EFFECT OF INDOLEBUTYRIC ACID, MEDIUM COMPOSITION, AND CUTTING TYPE ON ROOTING OF *GREVILLEA JOHNSONII* CUTTINGS AT TWO BASAL TEMPERATURES

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REVIEW OF LITERATURE

Grevillea johnsonii is a most attractive species. An upright shrub with fine, slender, deep-green foliage on reddish stems, it is quick growing and forms a more compact and neater shrub than the closely related *G. longistyla*. Occurring naturally in the Rylstone area of the central tablelands of New South Wales, *G. johnsonii* has proved frost hardy in Canberra and plants at the National Botanic Gardens have reached 4 m × 3 m in five years. The orange to pink flowers are borne in loose clusters in the upper leaf axils from late winter to early summer.

Vegetative propagation of *G. johnsonii* is considered difficult (4,10) although grafting onto *G. robusta* has proved successful (2,4). Generally, the use of soft cutting material taken from hard-pruned stock plants maintained in active growth by the regular application of nitrogenous fertilizer is recommended for the propagation of grevilleas (1,2). Hellriegel (10), working with *Grevillea* 'Ivanhoe', obtained superior rooting with tip cuttings compared with basal cuttings. In contrast Dupee and Clemens (4) obtained the opposite result with the difficult-to-root *Grevillea* 'Robyn Gordon'.

The use of a rooting hormone is generally recommended with *Grevillea* species (1,2) for which indolebutyric acid (IBA) has been shown to be superior to naphthaleneacetic acid (NAA), or an IBA/NAA combination in stimulating rooting (6,8).

A number of rooting mixes have been used successfully for *Grevillea* cuttings (1,2,4,6,10). Ellyard (6) employed a sand: sieved-German peat: perlite, 1:1:1 v/v mix, although recent observations suggest that a mix of higher air porosity might be more appropriate. In this regard the sand: sieved-German peat: perlite 2:1:1 v/v mix recommended by Hellriegel (10) is of interest.

Temperature has a definite effect on the rooting of cuttings. Difficult-to-root species appear to respond more to increased basal temperature than easily-rooted species (4,7,11,12). Increased basal temperature, however, can increase callus development (13), a finding relevant to many *Grevillea* species which consistently over-callus.

In the experiment reported here the effect of indolebutyric acid concentration, cutting type, and rooting medium on rooting and callus development of *Grevillea johnsonii* at two basal temperatures was investigated.

MATERIALS AND METHODS

The two cutting media used in this study were sand: German peat: perlite (1:1:1 v/v) and sand: German peat: perlite (2:1:1 v/v). The physical properties of the two media are given in Table 1. The percentage air-filled and water-filled pore space was determined by the method of Buscher and Van Doren (3), modified in that the pots were drained for 3 hours on sand (bottom heat, 24° ± 1°C) under mist prior to determining the drained weight. The medium pH was determined by both a 1:2.5 v/v dilution of soil in 0.01 M Ca Cl_2 and a 1:2.5 v/v dilution in distilled water.

Table 1. Physical properties of rooting media.

Particle Size (mm)	Percentage distribution 1:1:1 v/v medium	2:1:1 v/v medium
< 0.25	4.3	3.6
0.25-0.50	11.2	12.0
0.50-1.0	41.3	41.7
1.0 -2.0	35.8	36.1
> 2.0	7.4	6.6
pH in 0.01 M $CaCl_2$	3.5	3.7
pH in water	4.2	4.4
Air porosity (%)	28	27
Water porosity (%)	30	23

Cutting material was collected from a seven year old cultivated plant on 14 October, 1982, and two types of cuttings were prepared immediately. Terminal cuttings consisted of nodes 1-4, node 1 being that closest to the apex with a near fully extended leaf. The basal cut was made 1 cm below node 4 and the leaves were removed from nodes 3 and 4. Stem cuttings consisted of nodes 5-8. The basal cut was made 1 cm below node 8 and the leaves removed from nodes 7 and 8 and reduced in area at nodes 5 and 6.

