Water Spinach (*Ipomoea aquatica*, Convolvulaceae) A food gone wild

Daniel F. Austin

Research

Abstract

Water spinach (*Ipomoea aquatica*) has been considered native to Africa, Asia, and the southwestern Pacific Islands. The herbs have been a medicinal vegetable in southern Asia since at least A.D. 300, and perhaps since 200 B.C. People still gather plants from the wild and cultivate them. With European arrival in these regions in the late 1400s, they became aware of this medicinal food and began carrying water spinach around the world. As with other transported plants, Europeans took along some common names and cultural uses. With the later migration of people from Asian countries to other parts of the world, the food was imported into new areas. Doubt persists as to where the species was domesticated. Data from uses as food, regions of cultivation, medicinal use, phylogenetic studies, common names, and pathogens suggest that water spinach was first cultivated in southeastern Asia. The plants may have been domesticated in China and India, but the data are equivocal. The vegetable sometimes escapes from cultivation to become an ecologically invasive weed.

Introduction

As the binomial implies, this species is mostly associated with wetlands (Figures 1 & 2). While there are forms that are also cultivated in uplands, the wild plants are in waterways, such as canals, lakes, ponds, rivers, and in marshes and paddies with rice (e.g., Austin 1980, Fang & Staples 1995, van Ooststroom & Hoogland 1953). The fruits are tardily dehiscent or perhaps even indehiscent, and are presumably adapted for water dispersal. Like many others in the family, *I. aquatica* has "labyrinth seeds," retaining air pockets that allow them to float for long periods (van Heel 1970, 1971). Several members of the family are famous for being dispersed by water (e.g., Guppy 1917).

Europeans discovered *I. aquatica* in a variety of places in the Old World when they first arrived there. The first record was from the Malabar Coast of India when Rheede (1692) recorded it as **Ballel** (Table 1, Appendix 1). About the same time (1660-1690s) in eastern Indonesia, Rumphius (1741-1750) called the herb **Olus-vagum**.

Linnaeus (1753) cited the Rheede name under *Convolvulus reptans*, but the epithet cannot be used because of a typification problem (Merrill 1917, 1939, van Ooststroom 1940, Verdcourt 1963). In spite of that complication, authors for many years incorrectly used *I. reptans* (L.) Poiret and information on the plants will appear under that name, particularly in older references. Another name that partly applies to this species is *Convolvulus sagittaefolia* Burman f. (1768), but that cannot be used either.

Forsskål (1775) finally discovered the plants in Yemen and proposed the name now used, *I. aquatica*. An oddity about Forsskål's discovery is that he reported the herb from a desert area where the species presumably is not native. The horn of Africa and nearby Asia is mostly too

Correspondence

Daniel F. Austin, Arizona-Sonora Desert Museum, 2021 N. Kinney Road, Tucson, AZ 85743, U.S.A.
daustin@desertmuseum.org

Ethnobotany Research & Applications 5:123-146 (2007)

Figure 1. Flowering branch of *Ipomoea aquatica* on a lake in Brevard County, Florida. Photo by Greg Jubinsky.

Figure 2. Stems of *Ipomoea aquatica* growing on a lake in Brevard County, Florida. Photo by Greg Jubinsky.

Table 1. Some common names used for *Ipomoea aquatica*. For detailed information, synonyms, sources, and linguistic taxonomy, see Appendix 1.

Common Names	Languages
asagaona	Japanese
áwárwáróó	Hausa
bai phai	Thai
baláñgög	Ilokano
ballel	Malayalam
batata aquatica	Portuguese
batatilla acuatica	Spanish
beehob	Marind
boniato de agua	Spanish
camotillo	Spanish
cancon	Ilokano
cao coi	Mandarin Chinese
Chinese water spinach	English
dagoeblad	Sranan? [Creole Dutch]
daoen deli dili di	Kubu/Djambi
darat	Uncertain language
delbol	Fulfulde/Fulani
en-sai	Japanese
espinaca aquática	Spanish
furen gadu	Hausa
galatgat	Ilokano
ganthian	Panjabi, Eastern
ganthian	Panjabi, Western
giàu muông	Vietnamese
gladgrøntsag	Danish
ialanda	Malagasy
kako	Tidore
kalajau	Minangkabau
kalamba	Sanskrit
kalayan	Uncertain language
kalmai saaga	Hindi
kalmi	Hindi
kalmi sag	Bengali, Hindi, Nepali
kamchon	Thai Shan
kan-kun	Sinhalese
kang kong	Malay
kang koung	Uncertain language
kangko	Buru, Bentong, Gorontalo
kangkoeĕng	Madura/Madurese

