Sendera-clandi (*Xenostegia tridentata* (L.) D.F. Austin & Staples, Convolvulaceae): A medicinal creeper

Daniel F. Austin

Research

Abstract

In 1692 Rheede reported vines in India by the Malayalam name **sendera-clandi**. Soon afterward, the medicinal species was in London, imported from India and West Africa. Subsequent exploration of Africa and Asia revealed that these diminutive creepers were widespread and that they were considered medicinal throughout the Old World tropics. Now known scientifically as *Xenostegia tridentata* (L.) D.F. Austin & Staples, people have long recognized two distinct morphotypes, one African and one Asian. Recent research confirms that these two represent subspecies of *X. tridentata* whose ranges overlap in southern India and Sri Lanka. Historical data indicate that the overlap was caused, or at least enhanced, by traders moving between Asia and Africa.

Introduction

The old saying "*apparentiis decipiunt*" (appearances deceive) applies to plants called **sendera-clandi**, the Malalyalam name recorded by Rheede (1692:133). These herbs are prostrate and often small, and the flowers are inconspicuous, yellowish, and easily missed (Figures 1, 2). In spite of the species' low profile, people have been paying attention to these creepers for perhaps more than 2000 years.

Sendera-clandi, scientifically *Xenostegia tridentata* (L.) D.F. Austin & Staples, became known in Europe from Rheede's (1692:133) Hortus Malabaricus that discussed them in Kerala, India. Soon afterward, Petiver (1695:9) and Plukenet (1696:117) had *Xenostegia* in London. It is not clear if they had both living and dried specimens, but Samuel Browne (1623–1698) sent seeds and preserved material from India to Petiver (Heniger 1986:174, Stearns 1952:258) while Edward Bartar (fl. 1696–1700) sent specimens and assuredly seeds from western Africa (e.g., Petiver 1695:68, 684).

Xenostegia tridentata was widely spread across the Old World tropics by the time Europeans learned of it. There has been a trend to recognize two kinds of *X. tridentata* since at least the 1600s (Blume 1826:721, Brown 1810:485, Desrousseaux 1792:547, Plukenet 1696:117, cf. Rheede 1692:113,133). While these two have been called by several binomials, their almost distinct ranges led to them being considered subspecies—*X. tridentata* subsp. *tridentata* and *X. tridentata* subsp. *hastata* (Oostr.) Parmar. Analysis of pollen, ovary pubescence, sepal shapes, stem and root anatomy, and thin layer chromatography of β-sitosterol shows the distinctness of these two (Sereena *et al.* 2012, Simões 2013:196–203). Most records of subsp. *tridentata* are from Africa; all records of subsp. *hastata* are from Asia. The single known area of overlap is southern India and Sri Lanka, an area used by traders to move between southeastern Asia and Afri-

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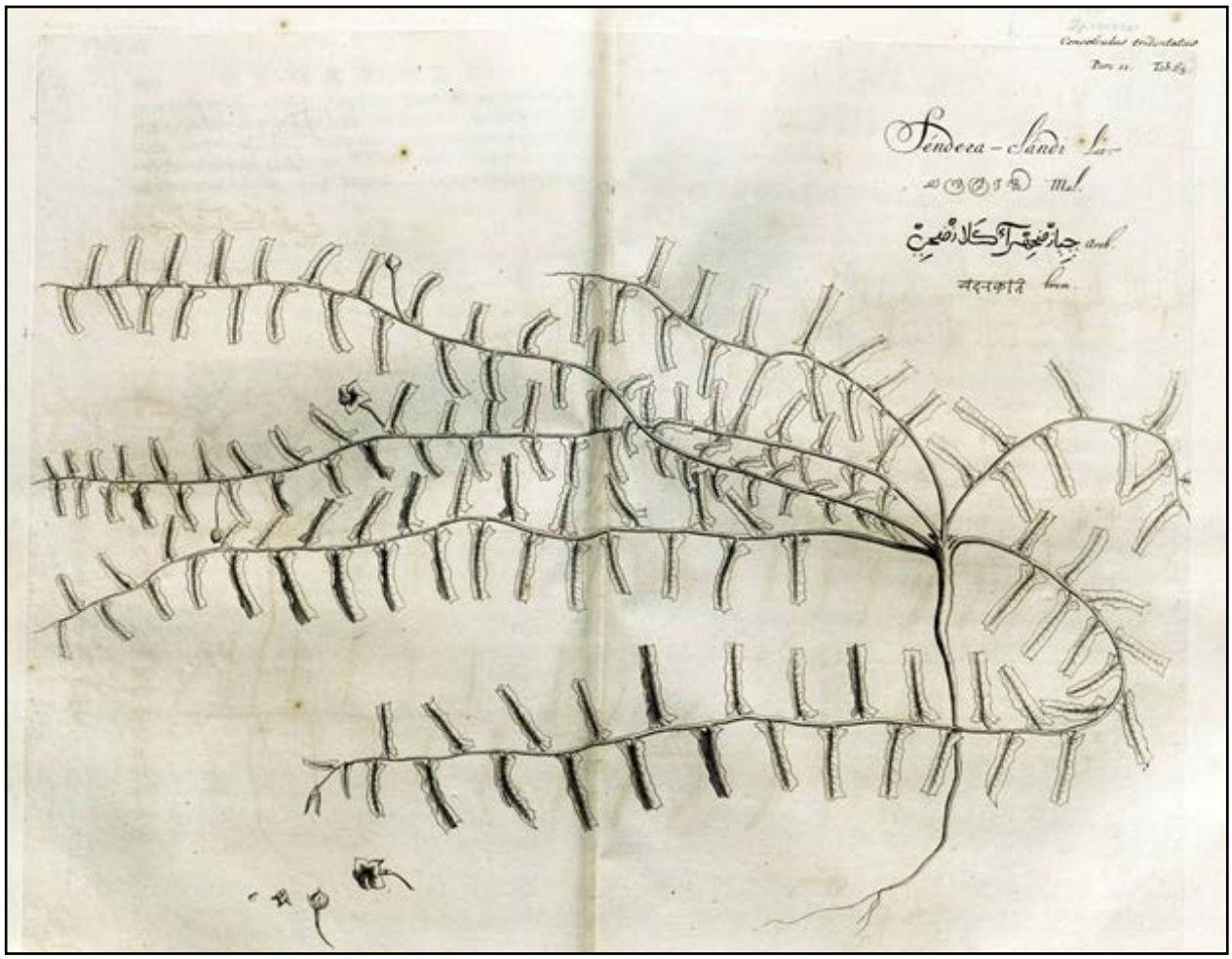

Figure 1. **Sendera-clandi**, *Xenostegia tridentata* (L.) D.F. Austin & Staples (Rheede 1692:133)

ca (e.g., Hawley 2008, Mangat 1969, Perbi 2001, Smith 1989).

These nondescript creepers are not the kind of plants that one might expect to be moved because of their beauty. Moreover, in the period when Europeans learned about them, it was their custom to move plants for potential medical uses, not for ornament (cf. Austin 2013 for recent synopsis). The discovery of that overlap between subspecies made me wonder what created it, and I looked into the history of the species. The results show long human involvement with *X. tridentata*.

