

STATUS AND DISTRIBUTION IN SINGAPORE OF *FICUS VIRENS* AITON (MORACEAE)

Si Hui Lee¹, Angie B. C. Ng, Reuben C. J. Lim¹, Riane Francisco, Wen Qing Ng¹, Xin Yi Ng¹, Louise Neo¹,
Alex T. K. Yee¹, Kwek Yan Chong¹ and Hugh T. W. Tan^{1*}

¹Department of Biological Sciences, National University of Singapore
14 Science Drive 4, Singapore 117543, Republic of Singapore

(*Corresponding author: dbsttw@nus.edu.sg)

ABSTRACT. — *Ficus virens* is a nationally critically endangered species in Singapore, with most of its individuals found in urban areas. *Ficus virens* has many uses and can be actively propagated through stem cuttings to increase its numbers and distribution in Singapore. Fruiting *Ficus virens* trees in parks may improve frugivore biodiversity but cultivation along roadsides may not be as well received owing to its periodic leafing resulting in much leaf litter.

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

INTRODUCTION

Ficus virens Aiton belongs to the subgenus *Urostigma*, section *Urostigma*, and subsection *Urostigma*. It is a deciduous, hemi-epiphytic species (Berg & Corner, 2005). It grows first as a hemi-epiphyte (Fig. 1A) then slowly establishes itself as a tree of up to 35 m tall. Trees may also grow independently (Fig. 1B). The hairless, spirally-arranged leaves have entire laminae that are egg-shaped, oblong or elliptical (Fig. 2A) with yellowish green petioles 2–4.5 cm in length, as well as pink stipules 0.3–1.5 cm in length, which can be up to 8 cm long on shoots with flushing leaves (Fig. 2B). *Ficus virens* sheds all its leaves intermittently, and during the mass production of new leaves, which lasts a few days, the stipules are shed (Ng et al., 2005). More syconia are produced after these leaf flushes (McPherson, 2005).

