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EFFECT OF ROOT PRUNING AT TIME OF PLANTING ON SUBSEQUENT ROOT DEVELOPMENT OF TWO SPECIES OF EUCALYPTUS

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Abstract. *Eucalyptus mannifera* subsp. *maculosa* (brittle gum) and *E. polyanthemos* (red box) were subjected to four root treatments immediately prior to transplanting from 0.5 liter and 4 liter poly bags, respectively. When plants were dug after 2½ years it was observed that the combination of vertical slicing and removal of the bottom 25 mm of the root ball significantly increased the number of vertical roots and largely eliminated root curling with both species. Despite the severity of this treatment it had no significant effect on shoot growth of *E. mannifera* subsp. *maculosa* and only inhibited shoot growth of *E. polyanthemos* during the first 6 months.

The development of an extensive, balanced root system is critical for the successful establishment and growth of woody plants transplanted into the landscape. Flemer (2) has observed that root curling can result in relatively large trees blowing over despite good early growth. Examination of the root system of such plants has shown poor root growth into the surrounding soil. Even where curling roots extend normally into the surrounding soil, they have been implicated in plant decline through the formation of girdling roots which reduce stem conductivity and radial communication between tissues (3).

It has been suggested that in nursery production the development of root curl is associated with the use of rigid containers and the problem can largely be eliminated by the use of flexible plastic polybags (1,4). Despite the fact that flexi-

ble polybags have been in use in our city nursery for many years (1), root curl continues to be a problem and restricted root systems as described by Flemer (2) are all too common.

If root curl is present in container plants it is important that such roots be removed before planting takes place. A common practice is to tease out such roots into the surrounding soil at planting. This process can be very time consuming. Since root initiation readily occurs near the end of severed roots (5) a quicker alternative might be to cut any spiraling roots. The study reported here was undertaken to compare the effect of teasing and cutting of root systems on subsequent root and shoot development.

Materials and Methods

Eucalyptus mannifera subsp. *maculosa* (brittle gum) and *E. polyanthemos* (red box) in 65 mm × 160 mm (0.5 liter) and 150 mm × 240 mm (4 liter) black polythene bags, respectively, were used in this study. The *E. mannifera* subsp. *maculosa* plants were propagated from seed sown directly into the 0.5 liter bags. The plants were approximately 9 months old when used in this study. Plants of *E. polyanthemos* were propagated from seed sown directly into 0.5 liter bags, potted up into 4 liter bags after four months and were approximately 13 months old when used in this study. Forty plants of each species were selected for uniform size and ten allocated randomly to each of the following four root pruning treatments, undertaken immediately before planting.

(i) bag removed, no root disturbance.

(ii) bag removed, roots at bottom of bag teased out.

(iii) the bottom 25 mm of the bag, medium and roots removed with a sharp knife and then the remaining bag removed.

(iv) the bottom 25 mm of the bag, medium and roots removed and four vertical equally spaced slices made into the root ball to a depth of 10 mm and 20 mm in the 0.5 and 4 liter bag, respectively.

The plants were planted in October 1980 on a 2 m × 2 m grid into small holes in soil dug eight weeks previously with a backhoe. All plants were mulched with pine chips *(p. radiata)* and thoroughly watered. The plants were watered every 2 weeks for the first 12 weeks. After that they received no supplementary watering, i.e. rainfall only. Fertilizer, 70 g N:P:K: 10:4:6, was applied to the mulched area (0.5 m^2) around each plant and mixed into the mulch layer 4 weeks, 6 months and 12 months after planting.

Plant height was measured at planting and again after 6 months and the percent increase in growth calculated. Plants were again measured in April 1982 and 1983, 1½ and 2½ years after planting.

In May 1983 the plants were dug carefully with the assistance of a backhoe retaining a root ball of 600-700 mm diameter. The extent of root curl present was rated on a three point scale; 1 - extensive root curl, 3 - no root curl. The number of roots 5 mm and greater in diameter 100 mm outside the original root ball was determined. Those at 0-45° to the horizontal were classified as horizontal roots and those greater than 45° classified as vertical roots.

