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Front Cover Picture: A flowering shoot of *Leptospermum ×violipurpureum* 'Karo Spectrobay'. Photo: R. Lamberts. (See p. 3)

Opportunities for *Leptospermum* Hybrid Ornamental Cultivars and a New Ornamental Cultivar – *Leptospermum* ×*violipurpureum* 'Karo Spectrobay'

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Introduction

In the course of research on New Zealand and Australian tea trees (Harris and Percy, 1988; Harris and Decourtye, 1991; Harris et al., 1992; Harris, 1993a, 1993b, 1994) a spontaneous hybrid was discovered (see front cover illustration) between the Australian species *Leptospermum spectabile* and *L. rotundifolium* 'Jervis Bay'. This article records the origin of the hybrid and formally names and describes it as an ornamental cultivar. The existence of this spontaneous hybrid highlights the considerable potential for further development of *Leptospermum* for ornamental use by purposeful interspecific hybridisation.

Most ornamental cultivars of *Leptospermum* have arisen from New Zealand *L. scoparium* (Harris, 1993a). *Leptospermum scoparium*, commonly known in New Zealand by its Maori name manuka, is the only species of *Leptospermum* that is indigenous to New Zealand, but it is also indigenous to Australia, where it occurs naturally in New South Wales, Victoria, and Tasmania. More than 100 ornamental cultivars of manuka have been named, whereas there are probably less than 30 named cultivars for all the other 78 species of *Leptospermum*. A detailed checklist of the ornamental cultivars of *Leptospermum* is in an advanced stage of preparation (M.I.D. and P.B.H.).

There is great potential to use interspecific hybridisation as a way to develop new ornamental cultivars of *Leptospermum*. Joy Thompson (1989) in her revision of the genus *Leptospermum* comments that interspecific sterility barriers do not seem to have had time to develop. Herbarium records, particularly for New South Wales, show many putative hybrids. Twelve mainly natural hybrid combinations are listed but not authenticated by Thompson. None of these hybrids involve either of the two species that are the parents of the interspecific hybrid described in this paper or *L. scoparium*.

Preparation of the checklist of cultivars of *Leptospermum* has uncovered several interspecific putative hybrids of *Leptospermum* that have been released as ornamentals. *L.* 'Pink Cascade'[1] is a hybrid raised in Australia between *L. polygalifolium* and a pink-flowered form of *L. scoparium* (Greig, 1987; Elliot and Jones, 1993). *L.* 'Green Eyes'[2] and *L.* 'Pink Surprise' are both *L. minutifolium* × *L. scoparium* hybrids raised in England at County Park Nursery, Essex (G. Hutchins, pers. comm. 1993; Lord, 1993, 1994). These are all spontaneous hybrids with poorly documented origins.

In addition to the interspecific hybrids referred to above, a natural intergeneric hybrid between the related genera *Kunzea* and *Leptospermum* has been reported in New Zealand. This cross, *Kunzea sinclairii* × *Leptospermum scoparium*, arose in cultivation from seed collected from *K. sinclairii* on Great Barrier Island (Harris et al., 1992), and has been named ×*Kunzspermum hirakimata* 'Karo Hobson Choice' (Harris, 1993b).

Flower Size and Colour Characteristics of the Parent Species

In their wild form *Leptospermum spectabile* and *L. rotundifolium* rank among the two most attractive species in the genus because of the large size and outstanding colour of their flowers. Analysis of the frequency distribution of flower size, from data given in Thompson's (1989) species descriptions, shows *L. spectabile* and *L. rotundifolium* to be in the top 10% (Fig. 1). *L. rotundifolium* has the largest flowers, to 30 mm or more in diameter, and *L. spectabile* has flowers 20 mm in diameter. By comparison, the flowers of wild *L. scoparium* are described by Thompson (loc. cit.) as being in the range 8–12 mm (occasionally larger), falling into the modal class for frequency distribution of the flower size of species in the genus.[3] Flower dimensions vary with environmental conditions, and measurements obtained from dried herbarium specimens that were probably the main source

Footnotes

[1] To avoid confusion with an earlier *L. scoparium* cultivar of that name, Australian *L.* 'Pink Cascade' is also known in New Zealand as *L.* 'Pink Beauty'.

[2] This English hybrid is different to the selection of an Australian species sold in New Zealand under the similar name of *L.* 'Green Eye'.

[3] However, the cultivars of New Zealand *L. scoparium* have been selected for their larger, showy flowers. Average flower diameter of these cultivars (measured from live material) is about 18 mm, ranging from 12 to 25 mm in individual cultivars (Metcalf, 1987).