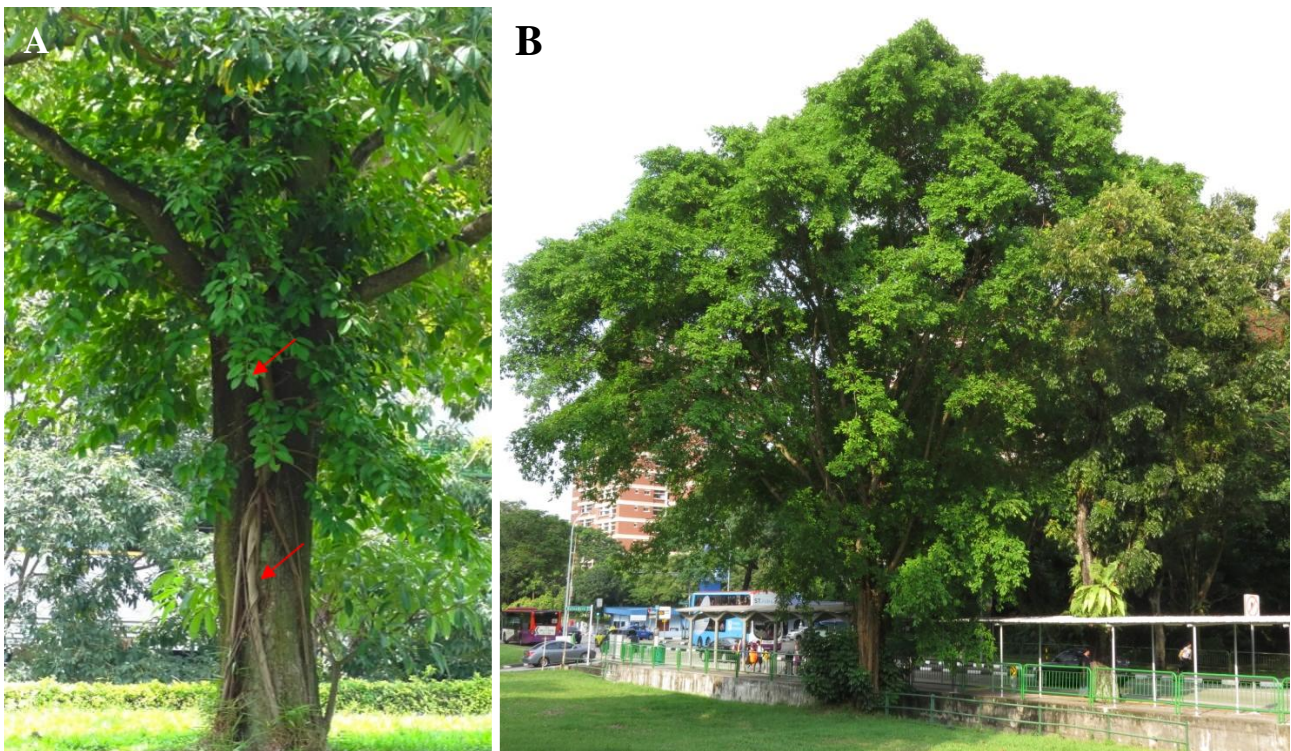


Fig. 1. *Ficus virens* Aiton: A, sapling (red arrows) growing as an epiphyte on an *Alstonia* tree along North Buona Vista Road; B, mature, 35 m tall tree growing along Tanglin Road. (Photographs by: Hugh T. W. Tan [A] and Lee Si Hui [B]).

Ficus virens can fruit twice a year (Corlett, 2006). The syconia are somewhat round and grow up to 1.2 cm wide (Berg & Corner, 2005). They ripen from white to pink to purple to black, and are either stalkless or borne on a stalk of up to 1 mm long (Fig. 2C). Syconia occur singly, in pairs or up to four on short-shoots of up to 5 mm long. Each tree will produce syconia that each contains female, male, and gall flowers (Berg & Corner, 2005).

The pollinator of *Ficus virens* is the fig wasp, *Platyscapa coronata* Grandi (see Wiebes, 1994). Female pollinators of monoecious *Ficus* species often travel a longer distance to seek receptive syconia of other conspecific individuals (Harrison & Rasplus, 2006; Jeevanandam & Corlett, 2013), while male fig wasps die within or near the syconia after mating. The difference in timing of receptivity of female and male flowers within a syconium also ensures that no intra-syconium pollination will occur. However, intra-tree pollination is feasible because of asynchronous syconium production on individual trees (Yao et al., 2005).

