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A NEW RECORD OF *PIPER ADUNCUM* L. (PIPERACEAE) IN SINGAPORE

H. T. W. Tan*[1], Ali bin Ibrahim[2] and **K.-x. Tan[1]**
[1]*Department of Biological Sciences, National University of Singapore*
14 Science Drive 4, Singapore 117543
[2]*National Parks Board, Headquarters (Raffles Building)*
Singapore Botanic Gardens, 1 Cluny Road, Singapore 259569
*(*Corresponding author: dbsttw@nus.edu.sg)*

INTRODUCTION

Piper aduncum L. is a treelet or tree that grows up to 8 m tall or more, with short prop-roots and drooping twigs bearing alternate, stalked leaves in two rows in one plane (Figs. 1–6). The spicate inflorescences opposite the leaves bear tiny, naked flowers, each developing into a one-seeded berry that is black when ripe (Waterhouse & Mitchell, 1998; Figs. 6–10). This species is naturally distributed in the West Indies and mainland tropical America (US Forest Service, Pacific Island Ecosystems at Risk, 1999). It is an aggressive weed or invasive species in Fiji and Papua New Guinea, colonizing clearings, grazing lands, abandoned gardens, along roadsides, in thickets, and occasionally in secondary forests or forested ridges, forming monocultures on agricultural land near roads (Henty & Pritchard, 1975; Smith, 1981; Waterhouse & Mitchell, 1998). In East Kalimantan, it grows from sea level to 400 m altitude (Smith, 1981) and occurs together with native pioneer species (Hiratsuka et al., 2006).

DETAILS OF COLLECTION AND DISCOVERY

Piper aduncum was first collected in Singapore on 20 May 2003 in wasteland vegetation along the Sungei Pang Sua, Kranji. Subsequently, it was found in Sungei Punggol on 3 Dec.2003, then along the Malaysian Railway line near the intersection of Commonwealth Avenue West and the Buona Vista Mass Rapid Transit (MRT) Station on 11 Aug.2004 (Figs. 6–10), along Neo Tiew Road (along the fence of Bollywood Veggies [Figs. 1 and 3]; at the junction of Neo Tiew Lane 2), at the Jalan Jelutong Campsite and after the first bridge along Jalan Endut Senin in Pulau Ubin (Figs. 2, 4 and 5), as well as the now expunged Ulu Sembawang Road, off Mandai Road. From recent field observations, it is spreading throughout Singapore and probably arrived by dispersal southwards from Peninsular Malaysia, where it has been reported earlier in Selangor (Turner, 1995). Table 1 lists the collections of the two herbaria in Singapore.

Table 1. Recent Singapore collections of *Piper aduncum*, in chronological order, deposited in the Herbarium, Singapore Botanic Gardens (SING, with bar code nos.) and Herbarium, Raffles Museum of Biodiversity Research, Department of Biological Sciences, National University of Singapore (SINU, with accession nos.).

S/No.	Accession/Bar Code No.	Collector	Collector's No.	Year	Locality
1.	SING 0044625	A. Samsuri, S. Lee, A.T. Gwee & P. Leong	KJ 15	2003	Sungei Pang Sua, Kranji
2.	SINU 2007015503	K.-x. Tan	884	2003	Sungei Punggol
3.	SINU 2007007711	H.T.W. Tan	1299	2004	Malayan Railway Line bear the intersection of Commonwealth Avenue West and Buona Vista MRT Station
4.	SING 0108813	Ali bin Ibrahim	SING 2007-438	2007	Campsite, Jalan Jelutong, Pulau Ubin

Fig. 1. Young *Piper aduncum* trees along Neo Tiew Road.

Fig. 2. Mature trees in Pulau Ubin. These are about 8 m tall.

Fig. 3. Young trees' trunks and branches. Note their green colour and the prominent nodes, superficially similar to those of a bamboo stem.

Fig. 4. Mature trees' trunks and branch. Note the light grey bark covered with whitish lichens. The trunk nodes are still prominent. Small prop roots are found at the base of the trunk in the foreground.

Fig. 5. Flowering, leafy branches of *Piper aduncum*.

Fig. 6. Flowering and leafy branch. Note the leaf-opposed spicate inflorescences. Scale bar = 5 cm.

Fig. 7. Infructescence of *Piper aduncum*. Scale bar = 5 mm.