In the following, I will address these questions: (1) Where is *X. tridentata* native? (2) When did Europeans learn of the species? (3) Is the migration of this plant human-mediated?

Methods

I have sporadically studied *X. tridentata* since the middle 1970s (e.g., Austin 1980, Austin & Staples 1980). Initial and ensuing studies allowed me to examine wild plants, herbarium specimens, and literary records. Subsequently, historical literature dealing with this species has been located and the entries noted, compiled, and summarized specifically to address the questions in this treatise. Original sources were analyzed, except for those in Sanskrit for which I had to rely on translations or interpretations. Since the original Sanskrit texts simply used the common name, all of the subsequent interpretations translated the word(s) as their authors thought proper. Since the translators were not botanists but linguists, those transcriptions into scientific names were sometimes inaccurate or reflect a wider usage of the same name for different taxa than in the scientific community.

Searches of the literature for *Xenostegia* and its taxonomic synonyms (e.g., *Merremia tridentata* (L.) Hallier f.) and common names were accomplished by scanning literature cited in known papers and also by using databases including but not confined to PubMed, Google Scholar, and Google Books. When obscure citations were found, these

Figure 2. *Xenostegia tridentata* (L.) D.F. Austin & Staples (Jacquin 1788, tabula 317).

were either found online if digitized or obtained from libraries.

Results

Nativity

There are two major data sets that are good indicators of where a species is native: (1) areas with its closest relatives and (2) regions where it has an abundance of common names. When we studied *X. tridentata* in relation to *Merremia* (Austin & Staples 1980), we discovered that morphologically it is similar to *Xenostegia media* (L.) D.F.Austin & Staples, a species restricted to Tanzania and Mozambique. Simões (2013) confirmed the relationship between these two and found that there are three other allied African species. One is widespread but restricted to Tropical Africa; another occurs only in Kenya, Tanzania, and Zimbabwe; the third is endemic to the Congo and Zaire. *Xenostegia tridentata* is more widespread, being known across tropical Africa, Madagascar, Southern India, Sri Lanka, and Malesia to Northern Australia. Thus, *X. tridentata* is widespread in Africa, and all of its relatives are endemic there. Relationships clearly point to Africa as the area of nativity. Relatives alone cannot confirm whether *X. tridentata* is native to Asia as well as Africa. The fact that different subspecies grow in each of those two continental regions suggests that they are native in Asia, but that assumption needs to be tested.

A survey of common names for *X. tridentata* shows that they are both abundant and widespread (Table 1). Although no attempt has been made at an exhaustive list of names, some 47 languages and 10 language families are represented. Those language families are heavily concentrated across Africa and Asia.

For the few names where there are data, those in the Indian region are up to 2000 years old. For example, Rheede (1692:113, 133) recorded the species with the Malayalam names **sendera-clandi** and **tala-neli** (Figures 1, 3). The former is no longer used in Kerala and has been super-

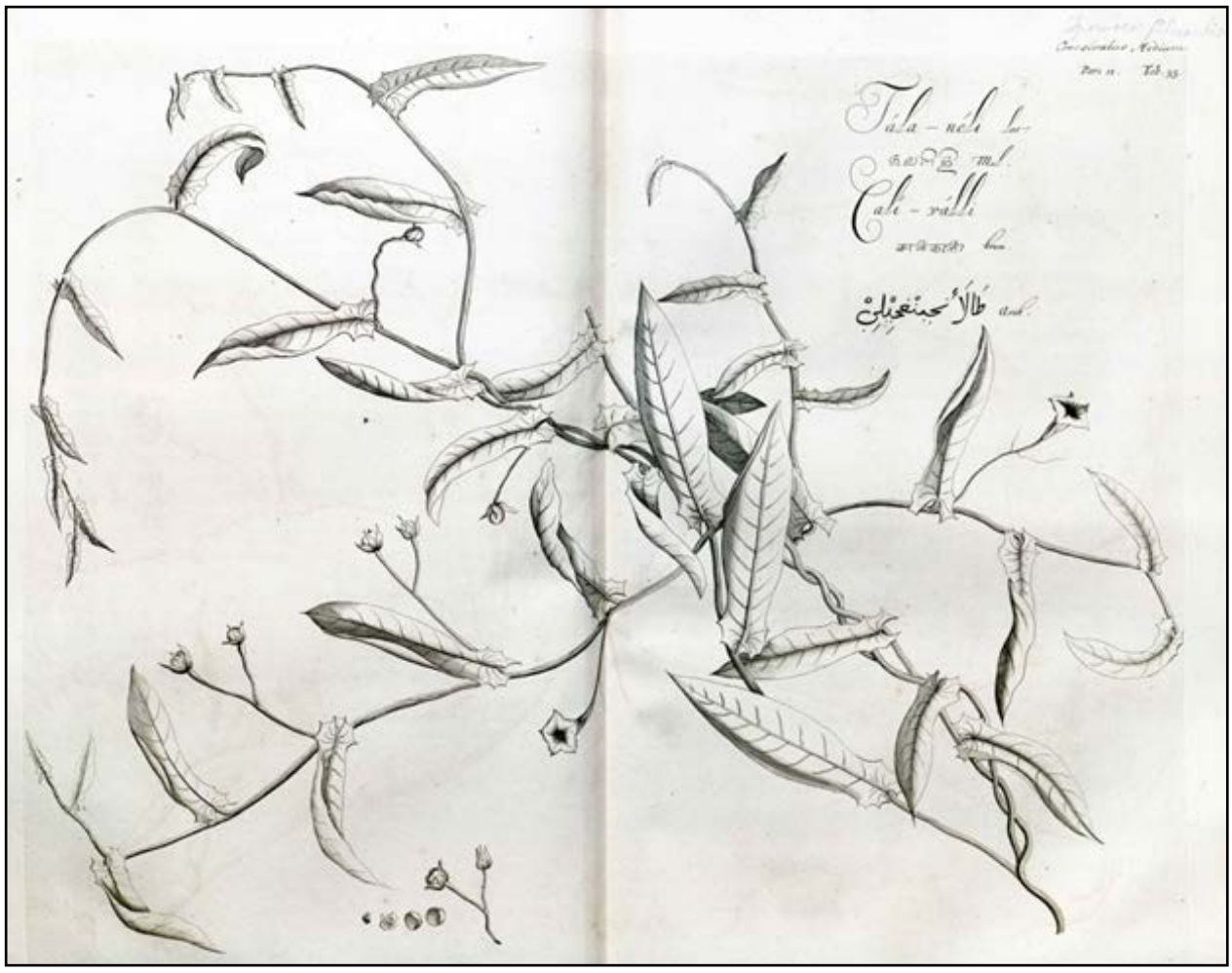

Figure 3. **Tala-neli**, *Xenostegia tridentata* (L.) D.F. Austin & Staples (Rheede1692:113).