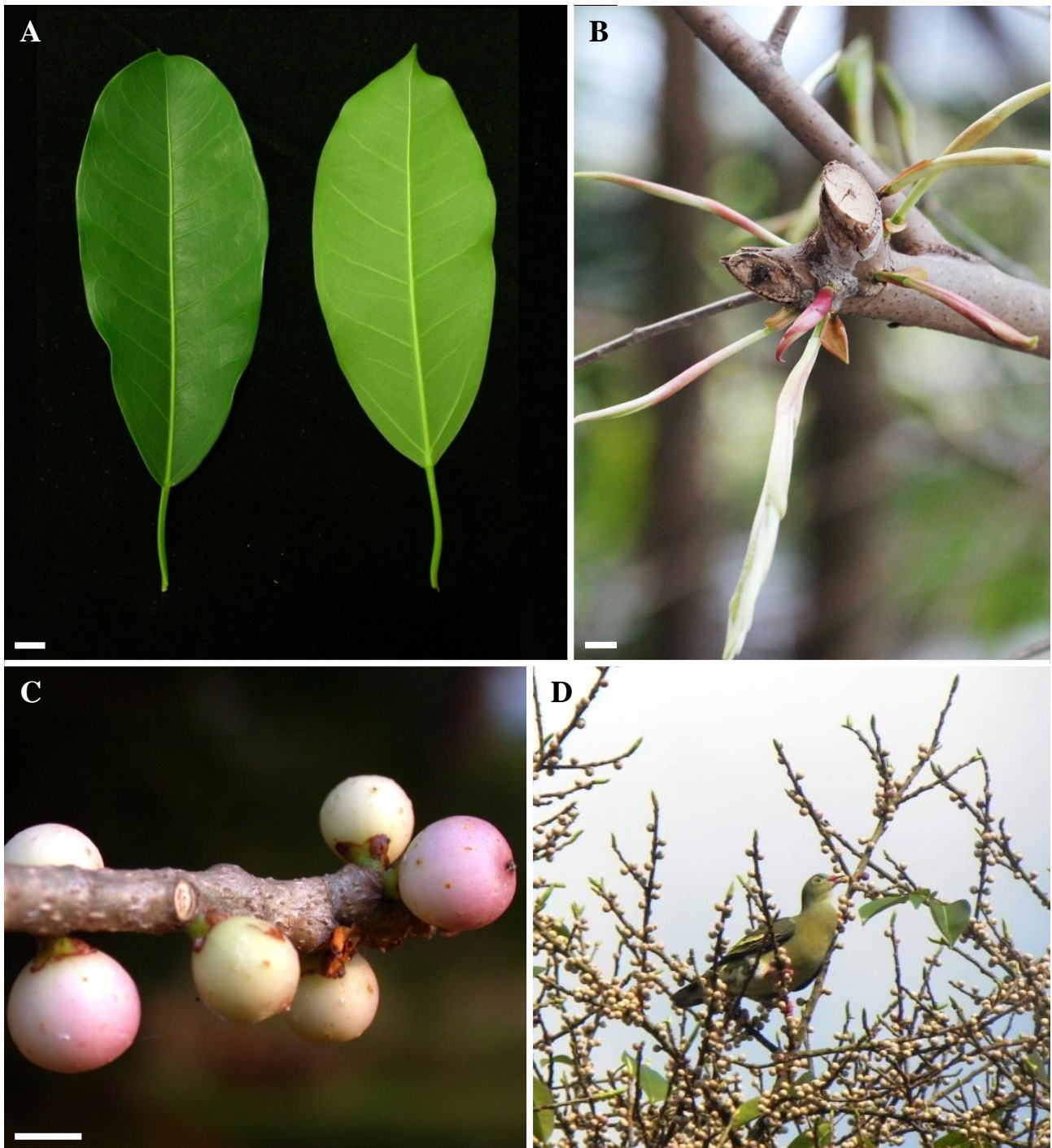


Fig. 2. *Ficus virens* Aiton: A, top (left) and underside (right) of leaves; B, pink stipules; C, syconia of different degrees of ripeness on the same branch; D, thick-billed green pigeon feeding on the syconia of *Ficus virens*. Scale bars = 1 cm. (Photographs by: Louise Neo [A], Ng Xin Yi [B], and Angie B. C. Ng [C, D]).

Ficus virens is ranked as one of the top 10 *Ficus* species that attract the most number of frugivorous species (Shanahan et al., 2001). Worldwide, there are 90 known frugivorous species that feed on its syconia, including various birds, bats, monkeys, and squirrels (Shanahan et al., 2001). Of these, at least 38 of the bird species are found in Singapore (based on Lim, 2009), including the thick-billed green-pigeon (*Treron curvirostra*; Fig. 2D).

Ficus virens can be found in coastal, monsoon or savannah forest, on cliffs, and also in secondary rainforest (Berg & Corner, 2005). It can also be found in lowland and hill forests (Turner, 1995). It has a natural distribution from Sri Lanka to southern China, across Southeast Asia to northern Australia (Berg & Corner, 2005), but is also cultivated in parks for ornamental or shade purposes in Australia and China (Jim & Liu, 2001; McPherson, 2005). Not only are the syconia edible, the new foliage of *Ficus virens* can also be eaten as a vegetable and pickle (Siwakoti et al., 1997). Also, the leaves contain antioxidants and exhibit free-radical scavenging activity, which can potentially be used in the prevention and treatment of human diseases (Abdel-Hameed, 2009). Individual trees also have potential uses for the phytoremediation of metals (Yeo & Tan, 2011), and have dust-retention capabilities such as intercepting heavy metal pollutants from the atmosphere (Qiu et al., 2009).

