for composting and the risk of ammonium burn, and plant growth was good. As time progressed the mix was changed to: 3 parts bark, 2 parts coarse sand, 1 part brown coal, and the fertilizer mix was changed to: 2 kg 8 to 9 month Osmocote, 1 kg 3 to 4 month Osmocote, 850 g lime, 850 g superphosphate, 200 g potash, 19 g Fritted Trace Elements, 75 g sulphate of iron, and 75 g G.U. 49 per cubic metre and, more recently, this has been changed to: 2 kg 8 to 9 month Osmocote, 1 kg 3 to 4 month Osmocote, 850 g lime, and 1 kg Micromax. This fertilizer blend is varied for different plants and pot sizes.

For *Proteaceae* we use: 2 kg 8 to 9 month Sierra Blend & Iron, 1 kg Micromax, 850 g lime, and 2.3 kg dolomite lime.

General Mix: 2 kg 8 to 9 month Osmocote, 1 kg 3 to 4 month Osmocote, 1 kg Micromax, 850 g lime.

For indoors the Osmocote used is: 2 kg 3 to 4 month Osmocote, 1 kg 8 to 9 month Osmocote. For large containers the Osmocote is: 1 kg 3 to 4 month Osmocote; 1 kg 8 to 9 month Osmocote, 1 kg 12 to 15 month Osmocote.

This medium has proved successful until last summer when the problems of watering were extreme. So two trial mixes were tested in an endeavour to eliminate this watering problem. These trial mixes were: (a) 2 parts bark, 2 parts coarse sand, 1 part sandy loam, and 1 part brown coal, and: (b) 3 parts bark, 1 part coarse sand, 1 part sandy loam, and 1 part brown coal

The second mix is the one we will be using as it is lighter but still gives us the required results.

PROPAGATION OF *BORONIA SERRULATA* Sm. (NATIVE ROSE) FROM CUTTINGS

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Abstract. *Boronia serrulata* is a plant with great horticultural potential but as yet is not widely propagated and grown for amenity horticulture A study was made into the effects of applied auxin, temperature at the base of the cutting, and source of cutting material on the rooting of cuttings of this Native Rose Response to auxin depended on physiological state and genotype of donor plant Cuttings selected in the spring (November) from wild donor plants showed improved rooting percentage to applied auxin, however those taken in late summer (February) were unresponsive Cuttings selected in November from container-grown mother stock plants showed little response to applied IBA up to 8,000 ppm. Basal temperature of 29°C improved rooting percentage in November but in February bottom heat caused drying of cuttings

Wild populations of donor plants gave rooting percentages ranging from 6% to 93% whilst cuttings from mother stock plants showed a rooting percentage of 85% Although the treatment of cuttings with auxin and the provision of basal heating can promote the rooting of Native Rose, greatest improvement in rooting can be achieved by careful selection and management of mother stock plants.

Boronia serrulata is a medium shrub growing in heath and open woodland. The distribution of Native Rose is confined to the soils of Hawkesbury sandstone in a coastal strip extending between Gosford and Waterfall, New South Wales.

The family Rutaceae is well represented in Australia and the genus *Boronia* is endemic. Many *Boronia spp.* have great horticultural potential but vegetative propagation has been reported to be slow and difficult (1,9).

The effect of applied auxin, temperature at the base of the cutting, and donor plant on the rooting of *Boronia serrulata* was investigated.

MATERIALS AND METHODS

The response of Native Rose cuttings to four auxin treatments and four basal temperatures was investigated in November, 1978, and February, 1979, in two factorial experiements.

Auxin Treatments:

1,500 ppm each of *NAA and IBA in 50% aqueous ethanol
1,000 ppm each of *NAA and IBA in 50% aqueous ethanol
500 ppm each of *NAA and IBA in 50% aqueous ethanol
Control, 50% aqueous ethanol

Basal temperatures:

19°C, 24°C, 29°C, 34°C

The source of cuttings was wild donor plants growing in the Royal National Park near Sydney. Cuttings were all ripened shoot tips 5 to 7 cm long. They were washed in aqueous calcium hypochlorite (0.5% available chlorine) for two minutes and rinsed several times in deionized water. Leaves were trimmed from the lower 2 cm and the base was dipped in the appropriate auxin solution for five seconds. Cuttings were stuck into a steam pasteurized coarse sand/peat mixture (3:1) in 30 mm diameter plastic pots. Pots were placed under intermittent mist in the temperature beds.