Figure 4. *Xenostegia tridentata* (L.) D.F. Austin & Staples (Hooker 1864, tabula 5426).

seded by **talanili** (see Table 1; cf. also Nicolson *et al.* 1988:94). Indeed, Linnaeus (1747:211) mentioned only **tala-neli** (*Convolvulus tridentatus* L.).

The Sanskrit name प्रसारणि (**prasarani**) dates from the Sushruta Samhita which was written in the 6th century BCE (Lock *et al.* 2001:836). Although **prasarani** is also applied to *Paederia* (see Tables 1, 2, and discussion below), this name suggests that *Xenostegia* has probably been in the Indian region for at least 2000 years.

Determining the antiquity of the names in Africa is not easy because there are no records similar to those in India. So far as I know, no linguist has made comparisons of the plant names in the region. Apparently no reports of local names are as old as those for the Indian region, probably because of their different histories. The one comparatively old exception found for Africa is by Petiver (1695–1697:683); he gave a single local name for Convolvulaceae; it is an *Ipomoea* and not *Xenostegia*.

The few common names in the New World are either imported or contrived (see Table 1). The contrived names in the Americas are unquestionably because the plants were introduced, probably in the 1800s. Graham (1839:131, as *Ipomoea filicaulis* Blume) listed it, without explanation, as native to "America" and several parts of the Old World. Hooker (1864) also wrote that *X. tridentata* inhabited the New World as well as the Old. The herbs were introduced into Puerto Rico some time before 1887 when Urban annotated a specimen (*Sintenis 6738* US) with the synonym *Ipomoea angustifolia* Jacq. (O'Donell 1941:539). German pharmacist Paul Sintenis (1847–1907) collected in Puerto Rico between October 1884 and June 1887. Plants in Puerto Rico are subsp. *tridentata* (Simões 2013:197) so

Table 1. Some common names for *Xenostegia tridentata* (L.) D.F. Austin & Staples.

Language Family (Subfamily)			
	Language	**Common name**	**Sources**
Afro-Asiatic (Chadic)			
	Hausa	**gadon machiji** (snake's bed), **gammon baawàa** [**gammon bawa**] (slave's head-pad), **koòrénhàwaíniyàá** (ringworm of the chameleon [doubtful translation of **koòrén**]), **maganin kunama** (medicine for scorpion), **yamburu** [**yamßururu**, **yámḿbururu**, **yam'ḿbururu**, **yimßururu**, **yim'bururu**] (includes some of the smaller species of *Ipomoea*, cf. Dalziel)	Burkill 1985:550, Dalziel 1937:440, Schuh, pers. comm. 02 October 2013
	Bade	**àlìyābə̂vjān** (turban-of-monkey)	Dagona 2009:12, Schuh, pers. comm. 02 September 2013
	Duwai	**èryāpə̂vji** (turban-of-monkey)	Daskum & Kachallah 2009:5, Schuh, pers. comm. 02 September 2013
	Karekare	**ilmà tà jadawài** (fat-of-widow)	Tikau *et al.* 2009:34, Schuh, pers. comm. 02 September 2013

Language Family (Subfamily)			
	Language	**Common name**	**Sources**
Austro-Asiatic (Aslian)			
	?	**karok rĕliya** [**karok relia**], **pung ulang** [**pungulang**] (corrupt *fide* Burkill)	Burkill 1966:2:1480
Austro-Asiatic (Mon-Khmer)			
	Vietnamese	**Bìm Bìm ba răng** (bindweed bindweed three teeth), **dây Lưỡi Đòng** (copper mesh wire)	Tran 2010
Austronesian (Malayo-Polynesian)			
	Igorot	**karadkad** (more than healthy)	Mansur 2001:371
	Javanese	**irit-iritan** (**irit**, save), **rangitan**	Mansur 2001:371
	Malagasy	**antsarake**, **atarikolo**, **lelatandraka**	Deroin 2001:123
	Malay	**andor na loemat** (Sumatra), **akar keremak** (Sumatra; **akar**, root; **keremak**, ?), **kangkong paya** (**paya**, marsh; **kangkong**, *Ipomoea aquatica* Forssk.), **kangkong laut** (**laut**, water)	Burkill 1966:2:1480; Bartlett 22 May 1927 (barcode 00942436 US!), Rahmat Si Boeea 1680202 (barcode 00965407 US!), Wong & Tan 1994:25
	Palauan	**kebeas**	US Forest Service 2008
	Tagalog	**maragta**, **talanuk**	Mansur 2001:371
Dravidian (South-Central)			
	Telugu	కొండసీతసవరం **konda síta savaram**, లంజసవరం **lanjasavaram**	Elliot 1859:97, 169, Heyne 1814:139, Watt 1889:IV:476
Dravidian (Southern)			
	?Kannada	**neyi kulovu**	Bhandary & Chandrashekar 2011:530
	Kannikaran [Kanikkar Bhasha or Malampashi]	**koonthalvalarthi**	Lalitha Rani *et al.* 2011:21
	Malayalam	**prasarini**, **pradharini** (derived from Sanskrit), ചന്ദ്രകരണ്ടി **sendera-clandi** [**chandrakranti**] (**chandra**, moon; **kranti**, Sanskrit for halo), തലനീളി **thalanili** [**talaneeli**, **talanili**] (തല **tala**, head; നാല് **neli**, smell), **cali-velli** ചാലി വള്ളി (ചാലി **cali**, mix ingredients in fluids; വള്ളി **vaḷḷi**, a creeping plant)	Enchanting Kerala 2009–2011, Burman 1769:9, Joseph & Antony 2012:96, Nayar *et al.* 2006:200, Nicolson *et al.* 1988:94, Rheede 1692:113, 133, Sasidharan n.d.
	Tamil	**auvaiyarkundal** (**auvaiyar**, collection?; **kūntl**, probably derived from Sanskrit कुन्तल **kuntala**, hair), முடியாற்குந்தால் **mudiarkunthal** [**mudiyakuntal**, **mudiyaakuntal**, **mudiyar-koonthal**, **mudhiyaar koonda**l] (possibly முடிய **mutiya**, end; கூந்தல் **kūntl** [probably derived from Sanskrit कुन्तल **kuntala**, hair], anything long and flowing in detached parts, as tresses, braids, etc.), சவோளிக்கொடி **savolikkoti** [**savulikodi**, **sarolikkoti**] (**savoli**, ?; கொதி **koti**, fever), திரிப்பன்புள் **tirippanpul** [**thrippan pullu**, **thirupal pullu**] (**thrippan**, ?; **pullu**, small)	Austin 1980:352, de Fonseka & Vinasithamby 1971:59, Ganesan 2008:168, Joseph & Antony 2012:096, Kamalutheen *et al.* 2009:943, Khare 2007:411, Siddhadreams 2013, Sri Aurobindo Ashram 2013:148, Watt 1889:IV:476
Indo-European (Germanic)			
	Dutch	**Drietandige Kruip-Winde** (tridentate creeping bindweed)	De Chalmot & Chomel 1789:4496