Common Names	Languages
kangkong	Aklanon, Bali/Balinese, Bisáya, Bukitan, Dutch, English, Ilokano, Javanese, Tok pisin, Yapese
kangkóng	Pampángan, Tagálog
kangkuĕng	Uncertain language
kangkum	Palauan/Belau
kango	Tok pisin
kankon	Japanese
kankong	Chamorro
kanto	Bolango
karkarei valli	Tamil
karmi	Hindi, Santali/Satar
karmira	Santali/Mundari
kingkoi	Maluku
klaamba	Sanskrit
koilangu	Tamil
kong cai	Mandarin Chinese
kong sim chae	Korean
kong xin cai	Mandarin Chinese
kpŏkpŏi	Mende
kramuwan	Tharu
ku-shin-sai	Japanese
kulum sag	Parbate
lalidih	Madura/Madurese
larĕ	Nusalaut/Tengah
laylayduuji	Mende
liseron d'eau	French
lorenzo	Nauruan
luve ni tombithi	Fijian
maaloole	Somali
mul si keum ch'i	Korean
nadi-shaka	Marathi
nálichi baji	Gujarati
nalike	Bengali
naniri	Bugis
nári	Panjabi, Eastern Panjabi, Western
ndrinikava	Fijian
nggango dano	Nusalaut/Tengah

Common Names	Languages
nir-kolmi	Tamil
no do	Karen
oetangko	Marind, Maluku/Kajeli
olus-vagum	Latin
ong tung tsoi	Cantonese Chinese
ota karisa	Fijian
pak bong phak bong	Laotian
pak boong chin	Thai
pak bung	Thai
pak bung phak bong	Laotian
panangoi	Gorontalo, Tonsawang
pangpong	Bali/Balinese
patate aquatica	Italian
patate aquatique	French
patuasag	Bengali, Gujarati, Hindi
paya	Uncertain language
phak thot yot	Thai
pintoer	Tonsawang
pui-sag	Hindi
rau muông	Vietnamese
roempoen	Minangkabau
rukau taviri	Rarotongan
rumpun	Aceh/Atjeh
sajor	Gorontalo, Mongondow
sajor kankong	Malay
sajoran lalap	Lembak
seeri	Chuukese, Puluwatese
sĕriokang	Gorontalo
sisu lum	Ririo
sisu lumi	Batatana
Sumpf-Trichterwinde	German
swamp cabbage	English
swamp morning glory	English
takako	Galela, Makian, Tidore
tangkong	Aklanon, Bisáya, Ilokano
tanidri	Makasar
tatanggo	Pamona/Bare`e
te kang kong	Kiribati
te ruku	Kiribati
teng cai	Mandarin Chinese
teng-teng cai	Mandarin Chinese
thota-kura	Telugu
tong cai	Mandarin Chinese
trâ kuön	Khmer
utango	Buru
vellucchio d'acqua	Italian
wa kumala	Fijian
Wasserspinat	German
water convolvulus	English
water sweet potato	English
wéng cài	Mandarin Chinese
wilec wodny	Polish
wu hsin ts'ai	Cantonese Chinese
wu xin cai	Mandarin Chinese
wung ts'ai	Cantonese Chinese
yô-sai	Japanese

dry to support these plants outside permanent water sites and gardens. Perhaps this discovery presaged the subsequent movement of the species as it is now pantropical, and is considered edible (Figures 3 & 4), medicinal, or a pernicious weed by different people (e.g., Edie & Ho 1969, Islam *et al*. 2004, Langeland & Burks 1998).

Invasive Species

Rumphius (1741-1750) was one of the first to comment on the wandering nature of these plants. He contended that the Malay name **kangkong** meant "it is restless." Later Heyne (1927) commented on the marked ability of *I. aquatica* to spread and compete with other plants. Although Ochse (1951) was advocating water spinach as a vegetable in Florida, he also pointed out that it had marked potential to escape. The species has been introduced repeatedly into Florida since before the 1950s and has escaped from cultivation (Edie & Ho 1969, Gordon & Thomas 1997, Ng 1954, Ochse 1951). The plants also have been introduced elsewhere in the New World, including Belize, Costa Rica, Cuba, Dominican Republic, Florida, Brazil, the Guianas, Haiti, Honduras, Jamaica, Nicaragua, Panama, Peru, and Puerto Rico. Water spinach is known and eaten in at least California, Florida, Oregon, New York, and Washington, basically throughout the United States because of dispersal to oriental populations. The vegetable is also marketed in several European countries.

The vigorous growth of the plants quickly covers expanses of water. Heyne (1927) wrote that "**Het wordt vermenigvuldige met stukken van de stengels en beslaat spoedig een groote plaats**" (It multiplies rapidly with pieces of the stems covering a large place in a short time). Under good conditions, *I. aquatica* produces 190,000 kg fresh weight biomass per hectare in nine months (Lange-

land & Burks 1998). Propagation is mostly by fragmentation (Edie & Ho 1969), but water spinach can produce 175-245 fruits per plant (Patnaik 1976).

