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STATUS AND DISTRIBUTION IN SINGAPORE OF *FICUS VASCULOSA* WALL. ex MIQ. (MORACEAE)

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ABSTRACT. — In Singapore, *Ficus vasculosa* Wall. ex Miq. (Moraceae), is a nationally endangered fig species that grows in hedges and secondary forest in various localities including Changi, Central Catchment Nature Reserve, Nassim Hill, Paterson Road, Pearl's Hill City Park, Pulau Ubin, Rifle Range Road, the Singapore Botanic Gardens, Tanglin Road, Teban Gardens Crescent, and Tyersall Road. It is a usually small, evergreen tree with lobed juvenile leaf blades and entire mature leaf blades, and is the only Singapore fig tree with stalked, glabrous, drop-shaped, red syconia. It has horticultural potential for cultivation in parks, gardens, and other sites to enhance the native biodiversity since it supports many insect and frugivorous animal species.

KEY WORDS. — *Ficus vasculosa*, Moraceae, Singapore

INTRODUCTION

Ficus vasculosa (Latin *ficus*, a fig tree; *vasculum*, a little vessel, referring to its syconia), is a usually small, evergreen, monoecious, latex-producing treelet or tree that can sometimes grow up to 45 m tall (Kochummen, 1978; Corner, 1988; Berg & Corner, 2005; Ng et al., 2005; Fig. 1). Its fissured- or smooth-barked trunk (Fig. 2) is buttressed to 2.5 m (Fig. 3) or not at the base and its glabrous twigs bear spirally arranged, stalked, glabrous leaves that have leaf blades that are oblong or somewhat drop-shaped, usually 5–15 cm long by 2–5.5 cm wide, with a pointed or blunt tip and rounded or wedge-shaped base. The leaf blade margin is entire in the leaves on the upper parts of the trunk (Fig. 4) but leaf blades are lobed at the base of the trunk (Fig. 5) or in short, young plants (Fig. 6). This plant displays a phase change (Poethig, 1990) with the mature phase leaves with leaf blades that are entire and those of the juvenile phase leaves that are lobed. The mature phase leaf blade has 9–12 pairs of lateral veins that are distinctly looping at the margins and tri-nerved at the blade base (Berg & Corner, 2005). The leaf stalk is usually 1–4 cm long. The stipules are usually 0.4–1.2 cm long and are shed quickly to leave ring-like scars on the twig (Fig. 4). Dried leaves are buff with a leathery leaf blade with characteristically prominent venation below. The stalked syconia are usually paired or sometimes single, usually in the axils of the leaves and bear three, short, persistent bracts at the base (Figs. 7–9). The somewhat round syconia are about 1.2–1.7 cm across with stalks about 0.6–1.7 cm long, and each with an ostiole 1–1.5 mm across. When ripe, the glabrous syconia turn light yellow then deep rose-red (Fig. 8).

Ficus vasculosa is naturally distributed from Myanmar, south China, Indochina, Thailand, Sumatra, the Malay Peninsula, Singapore, Java, and Borneo (Berg & Corner, 2005). It inhabits forests from sea level to 1,300 m altitude and in Singapore appears to occupy the more disturbed habitats such as hedges and secondary forest (Ng et al., 2005). It is categorized as nationally endangered in Singapore (Tan et al., 2008; Chong et al., 2009).

Shanahan et al. (2001) listed four bird and two mammal species that eat the ripe syconia of this fig but none of these animal species occurs in Singapore. XYN has observed the Asian koel (*Eudynamys scolopaceus*) and plantain squirrel (*Callosciurus notatus*; Fig. 10) eating the ripe syconia. It is quite possible that native doves, pigeons, parrots, hornbills, and barbets known to eat the syconia of figs (Wells, 1999) and whose gape sizes fit the dimensions of those in this species will eat the syconia of *Ficus vasculosa*.

Its fig wasp pollinator is *Dolichoris vasculosae* Hill (Agaonidae; Wiebes, 1994). Wasps from this genus were captured largely at 25 m above the ground during a survey with sticky traps on Kent Ridge, suggesting that they are probably

Fig. 1. *Ficus vasculosa* trees. A. Tree at Nathan Road photographed in 2004 but now gone. B. Trunk and crown of tree at MacRitchie Nature Trail, with diameter at breast height of 35 cm. (Photographs by: Angie B. C. Ng [A] and Yeoh Yi Shuen [B]).