Language Family (Subfamily)			
	Language	**Common name**	**Sources**
	English	African morningvine, arrow-leaf morning glory, slender-stalked *Ipomoea* (Hooker), trifid bind-weed (Aiton), Malabar bindweed with angular leaves (Petiver), small halbard-leaved bindweed (Petiver), tridentate-leaved *Ipomoea*	Aiton 1789:208, Don 1838:266, Hooker 1864, Petiver 1695:9, USDA 2013, US Forest Service 2008
Indo-European (Indo-Aryan)			
	Oriya	**paniloi**, **prasaruni** (from Sanskrit)	Sri Aurobindo Ashram 2013:148
Indo-European (Indo-Iranian)			
	Konkani	**semdar kalaudi**, **kalivel** (loan from Malayalam **cali-velli**?)	Shankar & Garg 2013
	Marathi	मोरगा **morga**	Shankar & Garg 2013
	Sanskrit	प्रसारणी **prasāraṇī** [**prasarini**, **prasaarini**] (from **prasara** or **prasArin**, creeping, creeper); also applied to *Paederia foetida* L. (Rubiaceae)	Joseph & Antony 2012:96, Kamalutheen *et al.* 2009:943, Khare 2007:411, Monier-Williams 1851:698
	Sinhala	හින්මදු **hin-madu** (හින් **hin**, narrow; මදු **madu**, milky creeper), හවරිමඩු **hawari-madu** [**hawaree-maddoo**] (හවරි **hawari**, long wig; මදු **madu**, milky creeper), ආපසුමදු (ආපසු, reflexed; මදු, creeper) given by Carter (1924) but not found elsewhere	Austin 1980:352, Carter 1924:736, Clough 1892:737, de Fonseka & Vinasithamby 1971:28, 30, Thwaites 1860:211, Trimen 1895:217, 218
Indo-European (Italic)			
	French	**liseron à trois dents** (three-toothed vine)	Lamarck & Poiret 1789:542
	Spanish	**aguinaldo de hoja tridentada** (three-toothed leaved morning-glory)	Hernández 2013
Niger-Congo (Atlantic-Congo)			
	Fula-Fulfulde	**leeßol pullo** [**leeɓol pullo**, **le'bol pullo**], **leebol** ("**FulBe** [**Fulani**] hair" *fide* Blench & Dendo), **leyleydi**	Blench & Dendo 2006:20, Burkill 1985:550, Dalziel 1937:440
	Fuliiru	**mburura**	Lejoly & Lisowski 1993:381
	Gbe-Vhe/ Éwé	**vudrai**	Burkill 1985:550
	Koongo	**nlangieal**	Lejoly & Lisowski 1993:381
	Luba-Kasai	**musandankeko**	Lejoly & Lisowski 1993:381
	Mandinka / Socé	**dioulou n'digon** [**duludigô**]	Burkill 1985:550, Chifundera 1987:31
	Mbunga	**mbasa** (spreading)	Chifundera 1987:31
	Oroko	**indondombo**	Lejoly & Lisowski 1993:381
	Serer-Sine	**law mbambé**, **lébel**, **lébèl pul** (cognate with Fula-Fulfulde), **nof ndol**, **pul**, **yuran**	Burkill 1985:550
	Sherbro	**sopant-lě** (also used for *Cassytha*)	Dalziel 1937:440
	Tswana	**motangtanyane**	Setshogo 1998:63
	Wolof	**salaulit** [**salaoulit**] (also used for *Fimbristylis* and *Tephrosia*, cf. Dalziel)	Burkill 1985:550, Dalziel 1937:440
	Zulu	**ulonja** (maybe **ulonda**, it preserves)	Foden & Potter 2005, Gaebler 2013
	Yoruba	**abiarunum**, **atewegbore**	Iwu 1993:205

Language Family (Subfamily)			
	Language	**Common name**	**Sources**
Niger-Congo (Mande)			
	Loko	**n-dangeha**	Burkill 1985:550
	Mandinka	**muso jong julo** (slave woman's ropes)	Burkill 1985:550
Nilo-Saharan (Saharan)			
	Kanuri	**tattir**	Burkill 1985:550, Dalziel 1937:440
Nilo-Saharan (Songhai)			
	Zarma	**kongo zaara**	Fakara Plants 2013
Sino-Tibetan (Chinese)			
	Mandarin	地旋花 **de xuan hua** (ground bindweed)	Fang & Staples 1995:300
Tai-Kadai (Kam-Tai)			
	Thai	เถาตดหมา [**theā td h̄mā**, **thao tod ma**, **thao tot ma**, **thao tot maa**] (เถา **thao**, vine; ตด **tot**, dog; หมา **maa**, fart; *Paederia foetida* has the same name)	Smitinand 1980:224, 2001:559, Mansur 2001:371, Staples 2011
West Papuan (North Halmahera)			
	Ternate	**jala ma tubu**	Mansur 2001:371

Table 2. Some common names for *Paederia foetida* L.

Language Family (Subfamily)			
	Language	**Common name**	**Source**
Austro-Asiatic (Mon-Khmer)			
	Khmer	វល្លិផ្អែម **vlĺi phaom** / **vear phnom**	Digital Herbarium 2010, Globinmed 2013
	Onamese	**thúi-ðit** (putrid-ass)	Anonymous 2013
Austronesian (Malayo-Polynesian)			
	Hawaiian	**maile pilau** (**maile**, lei plant, *Alyxia stellata* (J.R.Forst. & G.Forst.) Roem. & Schult.; **pilau**, stinking)	Starr *et al.* 2003, Wagner *et al.* 1990:1160
	Malay	**akar kentut-kentut** (**akar**, root; **kentut**, fart; so "root fart-fart"), **akar sekuntut** [**akar saktentuk**] (refers to fecal smell), **daun kĕntut** [**daun cantu**] (stinking leaf), **daun sekentut** (leaves **sekentut**), **kesimbukan** [**kasembukan**] (allusion to odor, shared with *Saprosma*, a notoriously fetid plant)	Anem 2011, Austin 1999:175, Burkill 1966(2):1648, Rumpf 1750:436
Dravidian (Northern Dravidian)			
	Malto [Pahariya]	**paedebiri** (loan from Nepali पादे **pade**, evil smelling; बिरि **biri**, name of *Paederia*)	Watt 1889:IV pt 1:2
Dravidian (South-Central)			
	Telugu	**savirela** [**savirel**], **takkeda** (balance, scales), **gontima-goru-chettu**, **gontimagomaru**	Hebber 2013, Sudarshan 1985: 220, Watt 1889(4), pt 1:2
Dravidian (Southern)			
	Kannada	ಕಳ್ಳನಚೌರಿ **kallana-chouri** (**kallana**, thief; **chouri**, hair-piece), **sarane-gida** (**sarane**, ?; ಗಿಡ **gida**, plant)	Sudarshan 1985:220
	Malayalam	**lēpacā** [**lepcha**], തലനീളി **talanili** (തല **tala**, head; നാല് **neli**, smell), **sāraṇi** സാരണി	Gundert 1872:436

