The Use of Copper Compounds as Root Pruning Agents©

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INTRODUCTION

Melaleuca alternifolia, commonly known as "tea-tree," contains special oil in its leaves famous around the world for its antiseptic qualities. During the 1990s an elite clone of *M. alternifolia* ('Clone 88') was identified for its superior oil qualities and high oil yields, and my nursery was contracted to mass-produce this clone for a large plantation in north Queensland.

Tea-tree plantations are planted at a very high density of plants (25,000–30,000 plants per hectare), and because of the very large number of plants required for a plantation, there is considerable pressure on nurseries to supply the plants at the lowest price possible.

Between 1997 and 1999, my company produced by cutting propagation 10 million plants of *M. alternifolia* 'Clone 88'. We became very proficient at the production process, achieving an average strike rate of 95% across the whole project and 99% strike rate on the final 2 million plants. Because of the high labour cost involved in cutting production (every cutting is prepared and set individually by hand) and the low price demanded by the customer, the cuttings were set directly into the final container to minimise labour and handling.

The container chosen in which to grow the plants was the 'Hiko' V50 tray, comprised of 67 cells per tray, with a cell volume of 50 ml. This particular tray was chosen because it met several important criteria including ease of handling, strength, space efficiency, depth of cell (deep roots), strong internal ribbing to prevent root coiling, and its ability to be re-used.

Once the plants were produced, they had to be dispatched to the plantation. Because of the very large number of plants required to be delivered each day, the plants were pulled from the cell trays and packed tightly into polystyrene boxes in order to maximise the number of plants that could be delivered per truckload and to minimise freight costs. At the plantation, the plants were planted by machines comprising a device mounted on the back of a tractor with a shute down which the plants were dropped into the prepared ground. The plants were planted 300–400 mm apart, and due to the very large numbers involved, planting was at a very fast rate. Therefore, the plants we produced had to have robust root systems that could withstand the rigours of the handling, packing, transporting, and the planting process without falling apart.

Root system quality is of great importance to the plantation owner because of its impact on plant vigour and growth, and ultimately therefore on oil yield and profit. Furthermore, since the plantation is harvested by machines which slice the plants off at ground level, strong root systems are essential to anchor, and brace, the plants against the physical shock of the harvesting process and to ensure that the plants re-shoot to provide another year of growth.

COPPER

During the 1990s, there was widespread interest within the nursery industry regarding the quality of the root systems of nursery-grown plants and in particular root coiling, which could lead to poor performance or even death of plants some time after planting out into the field. As a result, copper compounds (which can be readily mixed with paint and applied to the insides of containers) were widely promoted as effective root-pruning agents in container-grown nursery plants. Such applications work by killing root tips as they make contact with the copper-based paint. This stimulates the production of side roots within the root-ball, which then grow to the outside where they are again stopped by the copper. This process thus prevents root coiling and leads to the production of a root-ball consisting of a mass of branching fibrous roots. However, while widely used in seedling and forestry nurseries, we could find no record of, nor information on, the use of copper compounds with *M. alternifolia* or in cutting (as opposed to seedling) production.

Consequently, we set up a trial to investigate the use of copper in our tea-tree production system to determine if we could make improvements on our existing root systems and also to see if there may be any detrimental effects on the production process such as impacts on strike rate, plant vigour and growth, and plant handling during packing, dispatch, and planting.

THE TRIAL

We selected Kocide® (a commercial product containing 400 $g \cdot kg^{-1}$ copper hydroxide) as our source of copper because it was readily available, inexpensive, and in wide use in other nurseries. We applied it to the internal surfaces of the cell tray containers by mixing with a water-based low-sheen white paint. The trays were left to thoroughly dry for 5 days before use. From communications within the industry, we determined that the generally recommended application rate of copper was in the vicinity of 20 g copper hydroxide per litre of paint. We therefore set up our trials with various rates above and below this level (Table 1).

Table 1. Application rates of Kocide[1] in water-based, low-sheen white paint.

Kocide ($g \cdot L^{-1}$ paint)	0	10	20	30	40	50	60	70	100	200	300	500
Copper hydroxide ($g \cdot L^{-1}$ paint)	0	4	8	12	16	20	24	28	40	80	120	200

[1]Kocide® is a commercial product containing 400 $g \cdot kg^{-1}$ copper hydroxide.

Two trays (134 cuttings) were set for each application rate and placed in the cutting-house under mist. At all stages of the trial we used our standard, well-established and successful procedures for the cutting production of *M. alternifolia.* After 6 weeks the plants were shifted to a hardening-up area under light shade, then to full sun at 10 weeks. At 20 weeks a visual assessment of the plants was made and the strike rate recorded. At 24 weeks a thorough assessment of the plants was carried out as described below. The results are recorded in Table 2.

Table 2. Effect of copper hydroxide on *Melaleuca alternifolia* cutting production.