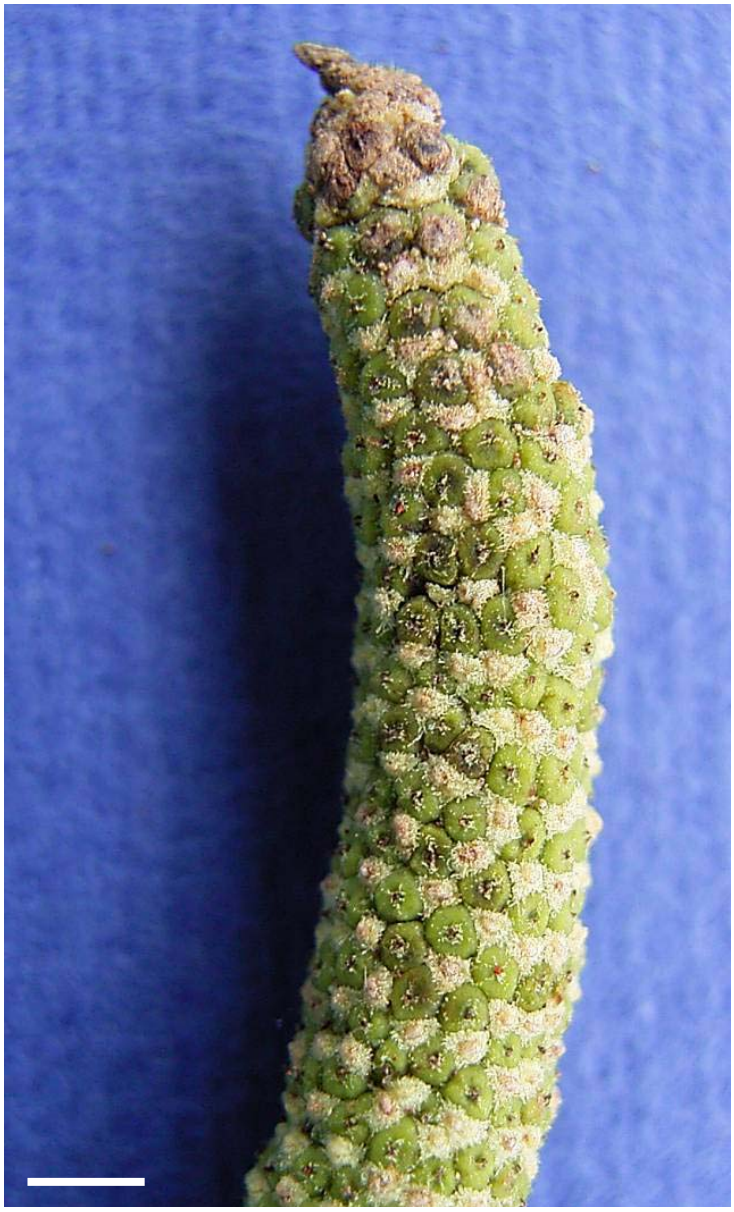

Fig. 8. Close up of the tip of the infructescence. Note the young fruits, each with a dark stigma in the centre. Scale bar = 2 mm.

Fig. 9. Cross-section of the infructescence. The seeds have been sectioned through. Scale bar = 1 mm.

Fig. 10. Seeds, some covered with fruit pulp. Scale bar = 1 mm.

Piper aduncum is well suited for growth, reproduction and establishment in Singapore. Its germination rate is severely affected by water restriction and enhanced when temperatures are increased to 24–30° C (Silva et al., 2007). This matches local conditions, where rainfall is very even throughout the year, averaging 2,345 mm per year, with a mean daily temperature of 26.8°C, a mean daily minimum of 23.9°C and a mean daily maximum of 30.9°C (Ministry of Information, Communication and the Arts, 2006).

This species reproduces by its tiny seeds which are reported to be dispersed by birds and fruit bats, and possibly also by machinery, and locally, by suckering to form large clumps (US Forest Service, Pacific Island Ecosystems at Risk, 1999). In Puerto Rico, the fruits are eaten by two species of nectarivorous bats (Soto-Centeno & Kurta, 2006). Primack & Corlett (2005) have noted that New World species, such as *Piper aduncum*, once introduced into the Old World, are quickly adopted by the local bats.

Because *Piper aduncum* tends to occupy a similar niche to those of *Macaranga gigantea*, *Macaranga hypoleuca*, *Mallotus paniculatus*, *Melastoma malabathricum* and *Trema cannabina* in East Kalimantan forests (Hiratisuka et al., 2006), it has great potential to be an invasive species of Singapore's forest sites, so should be eradicated while the numbers are still small enough. Indeed, *Piper aduncum* has invaded closed secondary rainforest and secondary fallow vegetation fragments of lowland Papua New Guinea, where the aggressive invasion and monospecific stands were attributed to the dominance in the soil seed bank, fast growth and high rates of biomass accumulation (Rogers & Hartemink, 2000).

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LITERATURE CITED

Hiratsuka, M., T. Toma, R. Diana, D. Hadriyanto & Y. Morikawa, 2006. Biomass recovery of naturally regenerated vegetation after the 1998 forest fire in East Kalimantan, Indonesia. *Japan Agricultural Research Quarterly* **40**(3): 277–282.

Ministry of Information, Communication and the Arts, 2006. *Singapore Yearbook: 2006.* Ministry of Information, Communication and the Arts, Singapore. 343 pp.

Primack, R. B. & R. T. Corlett, 2005. Tropical Rain Forests: An Ecological and Biogeographical Comparison. Blackwell Publishing, Massachusetts. Pp. 319.

Rogers, H. M. & A. E. Hartemink, 2000. Soil seed bank and growth rates on an invasive species, *Piper aduncum*, in the lowlands of Papua New Guinea. *Journal of Tropical Ecology* **16**(2): 243–251.

Silva, M. H. L., R. C. L. Costa, A. K. S. Lobato, C. F. Oliveira Neto & H. D. Laughinghouse IV, 2007. Effect of temperature and water restriction on *Piper aduncum* L. seed germination. *Journal of Agronomy* **6**(3): 472–475.

Soto-Centeno, J. A. & A. Kurta, 2006. Diet of two nectarivorous bats, *Erophylla sezekorni* and *Monophyllus redmani* (Phyllostomidae), on Puerto Rico. *Journal of Mammalogy* **87**(1): 19–26.

Turner, I. M., 1995. A catalogue of the vascular plants of Malaya. *The Gardens' Bulletin, Singapore* **47**(2): 347–757.

US Forest Service, Pacific Island Ecosystems at Risk (PIER), 1999. *Piper aduncum* L., Piperaceae. http://www.hear.org/Pier/species/piper_aduncum.htm. (Created 1 Jan.1999; last updated 18 Feb.2007). (Accessed 8 Aug.2008)

Waterhouse, B. M. & A. A. Mitchell, 1998. *Northern Australia Quarantine Strategy: Weeds Target List. 2nd Edition.* Australian Quarantine & Inspection Service, Miscellaneous Publication No. 6/98. Pp. 110.