Language Family (Subfamily)			
	Language	**Common name**	**Source**
	Tamil	**pinarisangai**, **mudiyara-kundil** (also applied to *Xenostegia*)	Hebber 2013, Sudarshan 1985:220
Indo-European (Indo-Iranian)			
	Assamese	**bedoli sutta**, **bhedai lota**, **paduri lota**	Hebber 2013, Nath & Deka 2010, Watt 1889(4) pt 1:2
	Bengali	গন্ধভাদুলে **gandhabhadulia** [**gandhabhaduliya**, **gandhabhadule**], গন্ধবণকি **gandhabanika** (গন্ধ **gandha**, odor, smell; বণকি **baṇika**, merchant, trader), **gandali** [**gandal**] গাঁদাল (derived from Sanskrit **gandha**, smell, odor)	Hebber 2013, Watt 1889(4): pt 1:2
	Gujarati	**gandhana** (derived from Sanskrit **gandha**, smell, odor)	Hebber 2013, Watt 1889(4): pt 1:2
	Hindi	खपि **khip**, गंधाली **gandhali** (derived from Sanskrit **gandha**, smell, odor), **so maraji**, **somraj**, बकुची **bacuchi** (to coil up), **gandhaprasarani** (**gandha**, smell, odor; **prasarani**, creeper), **pasaran**	Hebber 2013, Watt 1889(4): pt 1:2
	Marathi	हरणवेल **hiran-vel** (**haraṇavēla** possibly from हरिणें **hiraṇēṃ**, to seize, ravish; **vēla**, creeper), **chandabel** (छंद, **chanda**, a liking or fondness for; **bel**, **vēla**, creeper)	Sudarshan 1985:220, Watt 1889(4): pt 1:2
	Nepali	**padebiri** (पादे, **pade**, evil smelling; बिरि **biri**, name of *Paederia*)	Manandhar 2002:345, Watt 1889(4): pt 1:2
	Oriya	**gandali** (probably derived from Sanskrit **gandha**, smell, odor)	Watt 1889(4): pt 1:2
	Sanskrit	**prasarani**, **prasaram**, **gandha prasirini** (**prasirini**, creeper; **gandha** गन्ध, smell, odor)	Hebber 2013, Watt 1889(4): pt 1:2
	Sinhala	ප්‍රසාරණි, ප්‍රසරිනි **prasarini**, **apasutnadu**	Carter 1924:736
Japonic (Ryukyuan)			
	Okinawan, Central	鼓腸つる **hekuso kazura** (flatulence vine)	Austin 1999:175, Walker 1976: 985
Sino-Tibetan (Chinese)			
	Chinese, Mandarin	鸡矢藤 **jī shi teng** (鸡, chicken; 矢, dart or arrow [allusion to excrement]; 藤, creeper), 臭鸡矢藤 **chòu jī shǐ téng** (臭, stench; 鸡, chicken; 矢, arrow; 藤, creeper)	Austin 1999:175, Chen *et al.* 2012:282, 285
Sino-Tibetan (Tibeto-Burman)			
	Lepcha	**takpoedrik**	Watt 1889(4): pt 1:2
Tai-Kadai (Kam-Tai)			
	Thai	เถาตดหมา **thao tot muu** [**thao tot maa**] (เถา, vine; ตด, dog; หมา, fart; there are variant names with modifiers, including หญ้าตดหมา **ĥŷ̱ td ĥmā** [**yaa tot maa**] (หญ้า. grass; ตด, dog; หมา, fart)	Smitinand 1980:248

they were introduced from Africa, possibly arriving with slaves (Flores 2010:61–65).

Xenostegia tridentata was probably a waif in Georgia (U.S.A.) in 1902 when Harper collected it (O'Donell 1941:539, GH, not relocated by Danielle Hanrahan, September 2013) because *X. tridentata* is not included in Jones and Coile's (1988) atlas of the state flora. *Xenostegia* has not been found in Georgia since; there are no vouchers of the species in either GA or VSC (Wendy Zomlefer, J. Richard Carter, personal communication, September 2013).

Data on common names demonstrate a history in Asia of at least 340 years. The Sanskrit name suggests that *X. tridentata* has probably been there over 2000 years and is probably native. Thus both relationships and common names point to the species being native in Asia.

European discovery

European records. Just how widespread *X. tridentata* was in cultivation in Europe from the latter decades of the 1600s is not clear, but the species was grown in several gardens. Plants cultivated in Leiden at the *Hortus Beaumontianus* were identified by Plukenet (1696:117) and Linnaeus (1762:392) as this species. That garden belonged to Simon van Beaumont (1640–1726), the Secretary of the States of Holland and West-Friesland (Wijnands 1987:83). Frans Kiggelaer (1648–1722), the Dutch botanist and apothecary who maintained the *Hortus Beaumontianus*, said that they obtained the plants from Guinea in west tropical Africa (Kiggelaer 1690:13). "Guinea" at the time encompassed the lands between modern Sierra Leone on the west and Nigeria along the Bight of Benin off Cameroon on the east (Hondius 1625, Moll 1729).

Kiggelaer (1690:13) called the twiners "*Convolvulus Africanus, S[eu] Guineensis Pumilis sagittae foliis flore campanulato obsolete luteo fundo purpureascente*" (*Convolvulus* from Africa, or from Guinea, pubescent, sagittate-leaved, flowers bell-shaped, faded yellow, purplish at the base). Seba (1735:85, tabula 80, no. 3) claimed that the plants for which Kiggelaer used that phrase name were those in his illustration, which he said was drawn from the plants in the *Hortus Beaumontianus*. As Wijnands (1983:88) correctly observed, the plants in that illustration are Ipomoea ochracea (Lindl.) G.Don. Apparently, both Plukenet (1696) and Linnaeus (1753) had seen Seba's (1735) publication, but neither associated his illustration with Kiggelaer's 1690 report. Since the Kiggelaer phrase name does not really describe the plant in the drawing, Seba may have been wrong. We cannot know who was correct from the information available; Kiggelaer grew four kinds of plants in 1690 that he called *Convolvulus* (pp. 13, 14).

James Petiver (1695:9), a London apothecary, wrote that he was "…obliged to Mr. Edw. Bartar for this rare Plant; who gathered it about Cape-Coast in Guinny [Guinea]." Edward Bartar, a surgeon employed by the Royal African Company (Petiver 1695:68, 684, Swann 2001:91), collected in Ghana in the 1690s, and specimens of some species are in the Sloane collection at the Natural History Museum in London. Formerly called the Company of Royal Adventurers Trading to Africa (Zook 1919), the Royal African Company was established in 1660 with the restoration of King Charles II (1630–1685). The British company rivaled the Dutch West India Company in trade with western Africa.