MATERIAL AND METHODS

Past records of *Ficus virens* in Singapore were obtained from the Herbarium, Singapore Botanic Gardens (SING) and the Herbarium, Raffles Museum of Biodiversity Research, National University of Singapore (SINU). To ascertain the current distribution of *Ficus virens* within urbanised areas, ABCN, RCJL, and RF surveyed urban areas around Singapore by vehicle and foot. The locations of individuals visually estimated to be taller than 5 m were recorded using a Geographic Positioning System (GPS) receiver (Garmin model GPSmap 62s, USA) in the Universal Transverse Mercator (UTM) coordinate system. The GPS readings were made as close to the trunk as possible, depending on terrain type or accessibility.

The identification of *Ficus virens* was done on site. Although there are three known varieties of *Ficus virens*, of which two can be found in Singapore (Turner, 1995), the varieties were not differentiated in this survey in order to be consistent with the past records obtained. However, *Ficus virens* is superficially similar to *Ficus caulocarpa*, which can also be found in Singapore. Both species are deciduous and have spirally arranged leaves with leaf blades that are elliptic with entire margins. The difference lies in the petiole colour, as the petiole epidermis of *Ficus virens* is persistent and yellowish green, while that of *Ficus caulocarpa* usually flakes off, resulting in a brown petiole. Additionally, the syconia of *Ficus caulocarpa* only grow up to 6 mm wide, compared to 12 mm for *Ficus virens* (Berg & Corner, 2005). But as syconia are not borne continuously for either species, this characteristic is not as useful as the petiole colour for identification.

RESULTS AND DISCUSSION

According to past records obtained from SING and SINU (see Table 1), *Ficus virens* was found in forested areas such as Choa Chu Kang and Bukit Timah, as well as the roadside in 1889. It is possible that other *Ficus virens* individuals could have been found in other forested areas as well. Subsequent collections of *Ficus virens* individuals were made mostly along roads with a few on islands such as Pulau Ubin and Pulau Sajahat (see Table 1).

Currently, there are 19 individuals of *Ficus virens* found in urban areas of Singapore that have been visually estimated to be taller than 5 m. *Ficus virens* trees are mainly found in the central and south of Singapore, with two other individuals in Changi. At least five of these individuals are strangling their host trees. Besides the urban areas, *Ficus virens* has also recently been found in Nee Soon Swamp Forest (Turner, 1996), Pulau Sajahat (see Table 1), and on Pulau Ubin (National Parks Board, 2013). Because of the low numbers of *Ficus virens* individuals, this species' nationally critically endangered status as reported by Tan et al. (2008) and Chong et al. (2009) is confirmed. Fig. 4 presents the present localities of trees encountered in this survey as well as those of recent collections.

Ficus virens can be propagated by seed or stem cuttings (Yeo & Tan, 2011). The attractive, round crown of the tree suggests its horticultural potential as a park tree. Furthermore, *Ficus virens* has dust retention capabilities and can help with improving air quality, especially around industrial areas (Qiu et al., 2009). However, the mess created by the shedding of leaves which precedes leaf flushing can be an occasional problem for the maintenance of urban areas, and should be considered before the widespread implementation of *Ficus virens* in roadside plantings.

Actively propagating *Ficus virens* and planting it in parks or park connectors will not only boost the numbers of this rare species and increase its distribution, but it can also help enrich the avian diversity of areas where they are planted. Of the 38 Singapore bird species that are known to feed on the syconia of *Ficus virens* (Shanahan et al., 2001), 17 species are native to Singapore based on Lim (2009). These include two rare residents: the greater green leafbird (*Chloropsis sonnerati*) and the lesser green leafbird (*Chloropsis cyanopogon*), and uncommon resident species such as

the Oriental magpie robin (*Copsychus saularis*), red-crowned barbet (*Megalaima rafflesii*), blue-winged leafbird (*Chloropsis cochinchinensis*), blue-crowned hanging parrot (*Loriculus galgulus*), hill myna (*Gracula religiosa*), and thick-billed green pigeon (*Treron curvirostra*; see Lim, 2009).