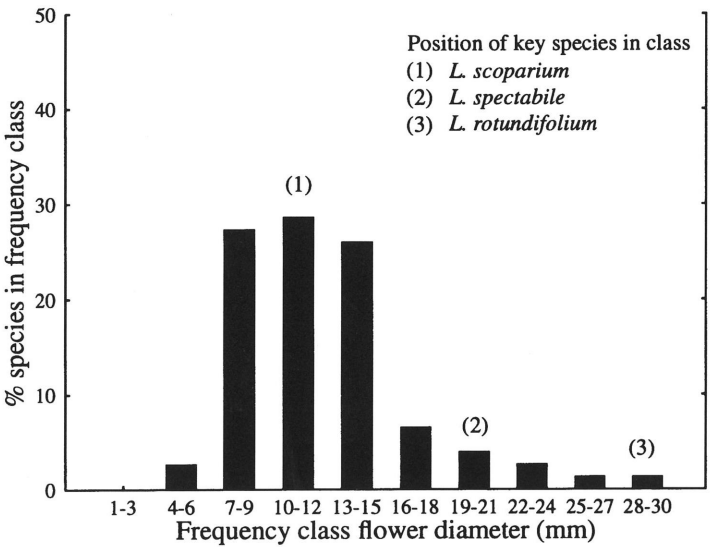

Fig. 1. Frequency distribution of flower diameters of 77 *Leptospermum* species. Data from descriptions in Thompson (1989).

Table 1. Comparison of leaf, flower, and capsule characteristics of *Leptospermum spectabile*, *L. rotundifolium*, and their putative hybrid. Standard errors are given where replicate measurements were made (n = 10).

	L. spectabile	Putative hybrid	*L. rotundifolium*
Leaf characteristics			
Leaf length (mm) – outdoors	27.2 ± 0.6	15.2 ± 0.4	12.2 ± 0.2
Leaf width (mm) – outdoors	4.6 ± 0.2	6.5 ± 0.1	7.3 ± 0.2
Leaf length:width – Ootdoors	6.1 ± 0.4	2.4 ± 0.1	1.7 ± 0.1
Leaf length (mm) – shaded	35.4 ± 1.0	19.6 ± 0.5	—
Leaf width (mm) – shaded	6.1 ± 0.3	7.3 ± 0.3	—
Leaf length:width – shaded	5.9 ± 0.2	2.8 ± 0.2	—
Leaf shape	narrow elliptic	elliptic	oval to orbicular
Flower characteristics			
Flower diameter (mm)	28.1 ± 0.4	27.9 ± 0.4	29.8 ± 0.5
Petal length (mm)	8.8 ± 0.1	8.9 ± 0.2	10.9 ± 0.3
Petal width (mm)	9.5 ± 0.1	9.9 ± 0.2	11.8 ± 0.2
Petal length:width	0.92 ± 0.02	0.91 ± 0.02	0.91 ± 0.01
Petal colour	R.H.S. 51A to 52A: rhodonite red to crimson	R.H.S. 80A: purple-violet group	R.H.S. 76A to 76D: lilac to white near receptacle rim
Receptacle disk diameter (mm)	11.4 ± 0.2	9.2 ± 0.1	8.7 ± 0.2
Petal length:receptacle disk	0.77 ± 0.02	0.97 ± 0.03	1.25 ± 0.04
Receptacle disk colour	R.H.S. 144A to 146A: green	R.H.S. 144A to 146A: green	R.H.S. 144A to 146A: green
Receptacle hairs	dense and conspicuously pubescent	pubescence of short hairs all over	slightly pubescent to glabrous in parts
Sepal length (mm)	7.6 ± 0.2	5.4 ± 0.1	5.9 ± 0.1
Sepal width (mm)	7.5 ± 0.2	5.1 ± 0.1	5.2 ± 0.1
Sepal length:width	1.01 ± 0.02	1.05 ± 0.02	1.11 ± 0.02
Sepal colour	green to white with pubescence	R.H.S. 145C: yellow green to pubescent white at margins	R.H.S. 53A: cardinal red and red near receptacle rim
Sepal hairs and glands	densely pubescent; gland cells not visible	circular gland cells visible through pubescence	pubescent around margins and tip; circular gland cells conspicuous in translucent tissue
Stamen filament colour, length	white to crimson near receptacle rim; 6-7 mm	white; 4.5-5 mm	white; 5 mm
Style colour and length	green; 5-6 mm	green; 4.5-5 mm	green; 4 mm
Capsule characteristics			
Diameter (mm)	10–12	14–16	11–13
Depth of base from rim (mm)	4	8	5
Height of valves above rim (mm)	3–4	6	6
Shape of base	broadly turbinate	turbinate	hemispherical
Sepals on mature capsules	conspicuous, partly reflexed, firmly attached	obvious and erect, readily detached	small and erect, usually shed
Opening of valves	opened within year of flowering	intact a year or more after flowering	can remain closed for several years

of Thompson's data are likely to differ from measurements made on living plants. Our flower diameter measurements on living material of *L. rotundifolium* (29.8 ± 0.5 mm) agree with Thompson's, but we record a larger flower diameter than Thompson (1989) for *L. spectabile* (28.1 ± 0.4 mm) (Table 1).