Auxin (in 50% ethanol) was applied as a 5-sec. quick-dip to the basal surface of the cutting and excess liquid allowed to evaporate before the cuttings were inserted into the cutting medium in 100 mm × 100 mm × 80 mm deep plastic pots (8 cuttings/pot).

The cuttings were placed on a sand bed under mist in a glasshouse (light transmission 25%). The mist was controlled by an electronic leaf set to maintain a relatively dry environment around the cuttings. Bottom heat was provided by electric cables buried in the sand bed. Two basal temperatures, 30 ± 1°C and 24 ± 1°C were used. The cuttings were treated regularly with a captan/benomyl fungicide mix. All cuttings were harvested at 12 weeks and the number of rooted cuttings/replicate and the number of roots/cuttings recorded. Each cutting was also rated on a 3 point scale with regard to the amount of callus present (1 = no or little callus, 3 = heavy callus). The experiment was designed to test the effect of four IBA levels, two cutting types, and two rooting media at two temperatures (not replicated) on the rooting of *G. johnsonii*. At each temperature the experiment was a 4 × 2 × 2 factorial set up in a randomized complete block design. Each treatment was replicated six times with 8 cuttings per treatment replicate.

RESULTS

At the basal temperature of 24°C both medium composition and auxin concentration had a highly significant effect on the percent rooting of *Grevillea johnsonii* (Figure 1 and Table 2). Of the two media, the sand:peat:perlite, 2:1:1 v/v, medium proved the superior. In this medium optimum rooting was obtained at 4000 ppm IBA; 8000 ppm IBA proved detrimental to rooting. In the sand:peat:perlite, 1:1:1 v/v medium a different rooting pattern was obtained, resulting in a significant difference in percent rooting in the two media at 4000 ppm and 8000 ppm IBA (Table 3). Cutting type had a significant but lesser effect on rooting. Calculation of LSD (0.05) showed the difference in the percent rooting of terminal compared to stem cuttings to be significant only in the sand:peat:perlite, 1:1:1 v/v medium at 2000 ppm IBA.

Table 2. Significance levels for struck cuttings and callus formation on *Grevillea johnsonii*.

Comparison	Significance levels (P)[2] 24°C	30°C
No. of Struck Cuttings		
Blocks	**	**
Medium	***	N.S.
Cutting type	*	N.S.
Auxin	***	**
Medium × Cutting type	N.S.	N.S.
Medium × auxin	*	N.S.
Cutting type × auxin	N.S.	N.S.
Medium × cutting type × auxin	N.S.	N.S.
Callus formation		
Blocks	N.S.	N.S.
Medium	***	N.S.
Cutting type	***	***
Auxin	N.S.	*
Medium × cutting type	***	N.S.
Medium × auxin	N.S.	N.S.
Cutting type × auxin	***	***
Medium × cutting type × auxin	N.S.	N.S.

[1] This analysis was undertaken on $\sqrt{x} + ½$ transformation of rooted cuttings/replicate date

[2] * = $P < 0.05$. ** = $P < 0.01$ *** = $P < 0.005$ N.S. = Not significant.