Leonard Plukenet (1696:117), Royal Professor of Botany and gardener to Queen Mary II, also had plants which he illustrated in his figures CLXVII [167] Figure 5 (from Madraspatan, India *fide* Petiver 1695:9, collected by Samuel Brown) and CCLXXVI [276] Figure 5 (from Guinea, Africa *fide* Petiver 1695:9, collected by Edward Bartar), calling them by different phrase names. Plukenet saw these plants at the Royal Society (Heniger 1986:174, Petiver & Brown 1702:1064). Nissen (1951:103, 142–143, 245) and Stafleu and Cowen (1985:300) said that the artist for the drawings for Plukenet's *Phytographia* (1696) was John Collins (ca. 1670–1690), but Sachiko Kusukawa (personal communication, 16 October 2013) pointed out a website that suggests Collins was instead another engraver (cf. www.npg.org.uk/collections/search/portraitLarge/mw138353/Leonard-Plukenet). So, the identity of the artist remains uncertain.

Linnaeus (1753:157) did not have living plants in Uppsala but based the name on Rheede (1692:133, tabula 65). In Vienna, Jacquin (1789:367, 1788:10, tabula 317) made his drawing from living plants that came from Guinea (Austin *et al.* 2014).

Aiton (1789:208) had *X. tridentata* (as *Convolvulus tridentatus* L.) at Kew, although those plants were reintroduced from the East Indies by Sir Joseph Banks in 1778. This introduction is also documented by the specimens collected in 1770 by Banks and Daniel Solander in "New South Wales, Bustard Bay, Endeavour's River" (BM, W-Jacq. 0042713, W 0042714).

Hooker (1864, as *Ipomoea filicaulis*) wrote that the plants grew in "India and the Malay archipelago … whence the seeds are often sent without name to Europe" where it was grown in greenhouses. *Xenostegia tridentata* (as *Ipomoea angustifolia*) was cultivated in Munich by 1805 (Schrank 1805:19), Berlin by 1809 (Willdenow 1809:202), and in Bonn by 1820 (Nees von Esenbeck & Nees von Esenbeck 1820:34).

Indian records. The Sanskrit name **prasarani** (Tables 1, 2) was first mentioned in two of the oldest known Vedic medicinal books (Ayurveda). The *Sushruta Samhita* was written in the 6th century BCE (Lock *et al.* 2001:836), and **prasarani** is mentioned in two passages (Bhishagratna 1911:427, 549). Rajashekhara *et al.* (2012:444) said that **prasarani** is also mentioned in the *Charaka Samhita*, probably written between 100 BCE and 100 CE, although the surviving text is a copy from 300–500 CE (Rudolph Hoernle 1909). There is no description of **prasarani** in either text and thus no way to know whether it was applied to *Paederia foetida* L. (Rubiaceae) or *Xenostegia tridentata*, or both. In modern Auyrvedic usage and several Indian languages *Xenostegia* is **prasarani** (Table 1) while *Paederia* is mostly called **gandha prasirini** or a variant of that (Table 2).

Prasarani was identified as *Sida cordata* (Burm.f.) Borss. (as *S. veronicifolia* Lam.) by some commentators on the *Dhanvantari Nighantu* [**Dhanvangarinighantu**] (13th century CE; Sharma 1970:367, Dash & Kashyap 1980:xxxv) and the *Kaiyadeva Nighantu* [**Kaiyadevanghantu**] (1450 CE; Dash & Kashyap 1980:xxxv). In the *Dravyaguna Vijnana* [**Dravyagunavijnan**] **prasarani** is treated under **rajabala** with the same Latin binomial (Warrier *et al.* 1995:26); the *Dravyaguna Vijnana* is more recent than the other two texts cited. However, in southern India, *S. cordata* is known in Malayalam as **vallikkuruntotti** and in Sanskrit as both **nagabala** and **bhumibala** (Warrier *et al.* 1995:26, Nayar *et al.* 2006:405). Indeed, **bala** is the Sanskrit generic term for *Sida*, and several species have associated descriptors (Vasudevan Nair 2004:33–37). Sanskrit names are sometimes applied to different plant species in northern and southern India (e.g., Austin 2008), and Meulenbeld (2007) illustrated the variation in usage of common names across India.

The possibility that **prasarani** was originally applied to both *Paederia* and *Xenostegia* stems from the fact that Ayurvedic medicine uses them to treat the same maladies and that both have a similar unpleasant odor when bruised. In *Paederia* the odor comes from sulfur compounds, largely dimethyl disulfide (Wong & Tan 1994). No reports have been found regarding the odor-producing chemicals in *Xenostegia*.

Thais use a name for *Paederia* and *Xenostegia* that suggests the smell of both resembles dog feces (Tables 1, 2). In English, *Paederia* (from Latin *pedor/paedor*, filth, odor) has the bowdlerized names Sewer-vine and Stinkvine (USDA 2013), but there are many other references to the fecal odor in other languages (Table 2). Moreover, the two plants are so often confused that photographs of *Paederia* appear in papers where they are labeled as *Xenostegia* (e.g., Neyanila *et al.* 2013:39). Such applications of common names in senses different from that used by the Western scientific community are frequent in the literature, and **prasarani** may have been used for all three genera at different times and places.

When Johannes Burman (1737:72) was working on Sri Lankan plants he used the Hermann phrase name "*Convolvulus zeylanicus, gracilis, tenuifolius APAS & APATHUAETHA Zeylonensibus*" (*Convolvulus* of Ceylon, slender, narrow-leaved, called **apas** & **apathuaetha** there). The only record of the purported Sri Lankan name **apas** may be the word **oubas**, meaning medicine or drugs in Sinhala (Clough 1892:91). No word resembling **apathuaetha** was found in any Sinhala dictionary, and other authors on Sri Lanka have not mentioned it. Later, when Nicolaas Laurens Burman (1768:77), son of Johannes Burman (1707–1780), was studying Indian plants, he used *Evolvulus tridentatus* (L.) L. for *X. tridentata*.

Burman (1737:73) also used the phrase name *Convolvulus zeylanicus, folio sagittato* (*Convolvulus* of Ceylon, with arrowhead-shaped leaves) from Hermann (1717:64), putting in synonymy "**Tala-Neil** H. Malab. part 11 Tab. 55." Indeed, the illustration from Rheede's (1692) *Hortus Malabaricus* is one of the two illustrations of *X. tridentata* in that compilation. Unfortunately, Burman had a mixed concept of this *Convolvulus zeylanicus*, *folio sagittato* since he also included Plukenet (1691:Tabula 85, Figure 3) and Boccone (1697:Tabula 33) in his concept. Neither of these illustrations are the same plants as those in Rheede's figure. Plukenet's (1691:Tabula 85, Figure 3) is *Ipomoea sagittata* Poir. (Britten 1894:170); Boccone 1697:Tabula 33) might be one of the leaf variants of *Ipomoea imperati* (cf. La Valva & Sabato 1983), which does occur in Sri Lanka (cf. Austin 1980). However, the Boccone illustration may also be *Convolvulus arvensis* L., as suggested by Tournefort (1703), which Burman also cites. Both *I. imperati* and *C. arvensis* occur in Italy.

Trimen (1888) and van Ooststroom (1937) noted that Burman had compiled his Ceylon flora from a collection made by Hermann that was sent to Johannes Commelin (1629–1692) in Amsterdam. Burman cited "Mus. Zeyl. pag. 39," a reference to notes compiled by Paul Hermann (1646–1695). Those notes were later edited by William Sherard (1659–1728) and published (Hermann 1717:39, 1726:39).

