Genetic Variability in the Propagation of *Eucalyptus sideroxylon* by Stem Cuttings[1]

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Abstract

Stem cuttings from mature trees and coppice regrowth of three red ironbark eucalyptus (*Eucalyptus sideroxylon* A. Cunn. ex Woolls) genotypes were used to study the rooting response over time. Mature tissues failed to root, but coppice regrowth from the same trees showed a range in rooting response from 0 to nearly 100 percent. The two genotypes that formed adventitious roots maintained this ability for the duration of the study. The one genotype that exhibited the greatest potential for adventitious root formation formed a greater number of roots per cutting and had a greater mean root length.

Index words: phase change, juvenility, maturation, K-IBA, red ironbark eucalyptus

Introduction

Eucalyptus is an important ornamental genus and is under study world-wide as a promising biomass producer (3, 4). Many species in the genus *Eucalyptus* are considered to be difficult-to-root (2, 5, 6, 7). Vegetative propagation of selected genotypes of *Eucalyptus* would be useful in the mass production of ornamental and biomass clones. Therefore, the purpose of this study was to investigate the rooting potential of stem cuttings from mature trees and coppice regrowth from red ironbark eucalyptus (*Eucalyptus sideroxylon* A. Cunn. ex Woolls), to determine whether the potential was constant throughout the year, and to assess the impact of genetic variability on rooting potential.

Materials and Methods

On June 10, 1984, three, seed-propagated, 9-year-old individuals (genotypes) of *E. sideroxylon* were randomly selected as test plants. These trees, each approximately 9 m (29.5 ft) tall and having a diameter of approximately 25 cm (9.8 in) measured 45 cm (17.7 in) above the ground, were planted 9 years previously and had received routine, but identical, irrigation and fertilization treatments. Terminal cuttings [10 cm (4 in) long with four leaves attached] were taken from actively growing shoots of mature (capable of flowering) wood of each of the three trees, treated for 15 seconds [basal 2.5 cm (1 in) submerged in the treatment solution] in deionized water, 5000 (0.5%), or 10,000 (1.0%) mg/l potassium salt of indole-3-butyric acid (K-IBA in deionized water, sixty cuttings per treatment). The cuttings were placed in flats [35.6 cm (14 in) wide × 61 cm (24 in) long × 7.5 cm (3 in) deep] containing a rooting medium of perlite : vermiculite (1:1, by vol). The experimental design consisted of randomized complete blocks of 10 cuttings per block. The flats containing the cuttings were placed under deionized water mist (2.5 sec/2.5 min, dawn to dusk) in a greenhouse maintained at 25–30°C (77–86°F) ambient and 27°C (81°F) bottom heat. Rooting was evaluated after 4 weeks. The trees in the field from which the cuttings were taken were cut down at 45 cm (17.7 in) above ground level immediately after the first set of cuttings were made. Beginning 6 weeks later on July 27, 1984 and on September 12, 1984, November 29, 1984, March 8, 1985, and May 10, 1985, 20 to 30 terminal cuttings were taken from the developing coppice regrowth of each chosen individual tree and treated as above with 5000 mg K-IBA/L (0.5%) for 15 seconds and rooted under mist in the same experimental design. The cuttings were harvested and data recorded four weeks after the cuttings were treated and placed in the rooting medium. Data included the number and length of adventitious roots formed. Any cutting having 1 or more roots was classified as rooted.

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Results and Discussion

The three individual trees selected had very different abilities to initiate adventitious roots (Table 1). Cuttings taken from mature trees did not initiate adventitious roots regardless of plant selected or K-IBA concentration (data not presented in Table 1). Cuttings taken from coppice regrowth of genotypes 2 and 3 formed adventitious roots; however, cuttings from genotype 1 never rooted. Previous work with coppice tissues of *E. sideroxylon* had indicated that concentrations of K-IBA greater than 5000 m/L (0.5%) were phytotoxic. More cuttings from genotype 3 rooted than did cuttings from genotype 2 throughout the course of the year they were under study. The same trend appeared when comparing the number of roots per cutting (Table 1). In general, the rooting response began to decline 9 months after cutting the trees down. Increased root length was also associated with genotype 3 during the first 6 months of the study.