A comparison of the flower colour of *Leptospermum* species (Thompson 1989) shows that 48 are exclusively white, 18 have white or pink flowers, four have white or cream flowers, and one (*L. purpurascens*) has flowers described as white, sometimes flushed with red. Consequently white is the dominant flower colour for *Leptospermum* species. For the remaining eight species, the colour of two is unknown as Thompson's description is based on specimens without mature flowers. *Leptospermum sericeum*, a local species in the vicinity of Esperance, Western Australia, has exclusively pink flowers. *Leptospermum*

scoparium is described by Thompson as having "white or, rarely, pink or red" flowers. Observations of wild populations of *L. scoparium* in New Zealand show that various degrees of pink shading of petals is not uncommon, and this points to the problem of determining flower colour from dried herbarium specimens in which subtle colour shades can be lost. Pink-flowered plants are characteristic of *L. scoparium* var. *incanum*, which is commonly encountered in the far north of the North Island. Red-flowered wild manuka is exceptionally rare. The origin of the carmine flower colour in most modern manuka cultivars can be traced back to *L. scoparium* 'Nichollsii', derived from a single wild plant with carmine flowers discovered near Kaiapoi, north of Christchurch, in 1898.

Thompson (1989) describes *Leptospermum spectabile* as having flowers that are exclusively "a rather dark red." Our observations, of plants raised from seed from the wild collection whose origin is described below, showed some petal colour variation from dark red to deep pink. Two other species closely related to *L. spectabile* are *L. macrocarpum,* which has "greenish white, pink or dark red" flowers, and *L. sphaerocarpum*, which has "rather greenish white or pink" flowers. Thompson includes these species in the same "putative natural subgroup" characterised by strongly woody seed capsule valves and retention of the sepals on the capsule.

Leptospermum rotundifolium is included by Thompson (1989) in the same subgroup as *L. scoparium*, and these species are characterised by strong woody seed capsule valves that do not retain their sepals. However, *L. rotundifolium* is unique among *Leptospermum* species in including purple coloration in its range of flower colour from "white to somewhat purplish pink."

Origin of the Parent Species and Hybrid

The natural habitat of *L. spectabile* is among sandstone boulders along the Colo River, a tributary of the Hawkesbury River in central eastern New South Wales not far north of Sydney. The interesting story of its discovery in 1957 is recounted by Harris and Percy (1988). Although publication of the formal name was delayed until 1989 (Thompson, 1989), horticultural interest in the species had reached New Zealand by the early 1980s.

Warwick Harris began his studies of the genetic variation of New Zealand tea trees with an experimental planting at the former Botany Division, DSIR, Lincoln in 1983 (Harris et al., 1992). At that time nine Australian *Leptospermum* species were included in the layout along with 72 provenances of New Zealand tea trees. Seed of *L. spectabile* was received from the Royal Botanic Garden, Sydney, as *"Leptospermum* sp. aff. *sphaerocarpum*, Colo River, below Boorai Ridge, (cc) NSW. 33°15´S, 150°32´E. Wallace 83003." Seed was sown in September 1983, and 24 plants were included in January 1984 in the experimental layout, where their growth and phenology were observed for several years. A further 35 plants from this sowing were retained in the nursery, and were planted in the field at Lincoln in June 1985. One of these plants (W. Harris reference number 81/23; Landcare Research Experimental Gardens accession number 45/95) was selected and named *Leptospermum* 'Christmas Star' (Harris and Percy, 1988). Now that the species is formally described (Thompson, 1989), the cultivar is correctly referred to as *L. spectabile* 'Christmas Star'.

Leptospermum rotundifolium occurs naturally in an area southward from Sydney on the tableland escarpment of central eastern New South Wales, and extends to the coast near Jervis Bay. Its usual habitat is in skeletal soils on sandstone. It was first named as a variety of *L. scoparium* in 1900, but was elevated to a species in 1919, and this status is supported in Thompson's (1989) revision of the genus.