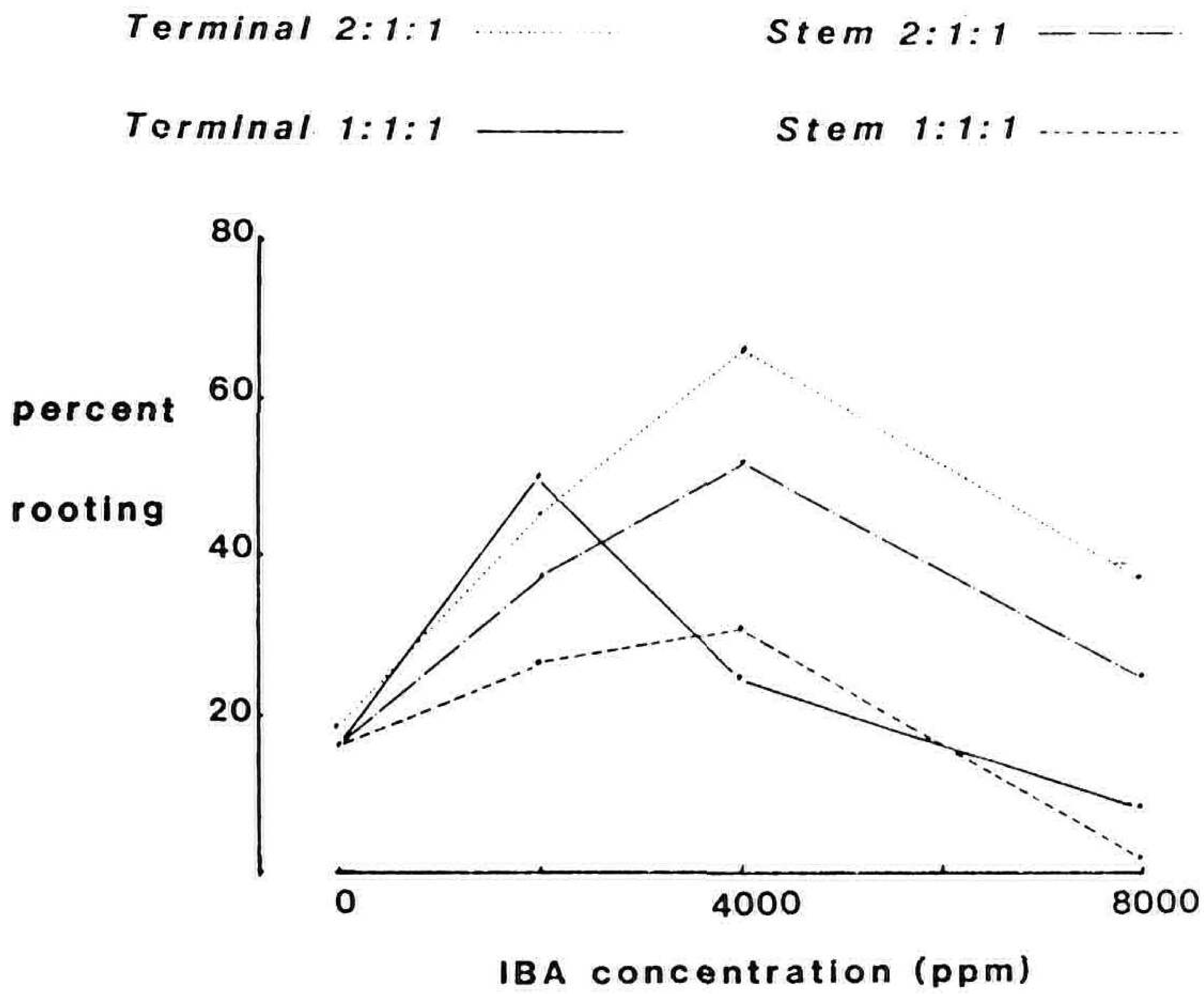

Figure 1. Effect of indolebutyric acid on the percent rooting of terminal and stem cuttings of *Grevillea johnsonii* propagated in sand:peat:perlite 2:1:1 v/v and sand:peat:perlite 1:1:1 v/v medium at a basal temperature of 24±1°C.

Table 3. Significance levels for the effect of media at 24°C on percent rooting at four auxin levels.

IBA Concentration	Significance of medium effect
0 ppm	N.S.
2000 ppm	N.S.
4000 ppm	**
8000 ppm	**

At the basal temperature of 30°C auxin application had a significant effect on percent rooting (Figure 2). High auxin concentrations appeared less detrimental to rooting than at 24°C. In contrast to the results obtained at 24°C, medium and cutting type were without significant effect on percent rooting.

No significant treatment effect on number of roots per rooted cutting was evident at either basal temperature.