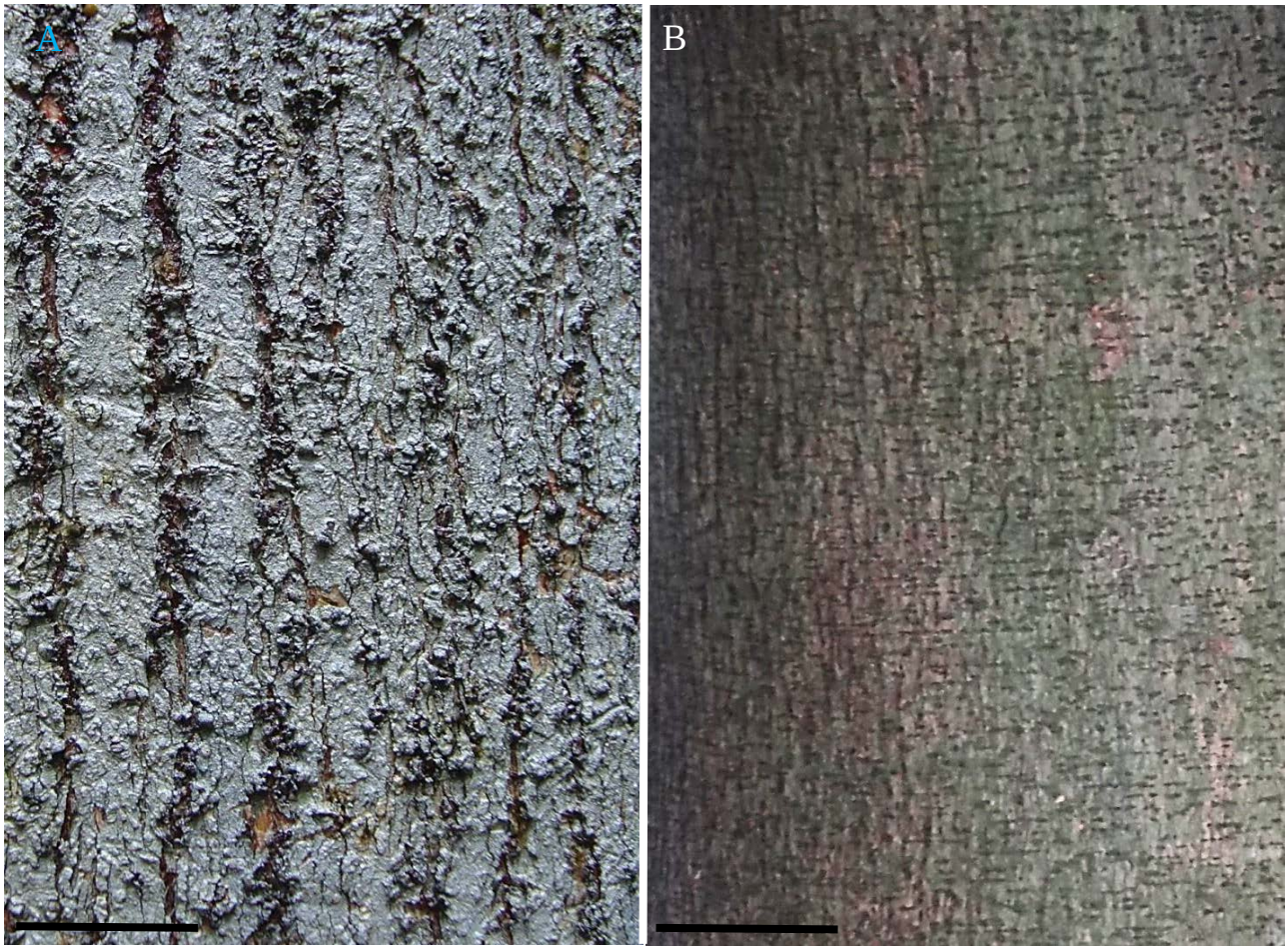

Fig. 2. Trunk bark. A. Bark of the tree along the MacRitchie Nature Trail. B. Bark of the tree along Teban Gardens Crescent. Scale bar = 1 cm. (Photographs by: Yeoh Yi Shuen [A] and Hugh Tan Tiang Wah [B]).

Fig. 3. Buttress roots. Trunk diameter = 35 cm. (Photograph by: Yeoh Yi Shuen).