Treatments were replicated 15 times; each replicate of four cuttings was a different donor plant. Cuttings were exam-

*NAA — naphthaleneacetic acid IBA — indolebutyric acid ined for roots after eight weeks. Rooted cuttings from November, 1978, were repotted and placed in a shade house (50% shade) Establishment of cuttings was noted three weeks later.

In November, 1979, a third experiment was designed to assess rooting response of cuttings (basal temperature 27°C) to the following auxin treatments:

8,000 ppm IBA in 50% ethanol
4,000 ppm IBA in 50% ethanol
2,000 ppm IBA in 50% ethanol
1,000 ppm IBA in 50% ethanol
Control, 50% ethanol

Cuttings were taken from 15-month-old container-grown plants propagated from one clone. These mother stock plants were grown in a shade house (50% shade). Cuttings were examined for rooting after eight weeks and observations made on the number of cuttings rooted, number of roots formed per cutting, and total root length per cutting. Cuttings were visually ranked 0-5 on root development (Figure 4).

RESULTS

In November, 1978, a greater percentage of cuttings rooted at a basal temperature of 29°C and 34°C compared to 19°C (Fig. 1) Cuttings planted in February rooted better at 19°C and 24°C

Cuttings from wild donor plants in November showed improved rooting with the application of auxin. IBA/NAA at 1,000 ppm significantly increased percentage rooted over the control. (Fig 2) The response to auxin in February was slight and not significant