The polynomial used by Burman is likely to be *X. tridentata* because it describes the plants and it does not apply to anything else on the island (Austin 1980). Moreover, there is a specimen of *X. tridentata* in London (LINN-HL393–6) from the Burman herbarium. That specimen is labeled #16, the species of *Convolvulus medium* from *Species Plantarum* (Linnaeus 1753:156) and was originally annotated as that by Linnaeus. He subsequently struck out "*medium*" and added "*tridentatus*," showing that he realized his error.

There is also a specimen of *X. tridentata*, annotated by Burman as "*Convolvulus medium*," at Geneva (G-Burman). The *X. tridentata* is mounted on the same sheet with an *Ipomoea*. The *Ipomoea* came from Java (cf. Staples & Jacquemoud 2005:451); presumably *X. tridentata* came from there too.

In spite of the notes he kept, Hermann (1687) did not discuss *X. tridentata*. Linnaeus (1747) did not list the plants under the main heading *Convolvulus* (pp. 31–32) but included the Burman polynomial under "*Classis XXVII. Barbarae. Pentandrae*" (pp. 211, 212). Linnaeus also based his *Flora Zeylanica* on the Hermann herbarium which he saw when he was in Leiden (van Ooststroom 1937:195). That Linnaeus did not know what to do with the plants under "*Barbarae*" shows that he did not find a specimen in the Hermann collection and apparently did not make the connection later when he described *Convolvulus tridentatus* (Linnaeus 1753:157). Indeed, there is now no speci-

men in the Hermann collections at the Natural History Museum (BM) in London (Natural History Museum 2013) or in Paris (Lourteig 1966). Nor is there a specimen in the Burman herbarium at Leiden (Heniger 1986:174).

In 1796 the Scottish physician, Benjamin Heyne (1770–1819), went to the Madras Presidency as botanist to the British East India Company in Samalkot (Andhra Pradesh state). Heyne (1814:139) recorded *X. tridentata* among the medicinal species he encountered, citing an Indian book called the *Kalpastanum* (pp. 125–180) which listed **prasarani** as equivalent to the Telugu **lanja savaram** among those producing gums and resins. Heyne identified the plant as *Convolvulus prostratus* Forssk., although he was certainly wrong. That species grows across northern India (cf. Austin 2008:191: Figure 1) and not in Madras (now Chennai, Tamil Nadu state) or Bangalore (Karnataka state) where the Telugu speakers are concentrated. Moreover, later authors equated **lanja savaram** with *X. tridentata* (Elliot 1859:97, 169 as *Ipomoea filicaulis*, Watt 1889:IV:476 as *Ipomoea angustifolia*). *Xenostegia* is concentrated in southern India (Simões 2013: Figure 6.4), and the Indian languages where *X. tridentata* has common names (Table 1) are in those southern states (Andhra Pradesh, Goa, Karnataka, Kerala, Odisha, Tamil Nadu).

Roxburgh (1814:14) recorded both *X. medium* (as *Convolvulus medium* L.) and *X. tridentata* (as *C. tridentatus*) as being in the *Hortus Benghalensis* in what is now Shibpur, West Bengal, India. *Xenostegia tridentata* was introduced into that garden by Francis Buchanan [a.k.a. Francis Buchanan-Hamilton] (1762–1829), a Scottish physician and naturalist who worked in southern India until 1807 when he moved to Bengal (JSTOR Global Plants 2013). Roxburgh listed *C. medium* as "accident," presumably meaning that it volunteered in the garden from an unknown source. Later Roxburgh and Wallich (1824:56) said that *C. medium* was in "various parts of India," implying that it was native.

Moon (1824:13) included *X. medium* (as *Convolvulus medium*) as **heen-madu** and *X. tridentata* (as *C. tridentatus*) as **hawari-madu** in Sri Lanka. He noted that *C. medium* was cultivated while *C. tridentatus* was wild in Columbo. The first common name was subsequently considered correctly applied to a variant of *X. tridentata* and completely distinct from *Convolvulus medium* (e.g., Austin 1980, Austin & Staples 1980, Simões 2013).

Thwaites (1860:211) decided that the two variants of *X. tridentata* (as *Ipomoea tridentata* (L.) Roth) graded into each other and were indistinguishable, citing C[eylon] P[lants] 1929 and 1930. When I studied those specimens of *X. tridentata* (Austin 1980:352), I learned that CP 1929 was actually a mixed collection with part being from Columbo District (Columbo. *Moon s.n.* PDA) and the rest from Polonnaruwa District (Minneri, Mar. 1858 PDA). CP 1930 came from Batticoloa District (*Gardner s.n.* PDA).

Trimen (1895:217, 218), like Moon (1824:13), listed two names that are now considered synonyms of *X. tridentata* (p. 217, as *Ipomoea angustifolia*; p. 218, as *Ipomoea tridentata*). Trimen also applied the Sinhalese name **hinmadu** to the former and **hawari-madu** to the latter.

Why move the plant?

The answer to why people spread *X. tridentata* seems to have been given first by Rheede (1692:113, 133) who wrote about their medicinal properties. He wrote (p. 113) that a "*[d]ecoctum hujus plantae, Samstravari, Glicirrhiza & oleo Sergelim permixta linimentum praestat, quo caput illinitur adversus cephalaeam & comae fluxilitatem*" (decoction of this plant mixed with **samstravari**, **glicirrhiza**, and oil of **sergelim** gives a liniment, with which the head is smeared against headache and loss of hair). **Samstravari** is *Barringtonia racemosa* (L.) Gaertn. *fide* Hasskarl (1867:30); **glicirrhiza** probably *Glycyrrhiza glabra* L.; and **sergelim** is *Sansevieria zeylanica* (L.) Willd. *fide* Dymock *et al.* (1893:493). Several common names refer to hair (e.g., in Fula-fulfulde, Sinhala, Tamil) and may be allusions to this application.

Rheede (p. 133) also wrote "*In decocto assumta* [sic] *antifebrile is* [sic]. *Cum Zaccharo ardorem jecoris restringit. In pulverem redacta & cum aqua capiti illita, omnes sedat dolores. Trita & cum Vaccae urina epota omnes arthriticos dolores, praecipue in pedibus, mitigat*" (The decoction is antifebrile. With sugar it restricts heat in the liver. Reduced in powder with water smeared on the head it alleviates headache. Pounded with cow urine and drunk it assuages arthritic pain, especially in the feet). Although Stokes (1812:324) listed the species as medicinal, he knew no more about it than what he found in the literature. Heyne (1814:139) listed **lanja savaram** as among those producing gums and resins. Elliot (1859:97, 169) made no comments other than giving the names in Telugu script and in the English alphabet.