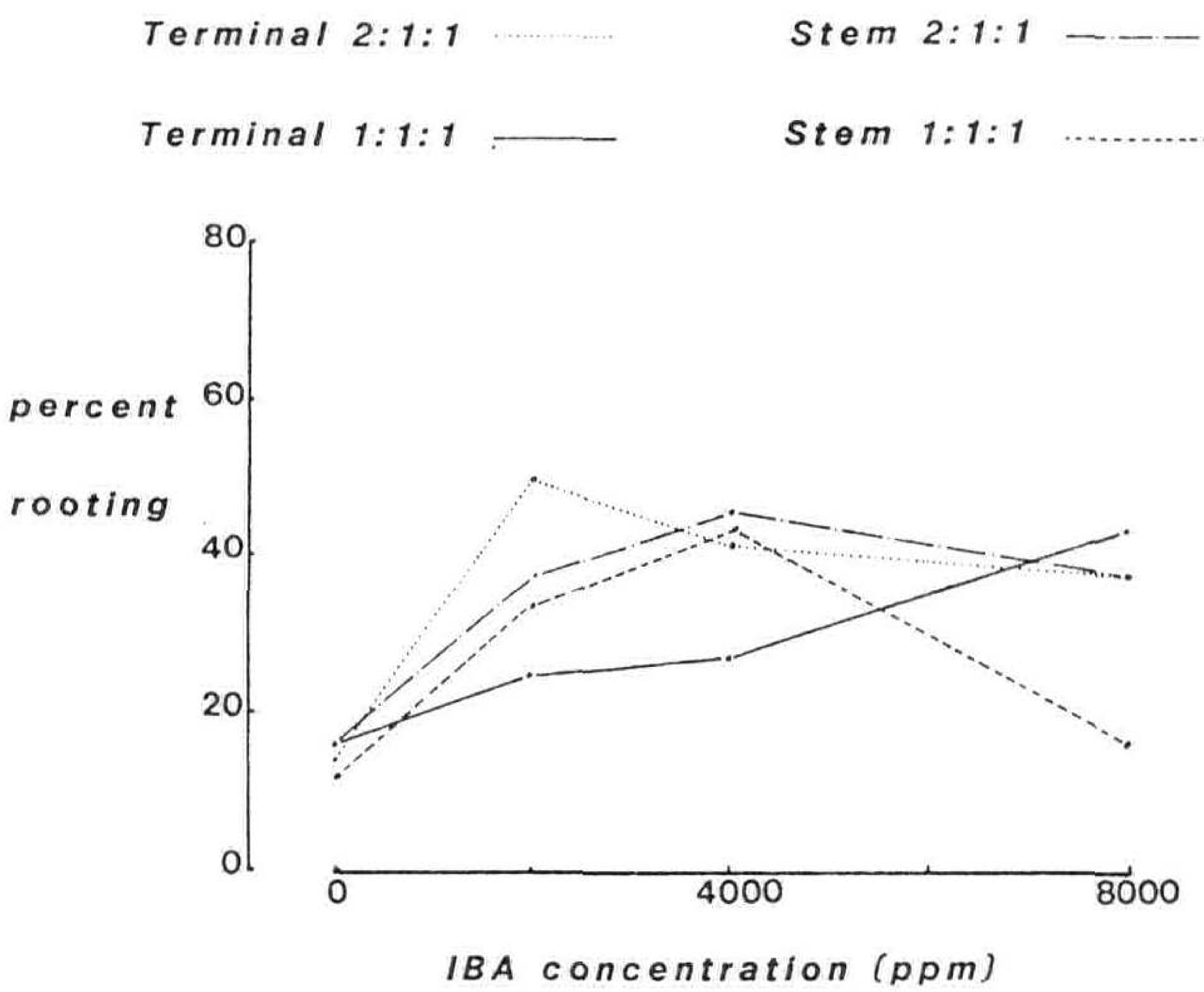

Figure 2. Effect of indolebutyric acid on the percent rooting of terminal and stem cuttings of *Grevillea johnsonii* propagated in sand:peat:perlite 2:1:1 v/v and sand:peat:perlite 1:1:1 v/v medium at a basal temperature of 30±1°C.