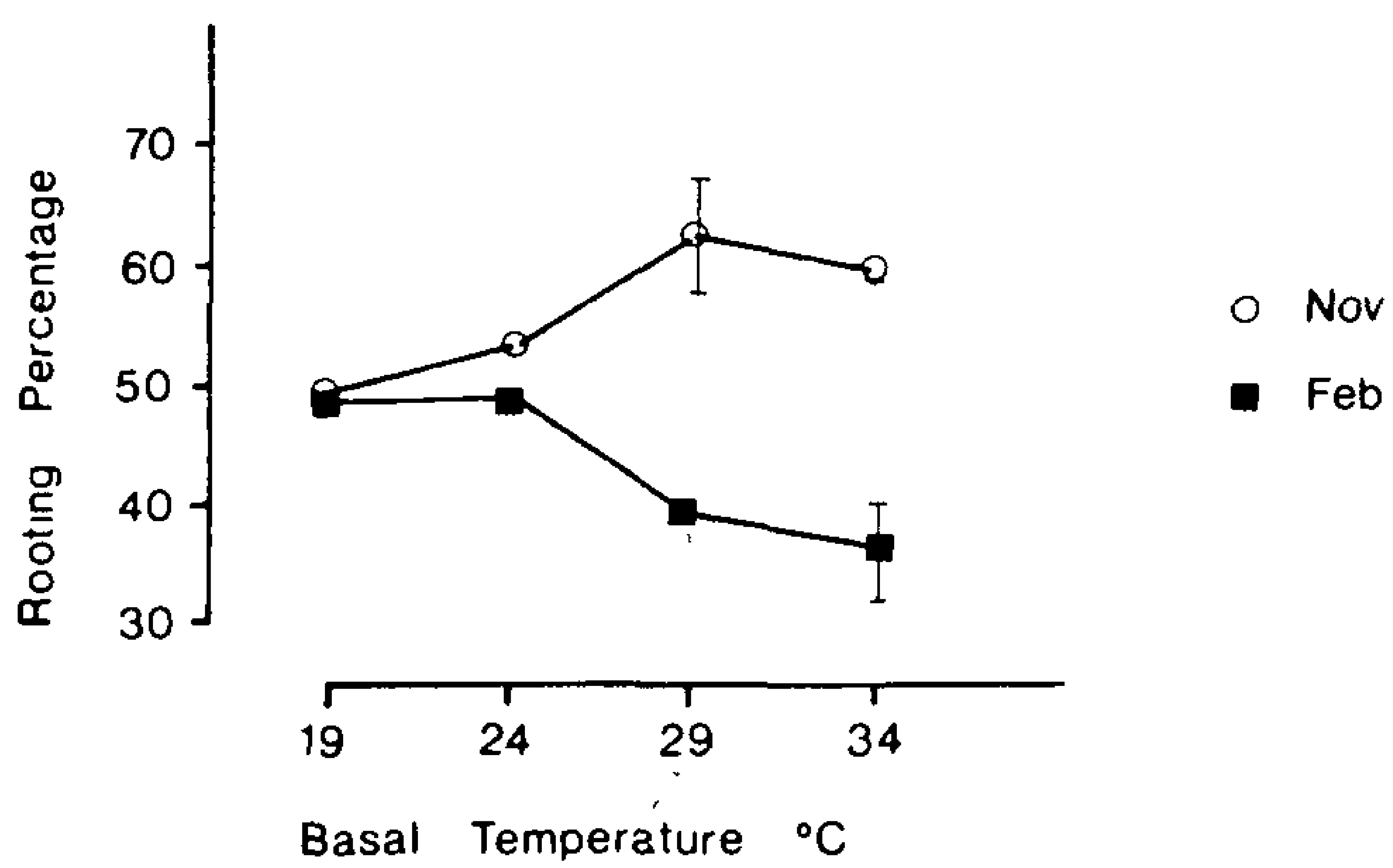

Figure 1. Response of *Boronia serrulata* cuttings to basal temperature

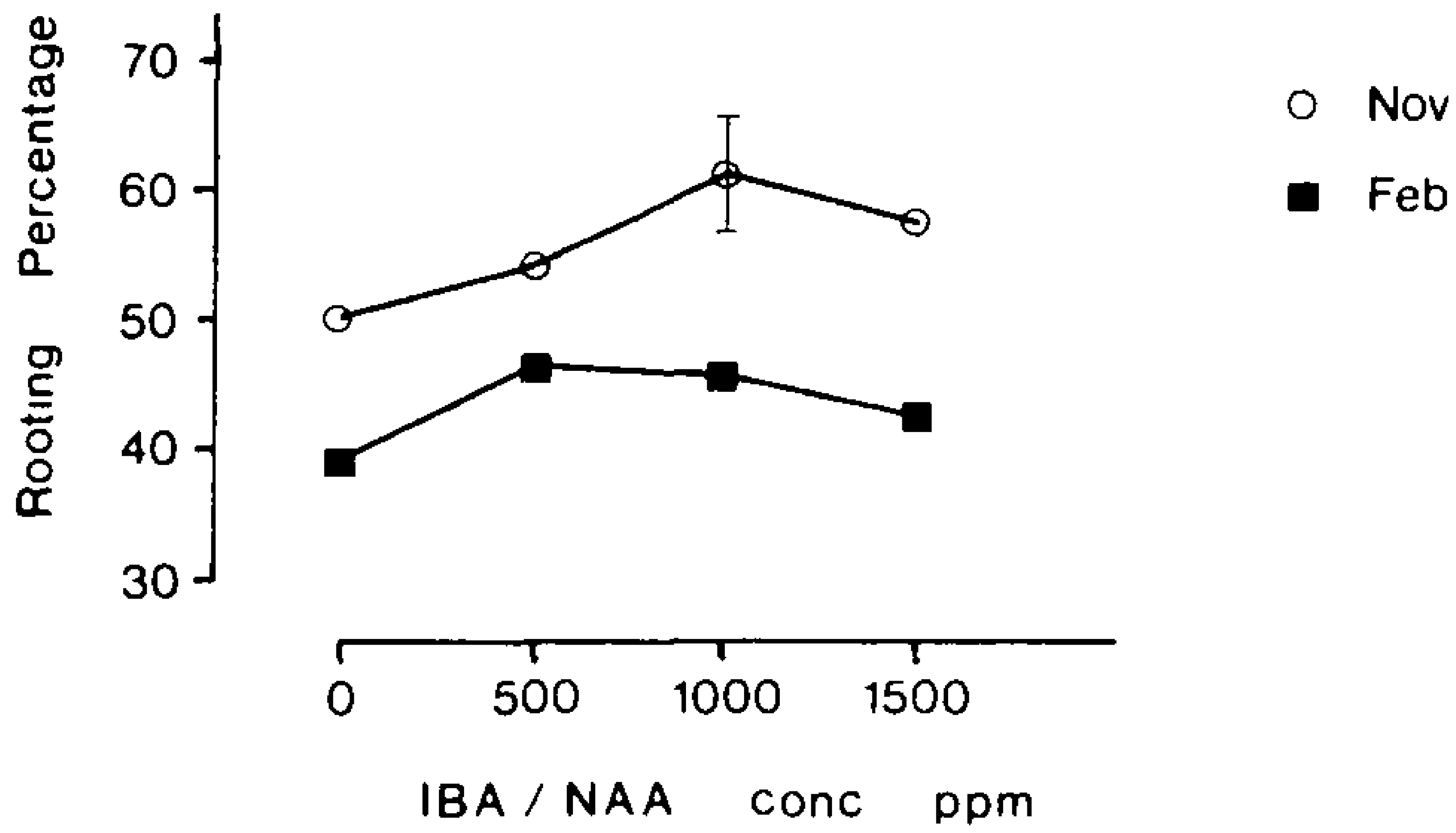

Figure 2. Response of *Boronia serrulata* cuttings to applied auxin

Rooting of cuttings (irrespective of temperature or auxin treatment) varied between 6% and 93% for the different donor plants (Fig. 3). The establishment of rooted cuttings from November 1978 is shown in Table 1. Donor plants showing a high rooting percentage did not necessarily establish better than those with a low rooting percentage

In Experiment 3 using mother stock plants, high levels of applied indolebutyric acid had no effect on the percentage of cuttings forming roots and the number of roots formed per cuttings (Table 2). Root development assessed visually (Fig 4) and total root length was greater when cuttings were treated with 8,000 ppm IBA