Fig. 4. Mature phase leaves with developing branches in two leaf axils. A. Upper surface of arrowed leaf. B. Lower surface of arrowed leaf. Note ring-like, stipular scars on the twig. (Photographs by: Ang Wee Foong).

very widely dispersed (Jeevanandam & Corlett, 2013), potentially linking Singapore's trees with the regional population of this fig species. In south China, cryptic species of *Philotrypesis quadrisetosa*, a non-pollinator wasp that inhabits the syconia of *Ficus vasculosa*, have been detected (Zhou et al., 2012).

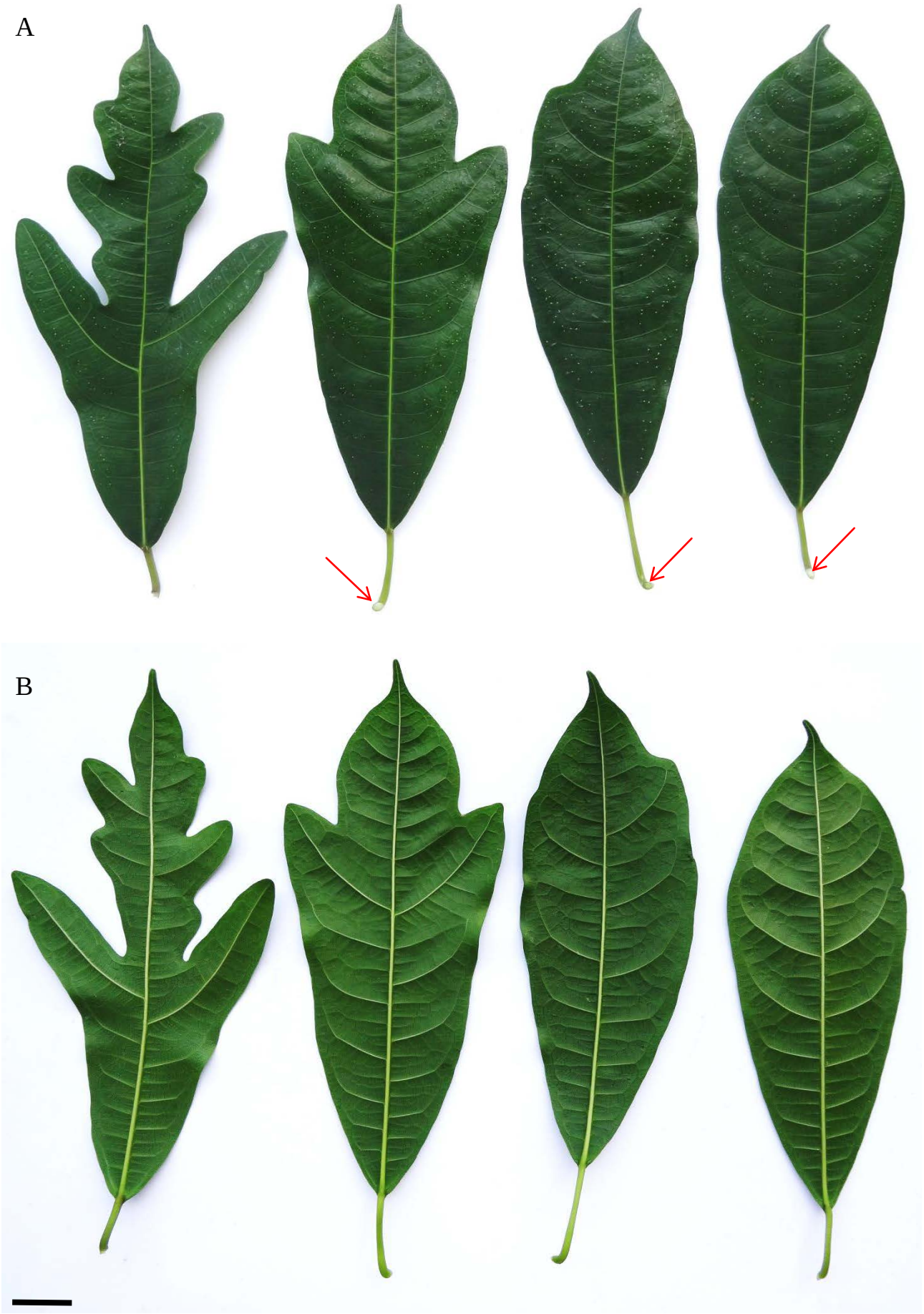

Fig. 5. Juvenile phase leaves showing the different degrees of lobing of the leaf blades from the most to the least, from left to right. A. Upper side. Note the white latex at the ends of some leaf stalks (arrowed). B. Lower side. Scale bar = 2 cm. (Photographs by: Hugh Tan Tiang Wah).