L. rotundifolium is an extremely variable, very ornamental species widely cultivated in Australia (Elliot and Jones, 1993). Wrigley and Fagg (1979) commented that *"L. scoparium* var. *rotundifolium* ... must be regarded as Australia's best *Leptospermum* species and that with the most potential for hybridization." We have evaluated five provenances of *L. rotundifolium* at Lincoln since 1984, and the species shows very attractive variations. It is surprising that in comparison with New Zealand *L. scoparium* little attention has been given in the past to the selection of ornamental cultivars of this species. We are currently aware of four cultivars of *L. rotundifolium* – *L.* 'Jervis Bay', *L.* 'Julie Anne', *L.* 'Lavender Queen', and *L.* 'Williamsi', as listed by Elliot and Jones (1993). The cultivar epithet for *L.* 'Jervis Bay' suggests that this selection originated in the wild from that locality in New South Wales, the coastal part of the range of *L. rotundifolium*. However, we have not seen any references that confirm this suspicion. This cultivar may correspond with the *"L. scoparium* Jervis Bay form" listed in *The Plant Finder 1990/91* (Lord 1990), which is a plant directory of material grown in England. Subsequent editions of *The Plant Finder* do not list it. *L.* 'Julie Anne' was obtained from a wild prostrate form of *L. rotundifolium* from Beecroft Peninsula, near Jervis Bay (Elliot and Jones, 1993). *L.* 'Lavender Queen' (Harrison 1974) and *L.* 'Williamsi' are both early cultivars. It appears that *L.* 'Williamsi' is no longer known under this name (Elliot and Jones, 1993).

One plant of *L. rotundifolium* 'Jervis Bay' was purchased in January 1985 (accession G 15849; plant purchased from Portstone Nursery, Ferry Road, Christchurch) and planted in a block with other *Leptospermum* adjacent to the area where the 35 plants of the *L. spectabile* accession were planted.

Plants from the September 1983 sowing of *L. spectabile* first flowered in December 1986, and seed was collected from three of these and sown in July 1987. Three seedlings were raised from plant 81/21, which was closest in the planting layout (distance 3 m) to *L. rotundifolium* 'Jervis Bay', and one of these was noted to have leaf characteristics distinct from all the other seedlings. When this plant flowered in 1991 it was seen to have large and distinctively coloured flowers, different to the relatively slight variation of flower colour and form in *L. spectabile*. It was entered as Landcare Research experimental gardens accession number 596/91 in October 1991 and propagated from cuttings. The pollen parent plant of *L. rotundifolium* 'Jervis Bay' had died before this date, but the *L. spectabile* parent 81/21 remains alive.

Comparison of Hybrid and Parents

Leaf, flower, and capsule characteristics of the seed parent species, the putative pollen parent, and the hybrid were compared to confirm the hybrid's origin (Table 1). As the *L. spectabile* parent in the field (81/21) was in poor condition, and there was no equivalent plant of the hybrid in the field, measurements were made in November 1993 of ten flowers each of *L. spectabile* 'Christmas Star' (81/23) and the hybrid grown in a glasshouse. Cuttings of *L. rotundifolium* 'Jervis Bay' were acquired from Ken Davey of New Plymouth in April 1992 (accession 138/92), and a flowering glasshouse specimen from these cuttings was available for measurement in December 1994. In December 1994 length and width measurements were made for ten mature and characteristic leaves taken from single plants of *L.* 'Christmas Star', *L.* 'Jervis Bay', and the hybrid grown in planter bags on trickle irrigation outdoors. Also plants of *L.* 'Christmas Star' and the hybrid grown in a shadehouse were measured for comparison. A record of the silhouettes of these leaves was made (Fig. 2). A comparison was made of year-old capsules from the 1993 flowering for *L.* 'Christmas Star',