Table 1. Previous Singapore collections of *Ficus virens* Aiton deposited in the Herbarium, Singapore Botanic Gardens (SING; with bar code no.) and the Herbarium, Raffles Museum of Biodiversity Research, National University of Singapore (SINU; with accession no.).

S/No.	Accession/ Bar Code No.	Herbarium	Collector(s)	Collector's No.	Date	Locality
1.	0014090	SING	H. N. Ridley	98	Jan.1889	Bukit Timah
2.	0014093	SING	H. N. Ridley	1602	30 Oct.1889	Chan Chu Kang FR, FRNS
3.	0014091	SING	H. N. Ridley	s.n.	1889	Bedok, roadside
4.	0014092	SING	H. N. Ridley	s.n.	1894	Bukit Timah
5.	0014096	SING	E. J. H. Corner	33565	22 Jun.1937	Tanglin
6.	0014097	SING	E. J. H. Corner	s.n.	22 Jun.1937	Tanglin
7.	0014094	SING	A. G. Alphonso	s.n.	5 Dec.1974	Penang Road
8.	0014095	SING	A. G. Alphonso	s.n.	5 Dec.1974	Penang Road
9.	0008068	SING	G. Weiblen	1079	15 Jul.1998	Cluny Road
10.	0019888	SING	J. Lai	411	1998	Cluny Road
11.	0043719	SING	A. T. Gwee	259	25 Feb.2003	Pulau Ubin, Chek Jawa
12.	2007007328	SINU	S. Sim & C. K. Yeo	s.n.	28 Aug.2003	Dunearn Road
13.	2007007332	SINU	S. Sim & C. K. Yeo	s.n.	28 Aug.2003	Dunearn Road
14.	2007007331	SINU	S. Sim & C. K. Yeo	s.n.	25 Sep.2003	Pulau Sajahat
15.	2007007330	SINU	S. Sim & C. K. Yeo	s.n.	29 Oct.2003	Netharavon Road
16.	2007007329	SINU	—	—	—	Singapore