Copper hydroxide ($g \cdot L^{-1}$ paint)	0	4	8	12	16	20	24	28	40	80	120	200
Strike rate (%)	96	93	94	93	96	81	70	81	82	93	87	78
Vigour[1] (1–5)	5	4	5	5	4	3	2	1	2	4	4	4
Colour[2] (1–10)	10	9	8	7	6	4	2	2	3	6	7	8
Shoot wt (g)	3.34	1.88	2.41	2.69	2.45	1.65	1.00	0.63	2.03	2.33	3.00	2.64
Root wt (g)	7.32	4.79	3.69	3.29	2.41	2.46	1.31	0.90	3.14	3.00	4.01	5.81
Handling[3] (1–10)	9.05	4.9	4.9	4.5	4.0	2.2	3.1	2.6	2.4	2.2	2.7	2.4

[1] Vigour was assessed visually on a scale of 1 (very poor) to 5 (very good) — see text.

[2] Colour was assessed against a colour chart on a scale of 1 (very yellow) to 10 (very green).

[3] Handling was assessed qualitatively on a scale of 1 (very poor) to 10 (very good).

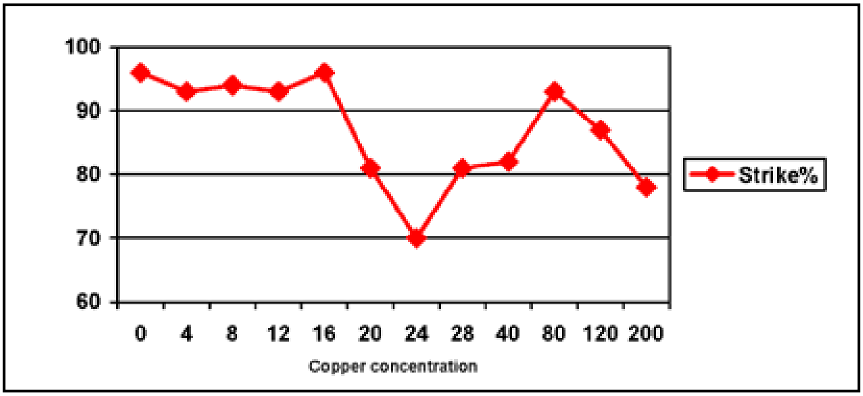

Figure 1. The effect of copper hydroxide[1] on the strike rate of *Melaleuca alternifolia* cuttings.

[1] Copper hydroxide concentrations are $g \cdot L^{-1}$ in water-based low-sheen white paint.

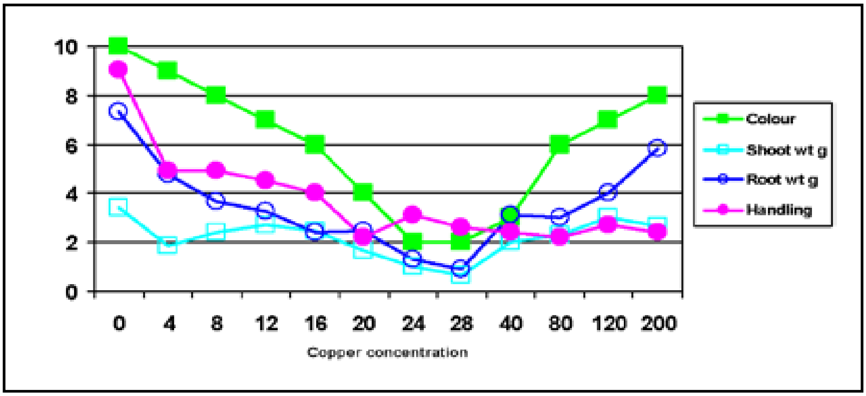

Figure 2. The effect of copper hydroxide[1] on the growth of *Melaleuca alternifolia* cuttings.

[1] Copper hydroxide concentrations are $g \cdot L^{-1}$ in water-based low-sheen white paint.

Strike Rate: The number of surviving plants was counted, and recorded as percent strike rate.

Vigour: The plants were visually assessed for vigour, on a scale of 1 (very poor) to 5 (very good), based on our experience of how the customer would assess the plants at sight.

Colour: The colour of the plants was assessed on a scale of 1 (very yellow) to 10 (very green) by comparing against a colour chart.

Shoot weight: Ten representative plants were selected from each application rate. The shoots were cut off at the base, at the junction with the root ball, dried of excess water (but not dehydrated), and individually weighed. The average shoot weight for each application rate of copper is shown in Table 2.

Root weight: The root balls from the plants selected above were then carefully washed to remove any media, dried of excess water (but not dehydrated), and individually weighed. The average root weight for each application rate of copper is shown in Table 2.

Handling: A further 10 representative plants were selected for assessment by our experienced dispatch staff for their ability to withstand the rigours of packing, handling, transport, and planting. Each plant was rated on a scale of 1 (very poor) to 10 (very good). The average rating for each application rate of copper is shown in Table 2.

CONCLUSION

It is clear from the data obtained in this trial that copper hydroxide is not suitable for use as a root-pruning agent in the cutting production of *M. alternifolia*. All application rates of copper hydroxide (including the recommended rate) adversely affected strike rate, vigour, colour, growth, and handling (Figs. 1 and 2).