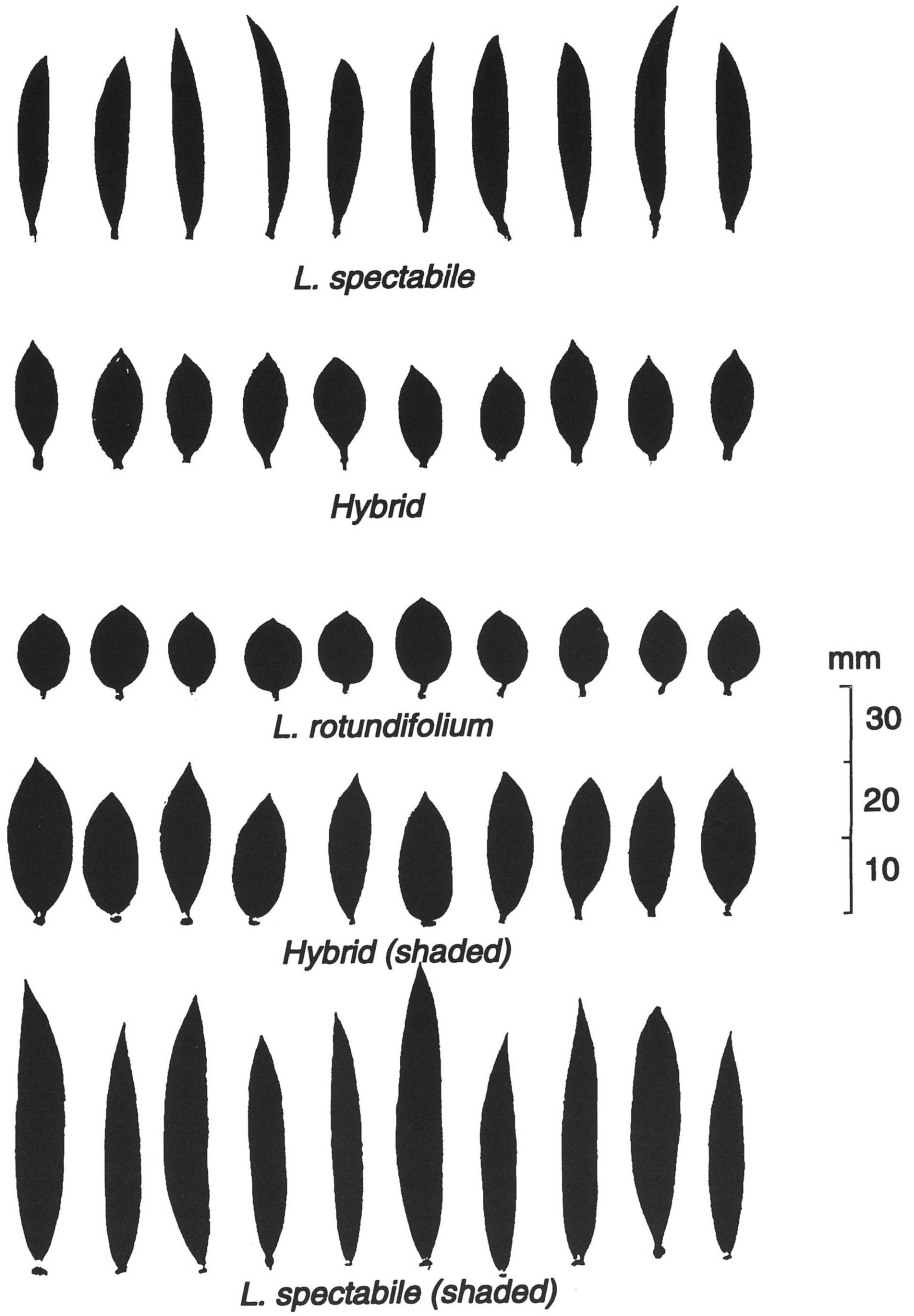

Fig. 2. Silhouettes of 10 characteristic mature leaves from plants of *Leptospermum spectabile* 'Christmas Star', *L. rotundifolium* 'Jervis Bay', and their hybrid grown in full daylight and in a shadehouse (shaded).

the hybrid, and wild provenances of *L. rotundifolium* as *L.* 'Jervis Bay' capsules were not available. Descriptions of colour are based on the 1966 Royal Horticultural Society Colour Chart (R.H.S.).

The leaf shape of the hybrid (Fig. 2) is intermediate between the distinctive shapes of the parents, but the leaf length and length-to-width ratios (Fig. 3; Table 1) are closer to the smaller-leaved *L. rotundifolium*. Interspecific hybrids with a leaf length and length-to-width ratio more similar to the smaller-leaved parent have also been recorded by Heenan (1994) for hybrids between the large-leaved *Hebe speciosa* and the smaller-leaved *H. pimeleoides* 'McEwanii' and *H. biggarii*. Leaf size is increased by shading, both *L. spectabile* and the hybrid becoming broader and longer-leaved under such conditions (Fig. 3; Table 1).

