Perilla shoots and flower heads command small niche markets in Japan, however, an assessment of their potential for production in New Zealand is difficult without accurate market statistics. Other market opportunities include oil production from both foliage and seed or production for medicinal use (perilla has bactericidal properties).

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Propagation of Chilean Native Plants with Ornamental Value

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Many Chilean native plants may be used as ornamentals. Nevertheless, little knowledge exists on their propagation and culture. Experiments into the cutting propagation of six species have been carried out in order to determine the effect of auxin (IBA) concentrations on rooting. Results show the following: *Crinodendron hookerianum* roots best with 2500 ppm IBA; both *Mitraria coccinea* and *Sarmienta repens* have excellent natural rooting abilities; *Desfontainia spinosa* does not have an increased rooting response within the range of 0 to 5000 ppm IBA; rooting of *Lomatia ferruginea* cuttings fluctuates between 42% and 72% but no clear effects are obtained by the use of IBA; *Embothrium coccineum* roots best with concentrations up to 500 ppm IBA.

INTRODUCTION

Chile has a rich vascular flora, reaching 6265 species (Marticorena, 1990), from which almost 85% are endemic and/or native plants. A great many of those species have a potential use as ornamentals. Nevertheless, only a few have been brought into culture. That is why the propagation systems of most of the native plants have not been properly studied in our country, although many of them are well known in other latitudes for their ornamental use.

A few years ago we started the first experiments into the vegetative propagation of a number of native plants growing in southern Chile, selecting some species for their most ornamental character: flowers or foliage. A great help in this project has been the work of Hoffmann (1982), providing rich information including descriptions, use and distribution of the species, with excellent drawings of their shape, flowers, and foliage.

This paper deals with six species growing in different areas of southern Chile, which might be introduced to horticulture as ornamental plants. All these species grow in "the Chilean lake district from the south of Temuco to the island of Chiloé, covering an area of about half the size of New Zealand's South Island, with which it has many botanical affinities" (Gardner, 1990).

The species are as follows:

***Crinodendron hookerianum* Gay (Elaeocarpaceae)** is known in Chile by the vernacular names of "polizón" or "chaquihue". This plant grows along the coast between Valdivia and Chiloé by stream margins and in swampy forests and shady conditions (Donoso and Ramírez, 1994). It is a bush of up to 4 m in height. It has very showy, solitary, hanging flowers of a light-red colour. As a very decorative and ornamental bush, it should be more frequently cultivated in public and private gardens (Hoffmann, 1982).

***Sarmienta repens* R. et Pav. (Gesneriaceae)** known as "medallita", is one of the three native gesneriads. As an epiphytic creeper it has long, striated stems with pulpy, thick, light-green leaves. The flowers are bright red, almost tubular, with the corolla widened in the middle and narrowing towards the upper part (Martínez). Its distribution is from Maule to Chiloé growing at a certain height above the sea level in both Cordilleras, predominantly in humid places.

***Mitraria coccinea* Cav. (Gesneriaceae)** is known as "botellita" for its similarity to a little bottle. It is less a true climber forming often spherical entanglements perched high up in the canopy of the surrounding flora (Gardner, 1990). This species grows in humid and shady places from Maule to Magallanes in the Andean and Coastal Cordilleras. It is a climbing shrub or facultative perennial creeper. The flowers are tubular and isolated, light to dark red, 4 to 5 cm long with a pubescent corolla (Hoffmann, 1982).

***Desfontainia spinosa* R. et Pav. (Desfontainiaceae)** is known in Chile as "taique". It grows from Maule to Magallanes but it is more abundant near Valdivia. As a small bush which does not exceed 2 m in height, it thrives in humid areas on sodden soils. It has very showy, large, tubular flowers with an orange/red corolla and yellow margins. Leaves are perennial, thick, thorny and serrated (Donoso and Ramírez, 1994).

***Lomatia ferruginea* (Cav.) R. Br. (Proteaceae)** is known in Chile as "romerillo", "fuinque", or "palmilla". It grows from Talca up to Magallanes in humid forests. It is a small tree up to 8 m in height with large fern-like leaves. The flowers are greenish-yellow and red inside. It is a very beautiful species for southern region gardens (Donoso and Ramírez, 1994; Hoffmann, 1982).