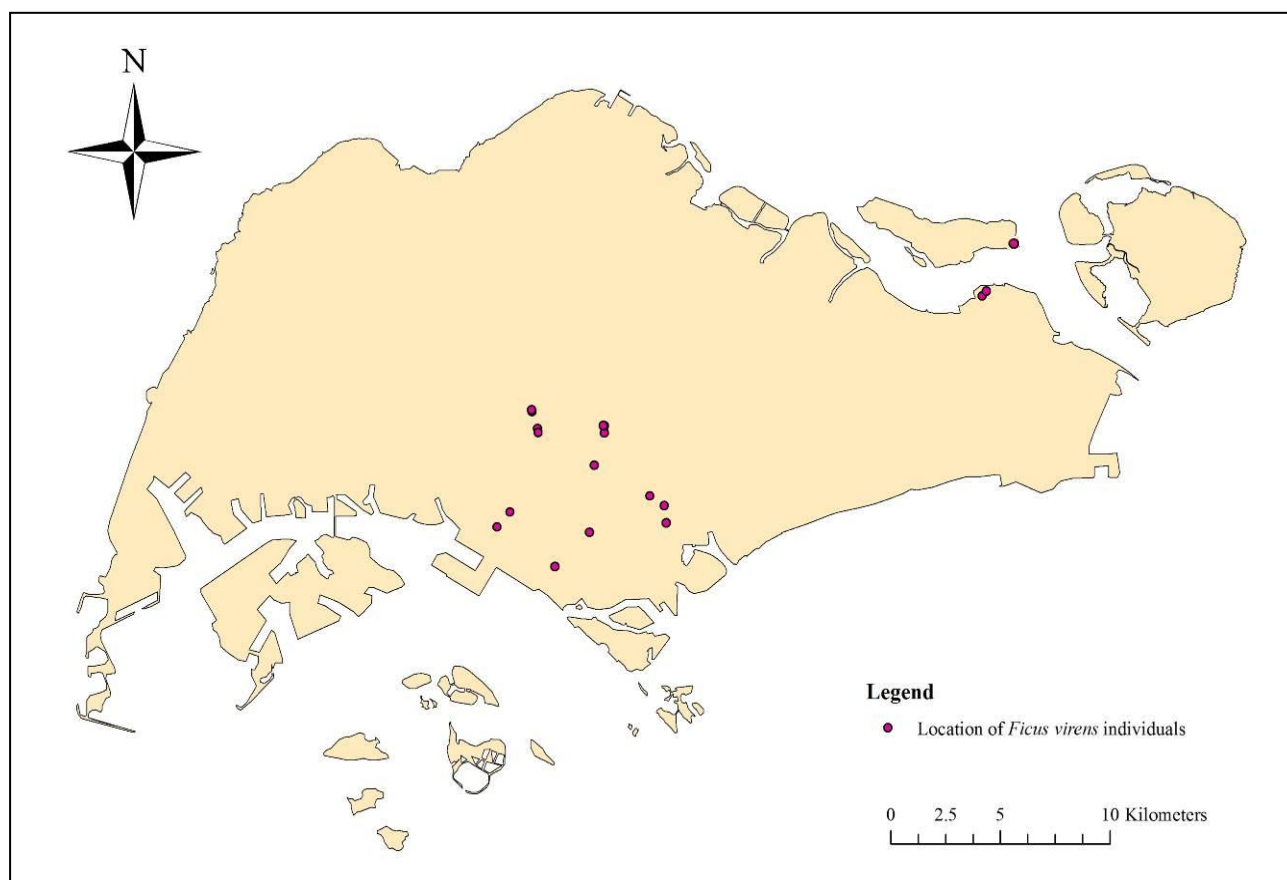


Fig. 4. Locations of *Ficus virens* trees in urban Singapore. At some of the locations, more than one individual was found. Most of the individuals were growing as hemi-epiphytes on trees or as solitary trees. (Base map by: Alex T. K. Yee).

ACKNOWLEDGEMENTS

We would like to thank Serena Lee of the Herbarium, Singapore Botanic Gardens (SING) and Chua Keng Soon of the Herbarium, Raffles Museum of Biodiversity Research, National University of Singapore (SINU), for kindly providing herbarium records on *Ficus virens*. This research was partially funded by the Ministry of National Development Research Fund for the Built Environment through the research grants for the two projects: “Enhancing the Urban Native Biodiversity in Singapore” in collaboration with the National Parks Board, and “Planning and Development for Sustainable High Density Living Project 3: Urban Greenery Studies” in collaboration with the Centre for Urban Greenery and Ecology of the National Parks Board, Housing and Development Board, and the Urban Redevelopment Authority.