The parents and hybrid all have very large flowers for *Leptospermum*. The hybrid has a distinctive violet-purple coloration of the petals arising from the blending of the distinctive flower colours of the parents. Petal colour in *Leptospermum* is due to anthocyanins; cyanidin is responsible for the red petals of *L. spectabile*, and delphinidin, a purple pigment, occurs in *L. rotundifolium* 'Jervis Bay' petals (R. Bicknell, pers. comm. 1994). A feature that influences the attractiveness of the flowers is the relative size of the petals and green receptacle disk. *L. spectabile* has a particularly wide disk relative to the size of the petals. The size of the disk for the hybrid is similar to that of *L. rotundifolium* but it has petals of similar size to those of *L. spectabile* (Fig. 4; Table 1). This changed ratio is an improvement of the flower characteristic of the hybrid compared to that of *L. spectabile*.

A feature of the hybrid is that it has distinctly larger capsules than either of the parents (Table 1). This size difference is most apparent in the depth of the capsule below the rim. In *L. spectabile* this part of the capsule appears to diminish in size relative to valves as the capsule matures. For *L. spectabile* the valves had opened within a year of flowering, whereas *L. rotundifolium* capsules can remain intact for several years after they are formed. Capsules of the hybrid also seem to remain unopened for several years *in situ*, but open before those of *L. rotundifolium* when they are detached concurrently. Seed of the hybrid is viable.

Names and Descriptions

***Leptospermum* ×*violipurpureum* W.Harris, M.I.Dawson *et* Heenan notho-sp. nov.**

Leptospermum ×*violipurpureum* is the collective epithet for *Leptospermum spectabile* (♂) × *L. rotundifolium* (♀). The epithet 'violipurpureum' refers to the colour of the petals, which is intermediate between violet and purple.

Diagnosis: Frutex ex hybridatione *Leptospermi spectabilis* et *L. rotundifolii* ortus; inter parentes intermedius; folis ellipticis; petalorum colore inter violam et purpuram intermedio.

Shrub, a hybrid of *Leptospermum spectabile* and *L. rotundifolium;* intermediate between parents; leaves elliptical; petal colour intermediate between violet and purple.

Holotype: CHR483436, W. Harris, 5 November 1993, Landcare Research Experimental Gardens, Lincoln, Canterbury, New Zealand.

The specimen was taken from a plant raised from a cutting of the original plant taken on 25 October 1991. The description given below is based on the same plant.

Parentage: Details of the origin of the hybrid are given above.

Distribution: Cultivated shrubs, in the Landcare Research Experimental Gardens, Lincoln, Canterbury. Clonal material has been distributed to commercial plant propagators for evaluation.

Description: Shrub broader than high; at 4 years from cutting grown in shadehouse 1.2 × 2.5 m; plants grown outdoors more compact and densely branched; habit open and weeping, with few main branches from base and with suppressed basal shoots. Branches tending horizontal from base before ascending, with higher-order branches and branchlets arched downwards. Mature bark firm, brown, and covered with a network of grey ridges; young bark light brown; stems near shoot tips with fine pubescence, orange-red. Leaves broad-elliptic to elliptic, green, incurved in cross-section, usually patent but young leaves usually erect near shoot tips and older leaves reflexed lower on stems, pleasantly aromatic when crushed, 15–20×6–7 mm; apex apiculate and slightly pungent; margin red, especially near apex; lamina surface glabrous, but with slight pubescence on margin and near base; petiole 1–2 mm long. Flowers usually borne singly on short terminal branches; terminal vegetative shoot extending above highest flowers, and new lateral shoots developing below mature capsules; flower buds surrounded by numerous golden-brown bracts which are shed after flowers are open. Sepals 5, triangular, hooded, yellow-green and white, pubescence showing petal colour on margins, visible through bracts in bud. Petals 5, broad-elliptic, violet-purple (R.H.S. 80A), slightly crumpled like crepe, especially at margins, 8–10 × 9–11 mm; fully open flower 26–30 mm diameter with petals well separated and sepals visible below. Stamen filaments 4–5 mm long, white, evenly distributed around receptacle. Style 4–5 mm long, green; stigma at about same level as anthers. Receptacle disk yellow-green (R.H.S. 144A), 9–10 mm diameter, remaining green after petals are shed. Capsule turbinate, strongly woody, grey-brown when mature, 14–16 mm diameter; rim distinct, and base deeper than height of valves. Flowering at Lincoln October to November. Capsules remain intact for a year or more.