***Embothrium coccineum* J.R. et G. Forster (Proteaceae)** is known in Chile as "notro" or "ciruelillo" and in the British Islands as Chilean fire tree or fire bush. It has simple and alternate leaves with a very variable shape and dark green colour. In October the trees are covered with beautiful red flowers, being one of the most spectacular plants in its distribution area (Gardner, 1990; Donoso, 1994). Yellow-, white-, and orange-flowering genotypes exist in nature but are very rare (Muñoz, 1980; Kramm, 1987). It grows from the Maule River up to Magallanes on the hills, but it is more abundant near Valdivia (Donoso, 1994).

MATERIAL AND METHODS

Plant Material. During the spring and summer months, cuttings were made differing in length according to the species. Most of them had at least four nodes. The species used for rooting experiments were: Chaquihue (*Crinodendron hookerianum*), Botellita (*Mitraria coccinea*), Medallita (*Sarmienta repens*), Taique (*Desfontainia spinosa*), Romerillo (*Lomatia ferruginea*), and Notro (*Embothrium coccineum*).

Auxin Treatments. After preparing uniform cuttings, they were dipped for 5 sec in 50% hydroalcoholic IBA solutions between 0 to 5000 ppm. One species (*C. hookerianum*) was also treated with NAA or IAA solutions, in the same range of concentrations.

Rooting Conditions. A peat : sand mixture (1 : 1, v/v) was used as a substrate in propagation beds in a glass-covered greenhouse. An air temperature of 22±2C and rooting zone temperature 20±2C were maintained. Humidity was provided by a misting system which was controlled by a self-made humidostat. Light conditions during the rooting period followed the natural photoperiod (13 to 15 h per day).

Experimental Design and Evaluation. For each particular species separate experiments were carried out using a completely random design where treatments were given by auxin type and concentration. Each treatment used 10 to 30 replicates, depending on the experiment.

Evaluation was done after rooting had been evident, 30 to 120 days after the beginning of the experiment. Rooting percentage as well as some rooting parameters (root number, length of the principal root, and rooting score on a 1-4 scale) were recorded. Data were submitted to ANOVA and means were contrasted by Tukey's H.S.D. procedure with a 5% significance level.

RESULTS AND DISCUSSION

Crinodendron hookerianum. Natural rooting capacity of this species seems to be very good (Table 1), reaching 84% rooting, without the use of exogenous auxins. Nevertheless rooting percentage was increased to 100% by 2500 ppm, but auxin source did not play an important role. Root number, length, and rooting score were significantly increased by the use of 2500 ppm IBA. Auxin type, specially IAA, only affected root length positively.

Table 1. Effect of concentration and auxin source on rooting of *Crinodendron hookerianum* cuttings.

Main effect	Rooting percentage	Roots		
		Number	Length (cm)	Score*
Concentration				
0	84.0	12.8 a	6.6 ab	2.3 a
2500	100.0	20.9 b	7.5 b	3.7 b
5000	100.0	17.3 ab	6.5 a	2.9 ab
H.S.D. 5% (Tukey)	--	5.4	0.9	0.0
Auxin source				
IAA	97.8	16.9 a	7.5 b	2.9 a
IBA	95.6	17.7 a	6.5 a	3.0 a
NAA	91.1	16.3 a	6.5 a	3.0 a
H.S.D. 5% (Tukey)	--	n.s.	0.9	n.s.

* min. = 1; max. = 4

Table 2. Rooting capacity of two Chilean gesneriads: *Mitraria coccinea* and *Sarmienta repens*.

IBA concentration (ppm)	Rooting percentage		Root number		Root length	
	M.C.[1]	S.R.	M.C.	S.R.	M.C.	S.R.
0	100	85	9.0 a	9.2 a	6.4 c	3.7 ab
250	100	100	14.6 c	20.8 b	6.5 c	4.0 b
500	100	95	22.0 d	31.0 c	6.5 c	5.1 c
1000	100	100	12.6 bc	18.2 b	5.3 b	3.7 ab
2500	100	80	11.2 ab	17.2 b	4.5 a	4.0 b
5000	100	80	11.4 ab	8.8 a	4.6 ab	3.1 a
H.S.D. 5% (Tukey)	--	--	3.0	5.8	0.8	0.6

[1]M.C. = *Mitraria coccinea*, S.R. = *Sarmienta repens*.

Table 3. Rizogenesis of *Desfontainia spinosa* cuttings as affected by IBA concentration.