LITERATURE CITED

- Abdel-Hameed, E.-S. S., 2009. Total phenolic contents and free radical scavenging activity of certain Egyptian *Ficus* species leaf samples. *Food Chemistry*, **114**: 1271–1277.
- Berg, C. C. & E. J. H. Corner, 2005. Moraceae—*Ficus*. *Flora Malesiana*, Series 1, **17**: 1–730.
- Chong, K. Y., H. T. W. Tan & R. T. Corlett, 2009. *A Checklist of the Total Vascular Plant Flora of Singapore: Native, Naturalised and Cultivated Species*. Raffles Museum of Biodiversity Research, National University of Singapore, Singapore. 273 pp. Uploaded 12 Nov.2009. http://rmbn.nus.edu.sg/raffles_museum_pub/flora_of_singapore_tc.pdf. (Accessed 31 Jul.2013).
- Corlett, R. T., 2006. Figs (*Ficus*, Moraceae) in urban Hong Kong, South China. *Biotropica*, **38**: 116–121.
- Harrison, R. D. & J.-Y. Rasplus, 2006. Dispersal of fig pollinators in Asian tropical rainforests. *Journal of Tropical Ecology*, **22**: 631–639.
- Jeevanandam, N. & R. T. Corlett, 2013. Fig wasp dispersal in urban Singapore. *Raffles Bulletin of Zoology*, **61**: 343–347.
- Jim, C. Y. & H. T. Liu, 2001. Species diversity of three major urban forest types in Guangzhou City, China. *Forest Ecology and Management*, **146**: 99–114.
- Lim, K. S., 2009. *The Avifauna of Singapore*. Nature Society (Singapore), Bird Group Records Committee, Singapore. 611 pp.
- McPherson, J. R., 2005. Phenology of six *Ficus* L., Moraceae, species and its effects on pollinator survival, in Brisbane, Queensland, Australia. *Geographical Research*, **43**: 297–305.
- National Parks Board, 2013. *Pulau Ubin*. National Parks Board, Singapore. http://www.nparks.gov.sg/cms/index.php?option=com_visitorsguide&task=parks&id=29&Itemid=73. (Accessed 30 Jul.2013).
- Ng, A. B. C., A. Ng, B. Lee, A. L. Chuah, S. G. Goh, J. T. K. Lai, G. C. Tan & V. D’Rozario, 2005. *A Guide to the Fabulous Figs of Singapore*. Singapore Science Centre, Singapore. 152 pp.
- Qiu, Y., D. Guan, W. Song & K. Huang, 2009. Capture of heavy metals and sulfur by foliar dust in urban Huizhou, Guangdong Province, China. *Chemosphere*, **75**: 447–452.
- Shanahan, M., S. So., S. G. Compton & R. T. Corlett, 2001. Fig-eating by vertebrate frugivores: A global review. *Biological Reviews*, **76**: 529–572.
- Siwakoti, M., S. Siwakoti & S. K. Varma. 1997. Ethnobotanical notes on wild edible plants used by Satar tribes of Nepal. *Tribhuvan University Journal*, **20**: 57–64.
- Tan, H. T. W., B. C. Tan, K.-x. Tan, Ali bin Ibrahim, P. T. Chew, K. S. Chua, H. Duistermaat, S. K. Ganesan, M. W. K. Goh, A. T. Gwee, R. Kiew, S. M. L. Lee, P. Leong, J. Lim, A. F. S. L. Lok, A. H. B. Loo, S. K. Y. Lum, T. Morgany, Saifuddin bin Suran, S. Sim, Haji Samsuri bin Haji Ahmad, Y. C. Wee, K. F. Yap, C. K. Yeo & J. W. H. Yong, 2008. Checklists of threatened species: Seed plants. In: Davison, G. W. H., P. K. L. Ng & H. C. Ho (eds.), *The Singapore Red Data Book: Threatened Plants and Animals of Singapore*. 2nd Edition. Nature Society (Singapore), Singapore. Pp. 213–245.
- Turner, I. M., 1995. A catalogue of the vascular plants of Malaya. *The Gardens’ Bulletin, Singapore*, **47**: 1–757.
- Turner, I. M., C. M. Boo, Y. K. Wong, P. T. Chew & Ali bin Ibrahim, 1996. Freshwater swamp forest in Singapore, with particular reference to that found around the Nee Soon Firing Ranges. *The Gardens’ Bulletin, Singapore*, **48**: 129–157.
- Wiebes, J. T., 1994. *The Indo-Australian Agaoninae (pollinators of figs)*. Koninklijke Nederlandse Akademie van Wetenschappen, Leiden, The Netherlands. 208 pp.
- Yao, J.-Y., N.-X. Zhao, Y.-Z. Chen, X.-C. Jia, Y. Deng & H. Yu., 2005. Seed and wasp production in the mutualism of figs and fig wasps. *Forestry Studies in China*, **7**: 25–28.
- Yeo, C. K. & H. T. W. Tan, 2011. *Ficus* stranglers and *Melastoma malabathricum*: Potential tropical woody plants for phytoremediation of metals in wetlands. *Nature in Singapore*, **4**: 213–226.