At both temperatures stem cuttings produced more ($P < 0.001$) callus than did terminal cuttings (Figure 3). This excessive callus production was often associated with considerable stem dieback which was not apparent on terminal cuttings. With terminal cuttings at 24°C, medium had a significant effect on the amount of callus produced, with the greatest callus production in the sand:peat:perlite, 1:1:1 v/v medium. No significant medium effect was evident with stem cuttings at 24°C, or with either terminal or stem cuttings at 30°C.

With regard to callus production stem and terminal cuttings responded differently to increasing auxin concentration at both basal temperatures. The increased callusing of stem cuttings with increasing auxin concentration was not evident with terminal cuttings.

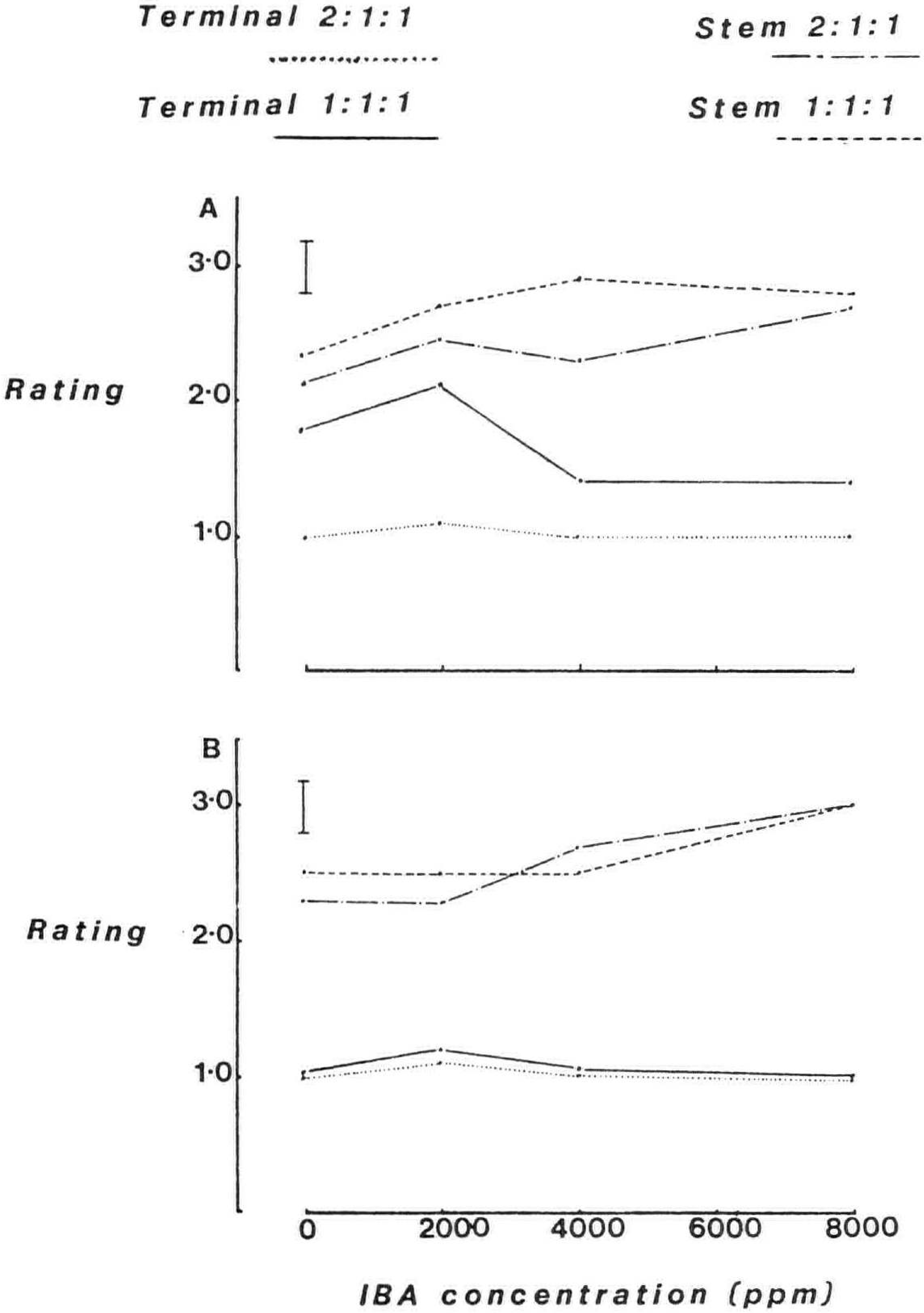

Figure 3. Effect of indolebutyric acid on the formation of callus on terminal and stem cuttings of *Grevillea johnsonii* propagated in sand:peat-:perlite 2:1:1 v/v and sand:peat:perlite 1:1:1 v/v medium at a basal temperature of 24°C (A) or 30°C (B). Cuttings were rated on a 3 point scale: 1 = no or small amount of callus, 3 = large amount of callus.

DISCUSSION

The results clearly show that under the right conditions a good rooting response can be obtained with *Grevillea johnsonii* cuttings. Other work (6,8) with a range of *Grevillea* species suggest that better rooting may be obtained with autumn cuttings.

The sand:perlite:peat, 2:1:1 v/v/v medium, as recommended by Hellriegel (10), with its lower water retention, is obviously the superior medium, particularly at the lower basal temperature.

The results suggest that the water content of the medium is very important in the rooting response. The 1:1:1 v/v/v medium at 24°C would seem to retain too much water for a good rooting response. At this temperature the 2:1:1 v/v/v medium is very significantly superior. At the higher basal temperature of 30°C, at which both media could be expected to dry out more and therefore retain less moisture, no significant medium effect was evident.