Fig. 6. Young plant grown by layering a juvenile phase branch so it bears only the leaves with lobed leaf blades. (Photograph by: Hugh Tan Tiang Wah).

Fig. 7. Unripe, green syconia on the twigs of the tree at Pearl's Hill City Park. Leaves wither yellow. (Photograph by: Ng Xin Yi).

The young leaves of this species are eaten as a wild vegetable by the ethnic groups of Xishuangbanna, Southwest China (Shi et al., 2011). The tree is also planted near villages for this purpose. *Ficus vasculosa* can easily be propagated by seed, stem cuttings, or layering of branches close to the soil surface. The National Parks Board Flora & Fauna Web describes this species as a plant that "may be suitable for parks and roadsides" (National Parks Board, 2013) indicating its horticultural potential. Young individuals make attractive pot plants because they have the lobed leaf blades of the juvenile phase (Fig. 6).

Fig. 8. Semi-ripe, yellow, and ripe, red syconia on leafy twigs of the tree at Teban Gardens Crescent. The ostiole of each syconium is distinct at the tip. (Photograph by: Hugh Tan Tiang Wah).

Fig. 9. Semi-ripe syconium, opened to reveal the fruits lining the inside surface. Scale bar = 2 mm. (Photograph by: Yeoh Yi Shuen).

Fig. 10. Plantain squirrel eating the near ripe, orange syconium of the large tree in Pearl's Hill City Park. (Photograph by: Ng Xin Yi).

Trees have a neat, dark green, cylindrical crown and their smaller size in comparison with the larger, wide-spreading strangler figs makes them ideal for parks and gardens.

PAST AND PRESENT RECORDS

From Table 1, localities that *Ficus vasculosa* have been recorded from include those on Singapore Island: Bukit Kallang, Bukit Timah, Chan Chu Kang Forest Reserve, Changi, Cluny Road, Grange Road, Hendon Road, Nassim Road, Seletar, Singapore Botanic Gardens, and Tanglin, and also the islands: Lazarus Island and Pulau Ubin. This species has also been reported in Dover Forest (Neo et al., 2013; S. Teo, pers. comm.), Upper Thomson Forest (Neo et al., 2014), and Sentosa (Resorts World at Sentosa) (Genting Singapore PLC, 2013). Syconium-producing trees are found in Changi, along the MacRitchie Nature Trail in the Central Catchment Nature Reserve, Nassim Hill, Paterson Road, Pearl's Hill City Park, Pulau Ubin, Rifle Range Road, Singapore Botanic Gardens (Jungle [with 68 individuals], Lawn T, and Evolution Garden), Tanglin Road, Teban Gardens Crescent, and Tyersall Road. A good sign of recruitment is that there are many sites with saplings, including two at the edge of a car park along Engineering Drive 1 in the National University of Singapore Kent Ridge Campus.

DISCUSSION

Deforestation is the most likely cause for the rarity of *Ficus vasculosa* in Singapore, with more than 90% of Singapore Island's primary forest having been lost by the 1880s (Cantley, 1884) and with subsequent development, with only about 250 ha of primary forest left currently (Corlett, 2011). This species seems tolerant of more open and disturbed sites such as hedges or secondary forests so it is more frequently observed than the rarer congeners that have more restricted habitat preferences.

Although few resident frugivorous bird species have been recorded to feed on the syconia of *Ficus vasculosa*, it is likely that many of the fig-eating frugivorous birds whose gape sizes match or exceed its ripe syconium diameter (1.2–1.7 cm) would feed on it. Besides the plantain squirrel, other mammals such as bats and civets probably feed on it too.

Table 1. Singapore collections of *Ficus vasculosa* Wall. & Miq. deposited in the Herbarium, Singapore Botanic Gardens (SING; with bar code number) and Herbarium, Lee Kong Chian Natural History Museum (SINU; with accession number).

