 fluid ounces/acre) latex) gave most buds followed by treatment 4 (0.1 litre/hectare (1.4 fluid ounces/acre) Metalosate Boron plus 0.25 litre/hectare (3.4 fluid ounces/acre) Metalosate Zinc and treatment 8 (0.4 litre/hectare (5.5 fluid ounces/acre) Metalosate Boron plus 1 litre/hectare (13.7 fluid ounces/acre) Metalosate Zinc plus 5 litres/hectare (68.4 fluid ounces/acre) latex).

The distribution of buds can be seen in Table 6, where it can be seen that for both 2/0 and 3/0 treatment 7 (0.2 litre/hectare (2.7 fluid ounces/acre) Metalosate Boron plus 0.5 litre/hectare (6.8 fluid ounces/acre) Metalosate Zinc plus 5 litres/hectare (68.4 fluid ounces/acre) latex) gave the most trees with 3, 4 and 5 buds.

<b>2/0</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
<b>Treatment 1</b>	2	15	15	5	1	1
<b>Treatment 2</b>	0	9	20	9	2	0
<b>Treatment 3</b>	0	12	15	11	2	0
<b>Treatment 4</b>	0	4	21	12	3	0
<b>Treatment 5</b>	0	5	27	7	1	0
<b>Treatment 6</b>	0	7	24	8	1	0
<b>Treatment 7</b>	0	3	21	11	5	0
<b>Treatment 8</b>	0	6	21	12	1	0
<b>3/0</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
<b>Treatment 1</b>	0	5	5	17	8	0
<b>Treatment 2</b>	0	1	21	21	2	0
<b>Treatment 3</b>	0	0	14	22	9	0
<b>Treatment 4</b>	0	5	24	15	1	0
<b>Treatment 5</b>	0	0	16	20	9	0
<b>Treatment 6</b>	0	3	21	12	8	1
<b>Treatment 7</b>	0	0	14	23	8	0
<b>Treatment 8</b>	0	3	11	24	7	0

Latex has probably had the desired effect. Unfortunately, there was no plot with the same concentration but without latex. There were no signs of phytotoxicity with latex.

Single treatments with boron and zinc increased the number of buds significant compared to untreated in 2/0 but the combinations boron and zinc had the best effect.

The nutrient analysis showed that 2/0 was better fed than 3/0. During the stretching there was a lack of nitrogen, potassium, sulphur and magnesium. In Figures 1 and 2 it can be seen that the content of macronutrients decreased after stretching, but the nutrient index of 2/0 was positive after the stretching except from sulphur and potassium, while the nutrient index of 3/0 were just as negative except for nitrogen which had become a little bit less negative.

3/0 was very light in colour in August. The cause wasn't a single nutrient because all the nutrient levels in general had been low during the whole period. 2/0 was nicely green throughout the whole trial.

Treatment 7 and 8 increased the content of boron and zinc in both 2/0 and 3/0. In general, the content of boron, zinc and copper were too low in 2/0 and 3/0.

Both 2/0 and 3/0 had a content of manganese that was within the plant range, but the level of 3/0 was half that of 2/0. The iron content was high in both 2/0 and 3/0.