Short communications

Cutting propagation of Victorian smokebush, Conospermum mitchellii (Proteaceae)

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Rooting and death of vegetative tip cuttings of Victorian smokebush, Conospermum mitchellii Meisn., taken from softwood, semi-hardwood and hardwood material, were examined using formulations of auxins (IBA and NAA) at three air temperatures (20°C/16°C; 25°C/20°C and 28°C/23°C; daylight). This species was found easy to propagate, particularly if softwood material is used or cuttings are treated with an IBA-based formulation. Formulations containing NAA should be avoided as they result in few rooted cuttings and a high incidence of cutting death. Air temperature had no significant impact on rooting under conditions of high relative humidity and root-zone heating.

Keywords: auxins, Conospermum mitchellii, propagation, roots, temperature.

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The smokebushes, Conospermum spp., are representatives of the family Proteaceae, sub-family Proteoideae, which has provided floriculture with several well-known African genera such as Protea, Leucospermum and Leucadendron, as well as the Australian Stirlingia. Most Conospermum species occur in Western Australia, and several of the western species are harvested extensively from natural populations for domestic and export use as cut flowers (Wrigley & Fagg 1991). The western species are considered difficult to propagate (Sainsbury 1991), and the purpose of this research was to assess the amenability to propagation of one of the eastern species.

Victorian smokebush, C. mitchellii Meisn., is an eastern species which occurs as an upright woody shrub to 2 m in height, producing large aromatic terminal corymbs of white or pale cream flowers, sometimes tinged with blue or lilac, in late winter and spring. The species is currently being assessed for commercial exploitation as a cut flower (Talcott & King, 1994). The species is currently being assessed for commercial exploitation as a cut flower (Talcott & King, 1994). The species is currently being assessed for commercial exploitation as a cut flower (Talcott & King, 1994). The species is currently being assessed for commercial exploitation as a cut flower (Talcott & King, 1994).

Vegetative tip cuttings of C. mitchellii were collected from a large natural stand near Anglesea, Victoria (38°25'S, 144°11'E) in late-November, mid-March and late-May representing softwood, semi-hardwood and hardwood cuttings respectively. After overnight storage at 4°C, cuttings were trimmed to 80 mm length, leaves were removed from their basal halves, and the stem ends were dipped in treatment solutions for approximately 40 s. Five different solutions were assessed: 1) water; 2) a commercial gel containing 3000 mg L⁻¹ indole-3-butyr acid (IBA) + macro- and micro-nutrients (Growth Technology, South Fremantle, Western Australia); plus fresh 50% ethanol solutions of 3) 5000 mg L⁻¹ IBA, 4) 5000 mg L⁻¹ α-naphthaleneacetic acid (NAA), and 5) 3500 mg L⁻¹ IBA + 1500 mg L⁻¹ NAA. A 50% ethanol solution was required for dissolving high doses of IBA, which precipitates at about 30% ethanol containing 4000 mg L⁻¹ IBA (Dawson and King, 1994).

Each treated cutting was placed individually in a 50 mm wide tube containing a steam-sterilized 1:1:1 coarse sand:perlite:peat mixture. Tubes were placed randomly in moist vermiculite in heated trays which maintained a root zone temperature of 28°C. An automatic misting system controlled by evaporative sensors, and polyethylene frames reaching 1 m above cutting height, maintained high relative humidity. The propagating trays were located in glasshouse cells which provided fine control of air temperature under natural illumination. Three air temperature regimes were tested: 20°C/16°C, 25°C/20°C and 28°C/23°C (day/night; 12 h/12 h cycle). For every treatment combination, 20 cuttings were used, and the percentage of rooted and dead cuttings for each combination was recorded after 8 weeks. Dead cuttings clearly displayed stem and leaf necrosis. Cutting type, auxin and air temperature effects on the percentage of rooted or dead cuttings were assessed using 3-way analyses of variance without replication. Where significant differences were detected, Tukey’s HSD comparisons were performed.

Rooting percentage and cutting mortality were not significantly affected by air temperature, but both were significantly affected by cutting type and by auxin treatment (P < 0.05) (Table 1). Softwood cuttings were the most amenable to propagation, providing a higher rooting frequency than either semi-hardwood or hardwood cuttings, as well as a lower incidence of cutting death than hardwood cuttings (Table 2). The highest rooting frequencies were also obtained using formulations containing IBA.