Results and Discussion

Root curl was common in polybag grown plants used in this present study (Fig. 1), contrary to the conclusion of Boden and Setchell (1) and Whitcomb (4) that their use eliminated root curl. With both species the removal of the bottom of the root ball together with vertical slicing largely eliminated this root curl (Table 1). With *E. mannifera* subsp. *maculosa* the removal of the bottom only was equally effective. When dug, all control plants of *E. mannifera* subsp. *maculosa* had a ball of fused roots corresponding to the bottom of the bag. A similar ball of fused roots was observed in 7 of the 10 teased root systems. This was not evident with plants in which the bottom of the bag had been removed. The results indicate that with plants grown in 0.5 liter bags root curl is largely restricted to the bottom portion of the bag.

The removal of the bottom of the root ball significantly increased the number of vertical roots (P 0.01) and increased the vertical to horizontal root ratio (Table 1). It might be expected that this increase in the number of vertical roots and the fact that secondary horizontal roots readily developed from these would contribute to the development of a more suitable, balanced root system.

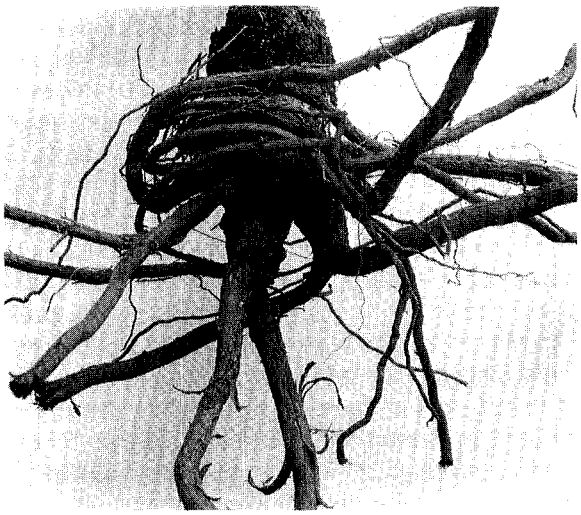

Fig. 1. Root system of *E. polyanthemos* showing extensive root curl.

Table 1. Effect of root pruning treatments 2½ years after planting on root development.

Treatment	*Root curl*	*No. horizontal roots*	*No. vertical roots*	*Vert/horiz root ratio*
E. mannifera* subsp. *maculosa				
Control	1.6a*	11.2a	1.8a	0.16a
Teased	1.8a	7.8b	1.5a	0.19a
Bot. removed	2.8b	9.1ab	3.5b	0.38b
Bot. removed/ sliced	2.8b	6.1b	3.4b	0.55b
E. polyanthemos				
Control	1.8a*	7.7a	2.4a	0.31a
Teased	1.8a	8.4a	3.4b	0.40a
Bot. removed	1.9a	5.5a	4.8bc	0.87b
Bot. removed/ sliced	2.7b	5.5a	6.1c	1.11b

* Mean separation in columns by Duncan's multiple range test, 5% level. Values are an average of 10 observations. Details on the root curl rating and the horizontal/vertical root classification are given in the materials and methods section.

Despite the severity of the root pruning treatment it had no long term effect on shoot growth. With *E. mannifera* subsp. *maculosa* no treatment effect on shoot growth was apparent at any stage during the trial. With *E. polyanthemos*, all three root treatments significantly inhibited shoot growth over the first six months. Over this period the mean percentage shoot growth for control, teased, bottom of bag removed and bottom bag removed/vertically sliced treated plants were 81.5, 50.6, 50.6, and 55.1, respectively. No significant treatment effect was apparent, however, when the plants were measured 1½ and 2½ years after planting.

The extent of the root curl present in many of the control and root teased plants in this present study could result in premature plant decline. The effectiveness and quickness of the root pruning procedure undertaken in this present work may therefore be of interest to those interested in the establishment of healthy, safe and long-lived trees within the landscape.

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