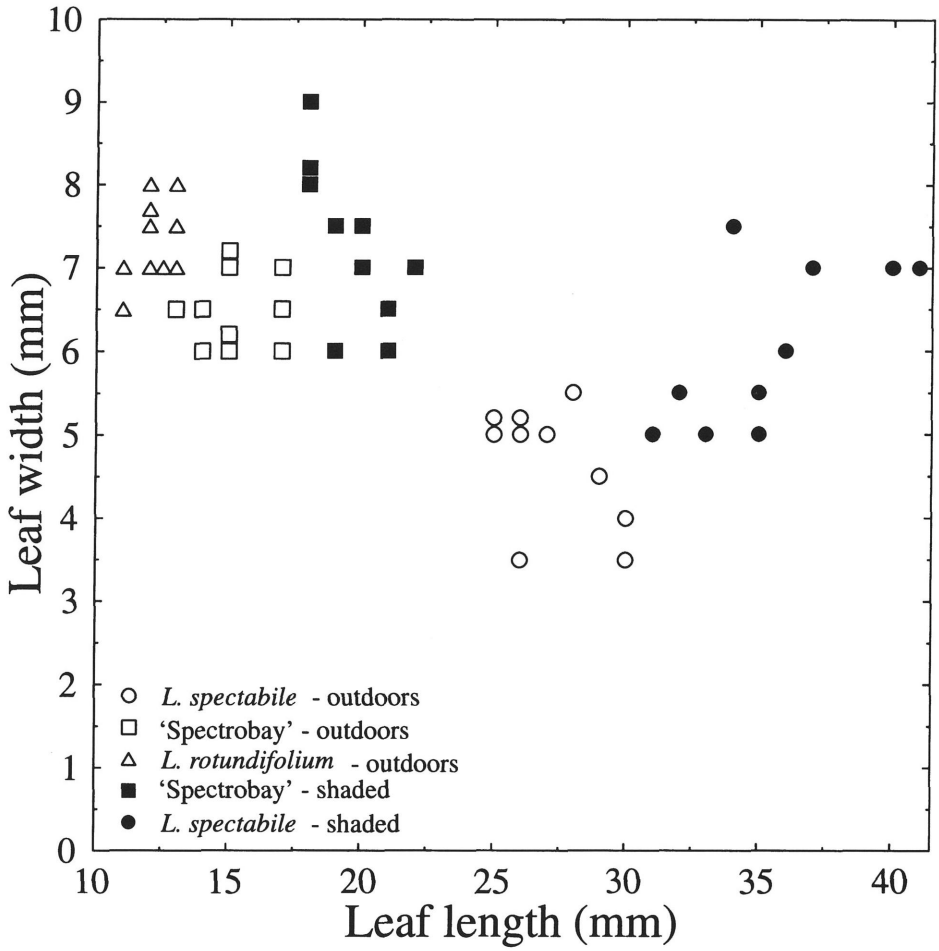

Fig. 3. Relationship between length and width of 10 characteristic mature leaves of *Leptospermum spectabile* 'Christmas Star', *L. rotundifolium* 'Jervis Bay', and their hybrid grown in full daylight and in a shadehouse.