S/Number	Herbarium	Bar Code or Accession Number	Collector(s)	Number	Date	Locality
1.	SING	0014086	J. S. Goodenough	5619	4 Feb.1800	Locality not indicated
2.	SING	0143799	G. King	s.n.	8 Sep.1879	Singapore Botanic Gardens
3.	SING	0014075	H. N. Ridley	5618	6 Apr.1889	Changi
4.	SING	0014078	H. N. Ridley	5620	1892	Chan Chu Kang Forest Reserve, FRNS
5.	SING	0014079	H. N. Ridley	3403	1892	Seletar
6.	SING	0014077	H. N. Ridley	5831	1893	Tanglin
7.	SING	0014076	H. N. Ridley	5856	1894	Bukit Timah
8.	SING	0014080	H. N. Ridley	s.n.	1899	Grange Road
9.	SING	0014083	C. X. Furtado	FSN 36523	26 Feb.1940	Singapore Botanic Gardens
10.	SINU	2007007308	Abu Kassim	2101	4 Feb.1959	Singapore Botanic Gardens
11.	SING	0014085	J. F. Maxwell	82-173	21 Apr.1980	Nassim Road
12.	SINU	2007007310	J. F. Maxwell	80-173	21 Apr.1980	Nassim Road
13.	SING	0014084	J. F. Maxwell	82-253	16 Sep.1982	Bukit Kallang
14.	SING	0041697	E. Tang & K. Sidek	937	5 Sep.1995	Napier Road
15.	SINU	2007007309	H. T. W. Tan, Ali bin Ibrahim, A. H. B. Loo & E. E. L. Seah	L 2062	3 Sep.1996	Pulau Sakijang Pelepah (Lazarus Island)
16.	SING	0019923	J. Lai	LJ 445	1998	Cluny Road
17.	SING	0042387	A. T. Gwee, P. Leong; A. Samsuri; S. Saifuddin & R. Kiew	GAT 52	5 Nov.2002	Pulau Ubin, Chek Jawa
18.	SING	0040422	Mohd Noor, A. Samsuri; P. Leong & A. T. Gwee	NR 50	12 Apr.2002	Singapore Botanic Gardens
19.	SING	0040149	Mohd Noor, A. Samsuri, et al.	NR 87	17 Apr.2002	Singapore Botanic Gardens
20.	SING	0055002	S. K. Ganesan & D. Yap	SKG 55	23 Apr.2004	Hendon Road
21.	SING	0158553	C. K. Yeo	s.n.	1 Apr.2011	Hendon Road
22.	SING	0014081	R. W. Hullett	FSN 208	Undated	Government House Ground
23.	SING	0014082	R. W. Hullett	FSN 208	Undated	Locality not indicated

Each *Ficus* species hosts one to four pollinator fig wasp species (but only one is recorded for *Ficus vasculosa*), and up to 30 non-pollinating wasp species (Cook & Segar, 2010) so *Ficus vasculosa* may support many species, especially if the predators of these wasps are also included which may be insectivorous birds or insects (Bronstein, 1988; Schatz et al., 2008), and thus each plant can significantly enhance the biodiversity at its site of occurrence. Jeevanandam & Corlett (2013) captured 43 individuals of *Dolichoris* fig wasps using sticky traps on Kent Ridge including at least two species, although *Ficus vasculosa* is the only known host for this genus in Singapore. Lastly, insect herbivores probably also eat its leaves, so all in all, this fig is likely to support many animals.

The lobed leaves of young plants (Fig. 6) or the juvenile phase lower portions of trees also makes this fig more unusual and attractive, so it has horticultural potential, and coupled with its tolerance for more open conditions such as hedges or edges of secondary forests, it is likely to be able to tolerate urban sites such as parks, gardens, and green corridors and like other fig species, to provide both ecosystem functions and services for other wildlife or for humans to cool down the urban environment, respectively (Lok et al., 2013).

CONCLUSIONS

Reproducing trees of *Ficus vasculosa* are found in various sites in Singapore including along the MacRitchie Nature Trail in the Central Catchment Nature Reserve, Nassim Hill, Paterson Road, Pearl's Hill City Park, Rifle Range Road, Singapore Botanic Gardens (Jungle [with 68 individuals], Lawn T, and Evolution Garden), Teban Gardens Crescent,

and Tyersall Road, so its nationally endangered status, as defined by Davison (2008), is confirmed as there are estimated to be fewer than 250 and more than 50 mature individuals in Singapore. That it can be easily propagated by seed, stem cuttings, or layering means that it is relatively easy to increase the number of individuals in Singapore. That this is a usually small tree of hedges and secondary forest, with its unusual and attractive lobed juvenile leaves, makes it an attractive candidate for planting along parks, gardens, and green corridors to enhance the biodiversity at those sites.

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