The results suggest that the water content of the medium also influences callus production since, as with the percent rooting data, the medium had a significant effect at 24°C but not at 30°C. This would seem to be in agreement with the finding of Bunker (1), who observed with tip cuttings of *Grevillea* 'Robyn Gordon', that a wet medium could lead to excessive callus production. In contrast to the percent rooting data, however, cutting type had the greatest effect on callus production. Hellriegel (10) who has made a similar observation with *Grevillea* 'Ivanhoe', suggests that the tendency for stem cuttings to over-callus is due to a change in the carbon/nitrogen ratio of the plant material and the lignification of cell walls which occurs during secondary growth.

High concentrations of IBA would appear to be more detrimental at 24°C than at 30°C, particularly in the more water retentive medium. Grange and Loach (9) have shown that water uptake by cuttings is directly proportional to the water content of the medium. Increased water uptake could be expected to result in increased auxin uptake. It is possible, therefore, that the decreased rooting percentage observed at 8000 ppm IBA in the 2:1:1 v/v/v medium and at 4000 ppm and 8000 ppm in the more water retentive 1:1:1 v/v/v medium at 24°C may result from the uptake of supra-optimal amounts of auxin. At 30°C basal temperature the media could be expected to be drier and therefore the cuttings subjected to less water and consequently less auxin uptake.

The relationship between auxin concentration, medium, and temperature and their effect on rooting is obviously complex and will require further investigation in the future.

Acknowledgement. The excellent technical assistance of J. Groves is gratefully acknowledged.

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HORTICULTURAL DEVELOPMENT OF AUSTRALIAN PLANTS

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Abstract. The potential of Australian native plants is examined over a broad spectrum of horticultural applications. The history of the development of this potential is traced and the future direction to which research should be aimed is proposed. The flora is examined for its potential in such categories as garden subjects, cut flowers, dried flowers, amenity plants for arid areas, forage plants for arid areas, indoor plants, and economic plants.