Table 1 Three-way analyses of variance to examine cutting type, auxin treatment and air temperature effects on rooting and mortality of Conospermum mitchellii cuttings

| Source of variation | df | MS    | F     | P         |
|---------------------|----|-------|-------|-----------|
| Rooting:            |    |       |       |           |
| Cutting type        | 2  | 2321.7| 9.98  | <0.001    |
| Auxin treatment     | 4  | 5560.3| 25.91 | <0.001    |
| Air temperature     | 2  | 61.7  | 0.27  | 0.769     |
| Error               | 36 | 232.6 |       |           |
| Mortality:          |    |       |       |           |
| Cutting type        | 2  | 2555.0| 4.83  | 0.014     |
| Auxin treatment     | 4  | 4560.3| 8.62  | <0.001    |
| Air temperature     | 2  | 1295.0| 2.45  | 0.101     |
| Error               | 36 | 328.9 |       |           |

Table 2 Effects of cutting type on mean (±sE) rooting and mortality of Conospermum mitchellii cuttings

| Cutting type | Rooting (%) | Dead (%) |
|--------------|-------------|----------|
| Softwood     | 45.3 ± 8.0a | 21.7 ± 3.8a |
| Semi-hardwood| 24.7 ± 6.0b | 32.7 ± 8.2b |
| Hardwood     | 23.0 ± 7.0b | 47.7 ± 10.4b |

Means within a column followed by the same superscript are not significantly different (Tukey’s HSD test; P > 0.05).
Table 3 Effects of auxin treatment on mean (±SE) rooting and mortality of Conospermum mitchelli cuttings

| Auxin treatment | Rooting (%) | Dead (%) |
|-----------------|-------------|----------|
| Water           | 26.7 ± 8.0a | 10.0 ± 4.4a |
| Commercial gel (3000 mg l⁻¹ IBA) | 60.6 ± 8.6b | 17.2 ± 3.8a |
| 5000 mg l⁻¹ IBA | 52.2 ± 4.8b | 27.8 ± 6.8a |
| 5000 mg l⁻¹ NAA | 2.8 ± 1.5c  | 53.9 ± 14.0bc |
| 3500 mg l⁻¹ IBA + 1500 mg l⁻¹ NAA | 12.8 ± 4.6e | 61.1 ± 9.8c |

Means within a column followed by the same superscript are not significantly different (Tukey’s HSD test; P > 0.05).

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Effect of oxifulvic acid supplemented with copper and/or iron on growth of bacterial and fungal plant pathogens

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South African bituminous coal can be converted by controlled wet oxidation to a highly oxidized water-insoluble product (oxihumic acids) and water-soluble oxifulvic acids (OFA). OFA, OFA-Cu and OFA-Fe, including various complexes, were evaluated against four fungal (Aspergillus flavus, Fusarium oxysporum, Colletotrichum dematium and Alternaria alternata) and three bacterial (Erwinia carotovora, Pseudomonas syringae and Clavibacter michiganense) plant pathogens. CuSO₄ and CuSO₄ & FeSO₄ significantly reduced growth of Erwinia, Clavibacter and Pseudomonas when compared to the control. CuOCl significantly reduced growth of Erwinia and Clavibacter. OFA, OFA-Cu & OFA-Fe reduced the growth of Pseudomonas and with the exception of the latter two, Clavibacter. CuSO₄ inhibited the growth of Colletotrichum, Alternaria and Fusarium significantly. OFA-Cu & OFA-Fe reduced the growth of Colletotrichum when compared to the control whereas OFA-Cu reduced growth in Alternaria significantly.

Keywords: Fulvic acid, oxifulvic acid, growth inhibition, plant pathogens.

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The role of chemical fungicides and pesticides is currently under closer scrutiny than ever before. As safety standards in developed countries increase and new data on health and environmental hazards become available, more and more products are being withdrawn from the market (Evans 1995). Current research is concentrating on alternative control methods. This has led to the re-examination and improvement of many old practices and to the development of new methods in controlling plant diseases. It has been reported by Hasset et al (1987) and Kai et al (1990) that humic substances possess an antimicrobial activity. Humic acid, isolated from domestic sewage, was shown by Hasset et al. (1987) to have bactericidal activity against Serratia marcescens, Bizio and Staphylococcus aureus Rosenberg. No direct reference to the antimicrobial activity of fulvic acid has been reported in the literature (Bosch 1993). However, water-soluble extracts, possibly fulvic acid, of bark were shown to have antifungal activity on compost (Kai et al. 1990; Hardy & Sivasithamparan 1991).

Alternative uses for the country’s abundant coal reserves and the need to overcome its lack of identifiable commercially recoverable crude oil reserves has been documented and this encouraged the research fraternity to explore the benefitization of coal for other applications. This led to the development of an environmentally friendly, controlled, wet coal oxidation process for the production of non-toxic chemicals that are similar to the humic acids and fulvic acids found naturally in fertile soils. These