IBA concentration (ppm)	Rooting		Root	
	Percentage	Score	Number	Length (cm)
0	75.0	2.5 a	14.4 a	13.3 a
250	77.7	2.4 a	11.9 a	13.0 a
500	68.8	2.4 a	16.4 a	13.2 a
1000	83.8	2.5 a	17.2 a	13.4 a
2500	77.7	2.5 a	18.3 a	13.6 a
5000	72.8	2.4 a	21.5 a	12.3 a
H.S.D. 5% (Tukey)	--	n.s.	n.s.	n.s.

Table 4. Rooting response of *Lomatia ferruginea* cuttings.

IBA concentration (ppm)	Rooting		Roots	
	Percentage	Score	Number	Length (cm)
0	71.6	2.5 a	7.0 b	10.0 a
250	50.9	2.2 a	4.7 c	5.8 a
500	64.2	2.4 a	9.4 ab	8.2 a
1000	54.2	2.2 a	6.8 b	6.5 a
2000	67.5	2.3 a	10.1 a	8.3 a
4000	42.0	2.0 a	4.9 c	4.6 a
H.S.D. 5% (Tukey)	--	n.s.	2.7	n.s.

Table 5. Effects of IBA concentration on rooting behavior of two *Embothrium coccineum* genotypes.

IBA concentration (ppm)	Rooting percentage		Rooting score*	
	Yellow	Orange	Yellow	Orange
0	18.8	11.1	1.5 b	1.2 a
250	44.4	55.6	2.1 c	2.0 c
500	50.0	50.0	2.0 c	1.9 c
1000	27.8	27.8	1.7 b	1.5 b
2500	5.6	5.6	1.1 a	1.1 a
5000	5.6	5.6	1.1 a	1.1 a
Mean	25.3	26.0	1.6	1.5

* 1 = min, 4 = max. rooting.

Table 6. Effects of IBA-concentration on root development of two *Embothrium coccineum* genotypes.

IBA concentration (ppm)	Root number		Root length (cm)	
	Yellow	Orange	Yellow	Orange
0	1.5 a	1.2 a	1.8 b	1.2 a
250	4.5 bc	3.2 b	2.5 c	2.3 d
500	4.8 c	3.1 b	2.3 c	1.9 c
1000	3.8 b	2.7 b	1.8 b	1.6 b
2500	1.3 a	1.3 a	1.1 a	1.1 a
5000	1.1 a	1.4 a	1.1 a	1.1 a
H.S.D. 5% (Tukey)	0.8	0.6	0.3	0.2

***Mitraria coccinea* and *Sarmienta repens*.** Both species have excellent inherent rooting abilities—*Mitraria* reaching 100% rooting in all treatments (Table 2) and *Sarmienta* at least 80% rooting. Nevertheless, root number and root length were significantly increased by the use of up to 500 ppm IBA. Higher concentrations led to decreased rooting in the two species.

Desfontainia spinosa. The use of synthetic auxins does not improve the good natural rooting ability of this species. As Table 3 shows, the rooting percentage ranges from 69 to almost 84%, obtaining a fairly good rooting score (2.5 on a 1 to 4 scale). Root number is slightly but not significantly increased by IBA concentrations higher than 1000 ppm, while the root length stays equal with all concentrations. Rooting of this species might be increased by better selection of the cutting source and by using a fog system.

Lomatia ferruginea. Natural rooting of this species using either 1 or 2 noded cuttings reached nearly 70%. No auxin treatment could increase the rooting response (Table 4). Only the root number was significantly higher by using 2000 ppm IBA. Nevertheless, no clear responses could be observed by increasing concentrations. This might be due to the use of cutting material not completely ripened—harvesting plant material later in summer might improve rooting results. On the other hand, the use of powder-based IBA concentrations might be better when using softwood cuttings of this species (Awad, 1993).

Embothrium coccineum. As Table 5 shows, both yellow- and orange-flowering genotypes have similar rooting responses. Rooting percentage is increased by low doses of IBA up to 500 ppm. Higher concentrations seem to be harmful, inhibiting the rooting responses. A similar tendency was observed in the rooting scores of both genotypes.

Values of root number and root length (Table 6) were highest with 250 to 500 ppm IBA, decreasing with higher concentrations. In spite of the low rooting responses of this species, the best responses are obtained in mid spring and early summer propagation, just before and after flowering flushes. Other seasons gave no rooting

results. Timpson (1986) reports rooting success of up to 85% using cuttings taken in early February (England).

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