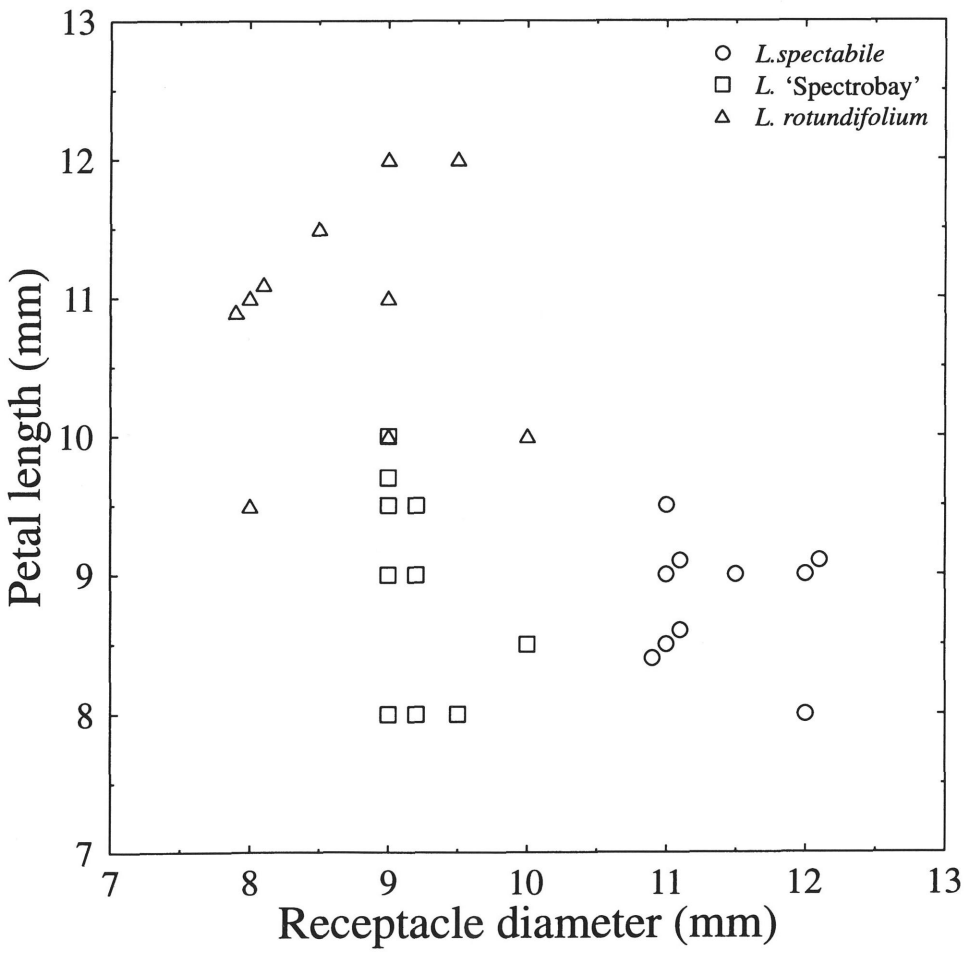

Fig. 4. Relationship between petal length and receptacle disk diameter for 10 flowers of *Leptospermum spectabile* 'Christmas Star', *L. rotundifolium* 'Jervis Bay', and their hybrid.

***Leptospermum* ×*violipurpureum* 'Karo Spectrobay' cult. nov.**

As the hybrid has ornamental qualities and is desirable as a garden plant it is given a cultivar name. The cultivar epithet 'Karo' is an acronym of 'known and recorded origin', used to identify plants selected through research undertaken by Manaaki Whenua - Landcare Research (Heenan, 1992). The epithet 'Spectrobay' is derived from a combination of parts of the specific epithets of the parent species and the cultivar name of the putative male parent. The description and holotype specimen provided for *Leptospermum* ×*violipurpureum* apply to the cultivar.

Ornamental Characteristics

In addition to the evaluations at Lincoln the hybrid has been let out for commercial evaluation by Elliot's Wholesale Nursery, Amberley, Canterbury; Liner Plants New Zealand Ltd and Lyndale Nurseries Auckland Ltd, Whenuapai; and the Auckland Regional Botanic Gardens, Manurewa. The large, well proportioned, distinctive-coloured flower of the hybrid has been clearly recognised as an outstanding ornamental feature, and the foliage has been judged to be excellent.

Like the parents the hybrid is susceptible to manuka blight and leafroller caterpillars, but no more so than *L. scoparium* cultivars. Manuka blight can be controlled by spraying with an insecticide plus a summer oil or an all seasons oil after flowering. Carbaryl can be used to control leafroller during spring and summer. Plants of the hybrid have survived two winters in an open field at Lincoln, but immature foliage has been damaged by frosts, which have been as severe as –8°C. In common with most cultivars of *Leptospermum*, *L.* 'Karo Spectrobay' is likely to do best with a minimum of fertiliser, in free-draining soil in a sunny position. *Leptospermum spectabile* plants have become chlorotic with application of phosphorus-rich fertiliser, so the hybrid may have similar sensitivity.

The open spreading habit of the hybrid is regarded as not being desirable for container-grown plants or for meeting the demand for compact plants suited to small suburban gardens. Although readily propagated from cuttings, the growth of the main stem from these cuttings tends to be horizontal before becoming erect. This growth characteristic is shared by one parent, *L. spectabile* (81/21), surviving after 11 years in the field with a minimum of care. This plant is 0.9 × 1.8 m, sparsely branched and with the main branch running 0.2 m horizontally before becoming erect. We do not have a mature plant of *L. rotundifolium* 'Jervis Bay' for comparison of its growth form. According to Elliot and Jones (1993) *L.* 'Jervis Bay' grows to about 3 m tall, with upright habit.

One plant has been grown by Warwick Harris in his home garden at Lincoln on the north side of a trellis. In this sheltered position the hybrid has not been damaged by frost, has developed more branches and a greater density of foliage, and flowered prolifically in late October 1994. This indicates that *L.* ×*violipurpureum* 'Karo Spectrobay' is well suited for growing against a fence or trellis, and its branching arrangement would make it suitable for espaliering. The presence of suppressed basal shoots suggests that it should recover well from hard pruning, and this would encourage more branching and a more compact form. With the variation of shrub form in both *L. spectabile* and *L. rotundifolium* there is potential to plan crosses that would produce a compact and densely branched hybrid of these species.

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