There is now a sizeable literature on *X. tridentata* being used medicinally. A Google Book search had 85 hits for the combination "*Merremia tridentata*" plus "medicine"; a Google Scholar search returned 110 (31 August 2013). PubMed resulted in only three hits (11 February 2014). Uses of the species are concentrated in Africa and Asia. Medicinal preparations treat a wide array of maladies and symptoms in India, including as an analgesic, antiarthritic, antibacterial, anti-diabetic, anti-hypertensive, anti-inflammatory, astringent, bitter, calefacient, diuretic, laxative, tonic, against colds, goiter, hemiplegia, herpes, intestinal worms, leprosy, mad-dog bites, piles, rheumatism, toothache, to reduce body temperature, reduce swellings, to treat diabetes, urinary disorders, skin diseases, promote hair growth, and for wound healing (Arunachalam *et al.*

2011, Arunachalam & Parimelazhagan 2012, Bapuji & Ratnam 2009:943, Baranwal *et al.* 2012:984, Bhandary & Chandrashekar 2011:530, Charumathi *et al.* 2008:23, Ganesan 2008:168, Hansen *et al.* 1995:46, 47, Joseph & Antony 2012:96, Kamalutheen *et al.* 2009, Lalitha Rani *et al.* 2011:21, Mali & Bhadane 2011:106, Pavithra *et al.* 2010:22, 23, 25, Rajashekhara *et al.* 2009, 2012, Rao *et al.* 2006:103, Shanmugam *et al.* 2012:431, Singh *et al.* 2003:93). Southeastern Asian reports have largely the same uses as in India, but they add that the roasted seeds are diuretic and antibilious (Akanitapichat *et al.* 2005:141, Mansur 2001:367)

Literature on Africa includes many of the Indian uses. In addition, it lists the plant as an anodyne, as antivenomous (against scorpion sting, snakebite), in treatment of gonorrhea and malaria, and food for domestic stock (Ariwaodo *et al.* 2012:546, Burkill 1985:550, Chifundera 1987:23, Fowler 2006:44, Hutt & Houghton 1998:102, Iwu 1993:206, Mors *et al.* 2000:631, 636).

Experimental data suggest that extracts of *X. tridentata* are active against gram-positive bacteria (Charumathi *et al.* 2008:47). The flavonoids diosmetin, luteolin, diosmetin-7-O-β-D-glucoside, and luteolin-7-O-β-D-glucoside have been isolated from the aerial parts (Mansur 2001:368), and Sereena *et al.* (2012) added the phytosterol β-sitosterol. The ethanol extract of the aerial parts also showed significant larvicidal activity on the tick *Rhipicephalus microplus* (Canestrini, 1888) (formerly *Boophilus microplus*) (Mansur 2001:368). Sowndhararajan *et al.* (2010) concluded that the plants are a source of anti-oxidants. Rhamani *et al.* (1985:350) reported triterpene-steroids in *X. tridentata*. Jenett-Siems *et al.* (2005:1456) found trace amounts of the alkaloids hygrine and nicotine. Eich (2008:268, 306) recorded betaines and glucosides of flavonols in *Xenostegia*. Rajashekhara *et al.* (2009:506) consider *Paederia* more effective than *Xenostegia* in treating **amavata** (rheumatoid arthritis), but that the morning glory had a less offensive smell.

Discussion

Xenostegia tridentata is a medicinal plant across Africa and Asia. Records show that people have treated many maladies with it for at least 340, and probably as many as 2000 years. Sanskrit evolved before the first millennium BCE, when the oldest Vedic texts were written (Houben 2005). The Sanskrit प्रसारणि (**prasarani**) appeared in the oldest known Vedic medicinal book, the *Sushruta Samhita*, from the 6th century BCE. It is not known if the name was applied to *Paederia foetida* or *Xenostegia tridentata*, or both.

Monier-Williams (1851:698) said **prasarani** was *Paederia*, but *X. tridentata* is not mentioned in his book under any name. However, the current most commonly used name for *Paederia* is **gandha prasirini** (stinking creeper). Moreover, several scholars on the Indian region equated **prasarani** with the Telugu **lanja savaram** (e.g., Heyne 1814:139, Elliot 1859:169, Watt 1889:IV:476). An additional suggestion that the name was applied to *Xenostegia* is that Heyne (1814:139) noted that **lanja savaram** contained gums and resins. I found no references to either gums or resins being in *Paederia*, although those compounds are recorded in *Xenostegia* (Heyne 1814:139) and other Convolvulaceae (Eich 2008:532–546).

Thus, it is possible that *X. tridentata* has been used in India since the period of the *Sushruta Samhita*. Apart from several books that mention the Sanskrit name **prasarani**, we have no further information on *Xenostegia*'s involvement with humans until the 1600s.

There is a long history of trade between the Indian region and Africa, going back into at least the first millennium BCE. In fact, trade between Egypt, the Near East, and the Greek and Roman worlds from as far away as China existed in the fourth millennium BCE but became active during the third through the first millennia (Harper *et al.* 1971, MetMuseum 2013). The Incense and Silk Routes are unquestionably the best known, but there were other roads carrying traders within and between continents (MetMuseum 2013). These included the Grand Trunk Road, connecting Calcutta in India to Peshawar in Pakistan (Kipling 1901, Sarkar 1926), the Trans-Saharan trade routes in northern Africa (Baiera 1977, Law 1967, Lydon 2009), and the Roman-India routes (Fitzpatrick 2011, Parker 2008, Pollard 2013). These networks were often interconnected and moved items great distances. Given the overlap of the ranges of subsp. *tridentata* and subsp. *hastata* in southern India and Sri Lanka and the long recorded history that was unquestionably preceded by an unrecorded history of human use of *X. tridentata*, it seems probable that people moved the plants between Africa and India. That transport between Africa and India is especially likely because the seeds were sent regularly to Europe in the 1800s (Hooker 1864) and *X. tridentata* became naturalized in Puerto Rico that century.

Surely there was a regular trade of these medicines. I found no direct evidence, either historical or archaeological, of movement of *X. tridentata* before the late 1600s, but I suspect that it had been moved for long periods, probably centuries, in the Old World. Given the rapidity with which this medicinal herb was moved after the 1600s, there is little reason to assume a slower rate of exchange earlier. While it is possible that the overlap of subspecies in southern India and Sri Lanka was a non-human mediated phenomenon, it is evident that it was at least enhanced by humans.

The bigger question is whether *X. tridentata* subsp. hastata diverged because of a naturally large range or because of human intervention. It is possible that the origi-

nal range of *X. tridentata* included the entire Old World tropics. If that was the case, then some non-human pressures caused the divergence between subsp. *tridentata* and subsp. *hastata* and humans learned to use the plants in both Africa and Asia. However, it is possible that humans may have moved *X. tridentata* from Africa into Asia at some early date and that selective pressure by humans caused a divergence into two subspecies. The diversity of distinctions argue against human selection alone but do not disprove it.

Humans move items that they find useful. It will be instructive to have someone test this trade theory to determine where the plants in the southern India and Sri Lanka area are most closely related and perhaps determine routes of travel. Phylogenetic, morphological, and historical data suggest that people did move the plants, but another approach will test that and perhaps add details.

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