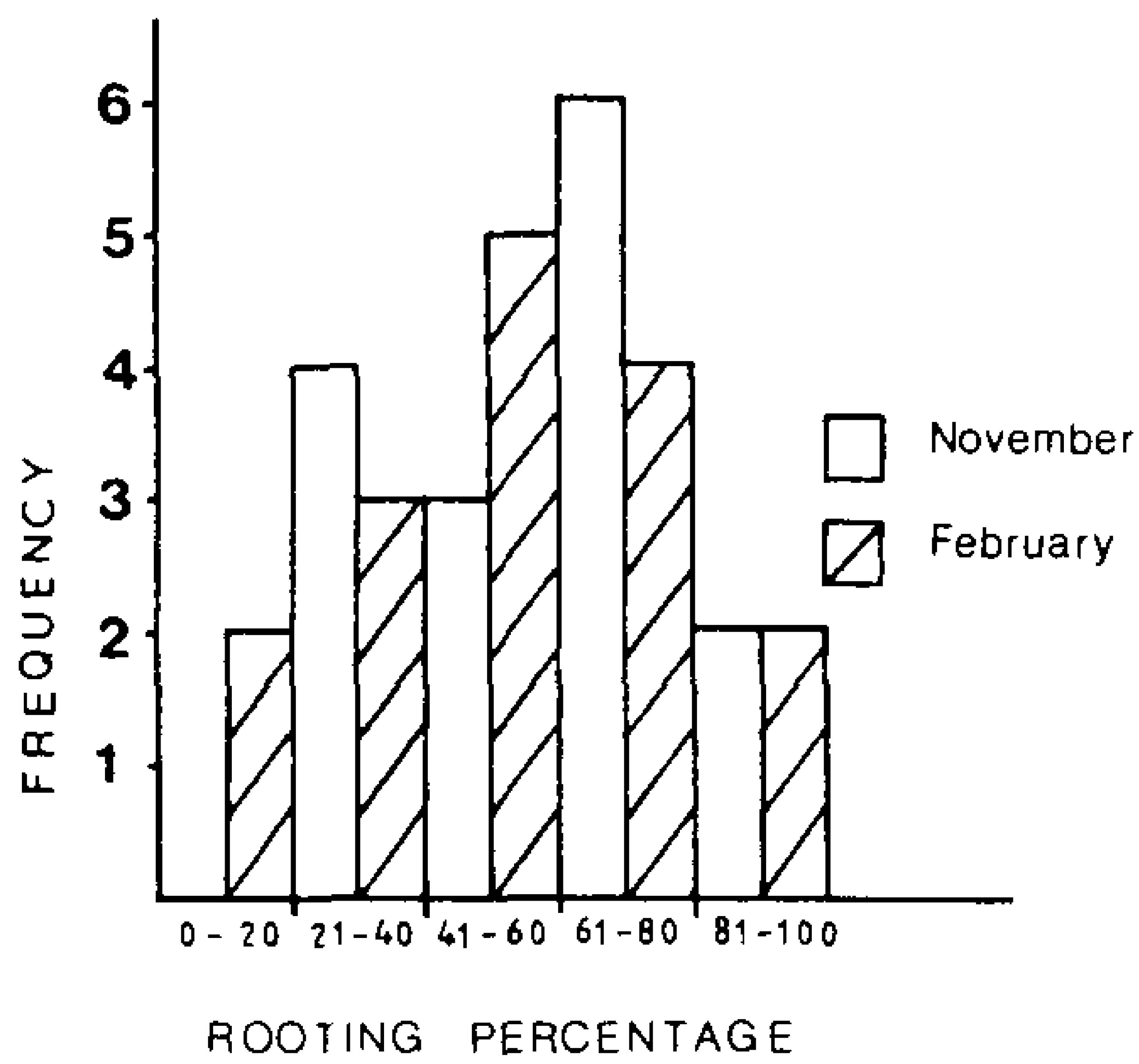

Figure 3. Frequency distribution of rooting percentage for different wild donor plants