The lack of response of the mature tissue to the two K-IBA concentrations and the increased response of the "rejuvenated" or "invigorated" coppice tissue have been noted

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Table 1. Rooting response of coppice shoots of three *Eucalyptus sideroxylon* genotypes over time. Means are from 20–30 cuttings for each genotype at each time ± one standard deviation. Cuttings treated with 5000 mg K-IBA/L for 15 sec.

Month	Genotype	# Cuttings with roots	Rooting percentage	Roots/ rooted cutting	Mean Root length (cm)
July 84	1	0	0	—	—
	2	21	70	1.7 ± 0.2	—
	3	27	90	2.8 ± 0.5	—
September 84	1	0	0	—	—
	2	15	50	2.6 ± 0.3	4.9 ± 0.6
	3	27	90	9.4 ± 1.0	8.2 ± 1.1
November 84	1	0	0	—	—
	2	17	57	2.7 ± 0.4	5.0 ± 0.6
	3	23	77	7.8 ± 1.2	6.6 ± 0.4
March 85	1	0	0	—	—
	2	16	64	5.4 ± 0.9	5.7 ± 0.7
	3	22	88	9.1 ± 1.7	3.6 ± 0.5
May 85	1	0	0	—	—
	2	9	36	3.1 ± 0.7	3.0 ± 0.5
	3	12	48	4.5 ± 0.8	3.3 ± 0.5

before in other eucalypt species (2, 6). Coppice regrowth of two of the three genotypes rooted better than genetically identical mature tissue. These two genotypes also maintained their capacity to form adventitious roots for several months. After a year it appeared that the rooting response was decreasing which may be due to seasonal effects, signal a gradual return to the mature condition in terms of root initiation, or signal a reduction in the invigoration due to coppicing. The coppice tissues had not yet begun to flower.

E. sideroxylon has been shown to demonstrate significant morphological variability (1). This inherent trait may also explain the variability in rooting response observed here among the three genotypes. The rooting responses range from no response (genotype 1) to about 50% of the cuttings forming adventitious roots (genotype 2) to nearly 100% rooting (genotype 3). The rooting results obtained here suggest that the ability to form adventitious roots is a genetically variable characteristic whose heritability could be investigated and it may provide a model system for the study of the inherent biochemical, cytological, anatomical, and physiological differences among these eucalypt genotypes to understand the fundamental aspects of root initiation.

Significance to the Nursery Industry

Variability in the rooting of cuttings is usually discussed in terms of the environmental conditions during rooting, applied treatments, cutting type, physiology of the stock plant, or inherent, genetic influences. This work demonstrates that in *Eucalyptus sideroxylon* the rooting response is most affected by the inherent ability of the individual plants to form adventitious roots since the rooting environment, stock plant treatment, cutting type and cutting treatment were all identical. This work supports the recommended practice of considering genetic factors when developing production-oriented, vegetative propagation schemes for difficult-to-root species.

Literature Cited

1. Bramwells, H.W. and T. Whiffin. 1984. Patterns of variation in *Eucalyptus sideroxylon* A. Gunn. ex Woolls. I. Variation in adult morphology. Aust. J. Bot. 32:263–281.

2. Cauvin, B. 1982. Rejuvenilisation multiplication d'ortets seniles—Eucalyptus. Annales de Recherches Sylvicoles. p. 73–105.

3. Cauvin, B. and J.N. Marien. 1979. La multiplication vegetative des Eucalyptus en France. Quelques aspects de la juvenilite et de la rejuvenilisation. Annales de Recherches Sylvicoles. p. 140–175.

4. Evans, J. 1980. Prospects for eucalypts as forest trees in Great Britain. Forestry 53:129–143.

5. Hartney, V.J. 1980. Vegetative propagation of the eucalypts. Aust. For. Res. 10(3):191–211.

6. Paton, D.M., R.R. Willing, W. Nicholls, and L.D. Pryor. 1970. Rooting of stem cuttings of *Eucalyptus*: A rooting inhibitor in adult tissue. Aust. J. Bot. 18:175–183.

7. Pryor, L.D. and R.R. Willing. 1963. The vegetative propagation of *Eucalyptus*—An account of progress. Aust. For. 27:52–62.