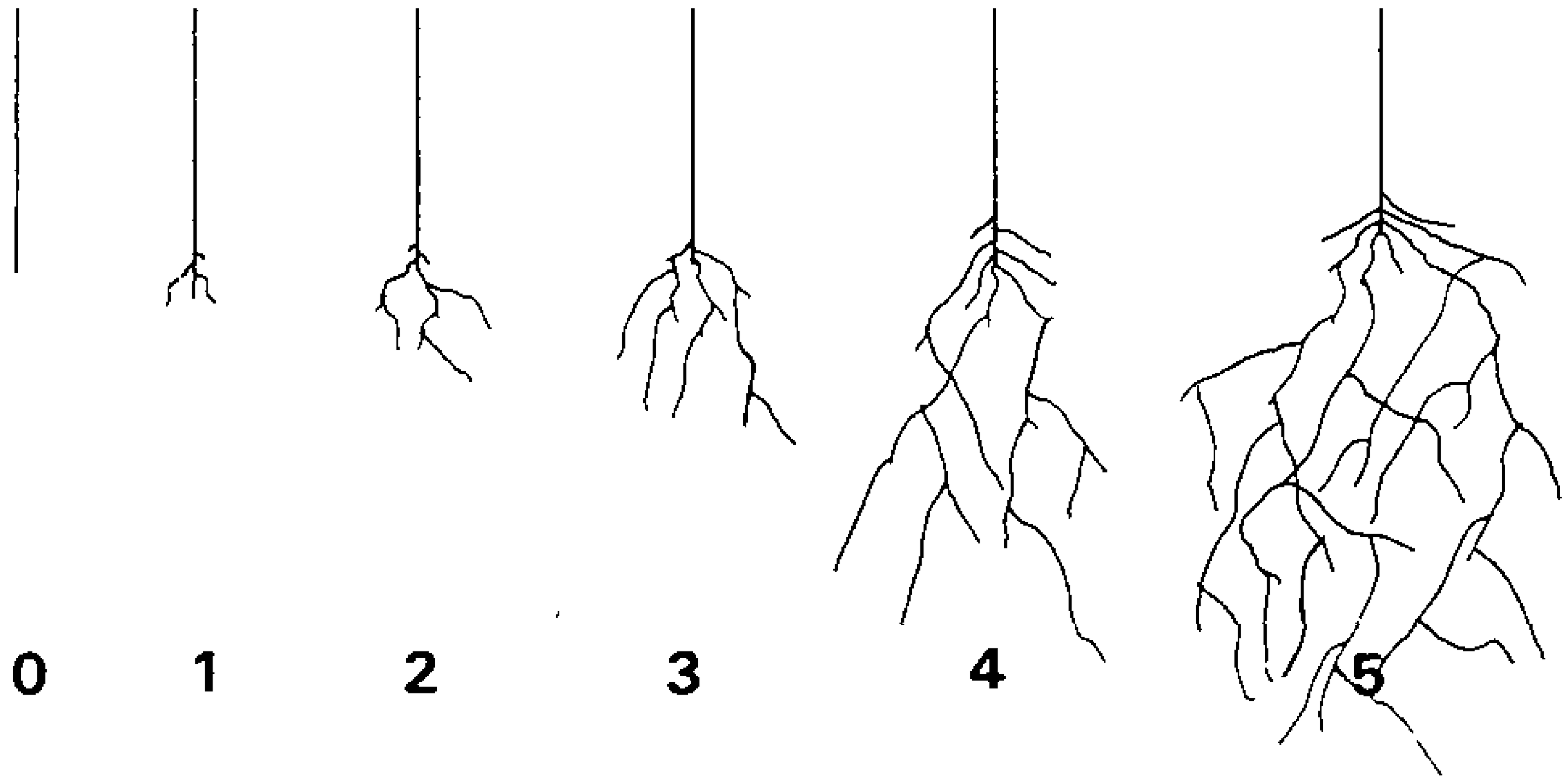

Figure 4. Rank based on degree of root development

Table 1 Establishment of rooted cuttings of *Boronia serrulata* after repotting

Donor Plant	Rooting Percentage	Percent Rooted Cuttings Established
1	70	73
2	61	100
3	53	50
4	73	73
5	63	100
6	27	100
7	33	60
8	82	84
9	52	62
10	27	100
11	93	71
12	21	83
13	67	50
14	44	55
15	75	56

Table 2 Effect of indolebutyric acid on rooting *Boronia serrulata* cuttings

IBA Conc , ppm	Percent of Cuttings Rooted	No of Roots per Cutting	Total Root Length, mm	Mean Rank
8000	87	2 5	212	2 5
4000	87	2 4	180	1 9
2000	77	1 8	147	1 3
1000	80	2 2	169	1 6
0	93	2 4	182	1 7
	N S	N S	$LSD_{5\%}$56	$LSD_{5\%}$0 61

DISCUSSION

Cuttings responded differently to basal temperature at the two planting dates. In November a basal temperature of 29°C improved rooting percentage. Other workers have found improved adventitious root formation if the basal temperature of the cutting is maintained between 25°C and 30°C (2,3). In the February planting rooting percentage was depressed as basal temperature rose above 24°C because the base of the cutting tended to dry out.

The response of *Boronia serrulata* cuttings to applied auxin varied according to the time of year and source of cutting Cuttings selected from wild plants in November showed improved rooting percentage with applied auxin (1,000 ppm IBA/NAA) although cuttings taken in February were variable in their response. When container-grown plants were used as the cutting source, development assessed visually was only marginally improved when cuttings were treated wtih 8,000 ppm IBA.

Adventitious root initiation in cuttings is a complex phenomenon controlled by several internal factors and affected by environmental conditions. Many species, which are difficult to root, display juvenile and adult phases depending on the ontogenetic age of the plant. The adult phase has been associated with the presence of rooting inhibitors and/or the absence of rooting cofactors, including auxins (5,6). The age of wild donor plants of Native Rose was up to 11 years (last bushfire, January 1967) whilst mother stock plants derived from cuttings were 15 months old. Genotypic variation in natural populations can also account for great differences in the ease of rooting. Good *et al.* (4) and Howard and Shepherd (7) note the clonal variation in rooting of trees and shrubs. Rooting percentages in wild populations of Native Rose ranged between 6% and 93% compared to 85% for mother stock plants.

Physiological state of donor plants has also been shown to influence endogenous auxin levels and the presence or absence of rooting cofactors and inhibitors (5) Mother stock plants were healthy and vigorous and provided many ripened cuttings. Wild donor plants appeared dormant in November (possibly due to moisture stress) and, in February, were undergoing the transition from vegetative to reproductive growth (unpublished data of author).

Considering the factors of age of the donor plant, genotype, and physiological status it is not surprising that cuttings selected from wild donor plants display great variability in rooting. Although the treatment of cuttings with auxin and the provision of basal heating can improve the rooting of Native

Rose, greatest improvement in rooting can be achieved by careful selection and management of mother stock plants.

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AUTOMATING AERATED-STEAM TREATMENTS

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Since we introduced aerated-steaming of soil in our nursery in early 1962 we have gained a lot of experience and have greatly upgraded the equipment. We know the areas for cold spots, the time it takes to bring the various mixes up to temperature, etc , and with this knowledge we set out to automate these operations

Initially we used electronic equipment for temperature control of the steam-air mix, the sensing of the soil temperature and the timing of the sequences. Unfortunately this