Some even consider water spinach a problem in its homeland. Patnaik (1976) studied *I. aquatica* trying to find a vulnerable period in its lifecycle to control it in Orissa, India. Similarly, Gangstadt (1976) tried to discover effective management for the Philippines. Why the plant has become a problem only in Florida in the United States is not clear. It may be as simple as time since introduction, but Edie and Ho (1969) suggested climate as a factor. They said the crop only grew satisfactorily when the mean temperature is above ca. 25°C. The species continues being cultivated in California, Texas, and the U.S. Virgin Islands. California grows nearly 90% of the U.S. commercial crop, which is exported to at least Oregon, Washington, and New York (Harwood & Sytsma 2003).

Possession of *I. aquatica* in Florida has been prohibited since 1973 (McCann *et al*. 1996), but Asians continue growing it illegally and it is still for sale (Austin, unpublished data 2001, Thirumala pers. comm. 2006). Infestations in some Florida public lakes have been eradicated, or at least the attempt made (Langeland & Burks 1998). Water spinach was listed as a noxious weed in 35 states by 2003 (USDA 2006). Some include this aquatic food plant among the “100 of the worst” of the world’s invasive plants (ISSG 2005).

There are academic and practical reasons for knowing where *I. aquatica* was domesticated. This paper examines data from six aspects of the species to explore where water spinach may have been taken into cultivation.

Human and Animal Food

Throughout much of tropical Asia this is a common food eaten by all social groups (Burkill 1966, Roxburgh 1824). This potherb is popular across an array of countries as an addition to other foods at mealtime; some eat water spinach two or three times a week (Cornelius *et al*. 1985). There are several ways people consume these herbs, although the most frequent is a cooked vegetable. A common method is to lightly fry the young tips, including stems and leaves (Westphal 1993). However, tips are also eaten boiled, steamed, or added to soups, stews, curries, sambals (Facciola 1990), and even pickled (Figure 4). Often the branch tips are cooked with onions and chilies, or with garlic, ginger, other spices, shrimp paste, and cuttlefish (Herklots 1972, Wikipedia 2006). Several dishes are regional favorites, such as Cantonese **furu** (**wéng cài** 蓊菜 with bean-curd), and with bean paste and shallots in Hakka cuisine (Fujian, Guangdong, Jiangxi,). Thais stir-fry **pak bung** with oyster sauce and shrimp paste. In Vietnam

Figure 3. Fresh cuttings in Bangkok market. Photo by author.

Figure 4. Pickled branches in Bangkok market. Photo by author.

giàu muông is used as a garnish and eaten with noodles. The dishes **adobong kangkong** (spicy pork or chicken) and **sinigang** (**kangkong**, sour fish, and meat stews) are popular in the Philippines (Wikipedia 2006).

Ipomoea aquatica is also fodder for animals, in limited quantity as it is somewhat laxative. These herbs are often grown in fish ponds by Chinese, particularly as food for their pigs (Ly *et al*. 2002, Westphal 1993), although they are also fed to cattle and fish (Edie & Ho 1969). In Vietnam, **giàu muông** is fed to chickens, ducks, and pigs (Ogle *et al*. 2003).

While the herbs are eaten in Africa, their use is known in only Ethiopia, Sudan and Tanzania (Dalziel 1937, Vaino-Mattila 2000, Williams 1949, Sebsebe pers. comm. 2006). Of seven regions in Ethiopia, only one locality in the Ilubabor region claimed to eat the plants (Sebsebe pers. comm. 2006). Similarly, in Australia, there is no record of long and widespread use, and Payne (1956) thought the plant was introduced there.

Water spinach retains an importance as food in southeastern Asia. These data suggest a nativity in southern and southeastern Asia.

Regions of Cultivation

Records were found of water spinach being cultivated in Bangladesh, Burma, Cambodia, China, Fiji, India, Indonesia, Japan, Malaysia, Nepal, New Guinea, Okinawa, Philippines, Sri Lanka, Taiwan, Thailand, and Vietnam (Clarke 1885, Cornelius *et al*. 1985, French 1986, Herklots 1972, Heyne 1927, Manandhar 2002, Walker 1976, Watt 1889 [1972], Westphal 1993, Wiser 1955, McDonald pers. comm. 2006). In many of these places, growing of the food is deeply embedded in local cultures. While the species is cultivated in places not in the core of its range, like northern Australia and Hawaii, there *I. aquatica* is associated with diaspora from southeastern Asian countries, particularly China, Vietnam, the Philippines, and western Malaysia. Indeed, a survey of the literature about this crop suggests a dominantly southeastern Asian group of researchers (cf. Literature cited).

For some time, **kangkong** has been extremely important in Malaysia and at least western Indonesia. Many consider water spinach second in importance to **pak choi** [**bai cai**] 白菜 (*Brassica rapa* L. Parachinensis group, syn. *B. chinensis* L.), the ubiquitous Chinese vegetable (Tay & Toxopeus 1993). **Pak choi**, an avowedly Chinese vegetable, dates back to the 5th century A.D., yet it was introduced into the Malacca Straits Settlement only in the 1400s. Cultivation regions do not contradict a southeastern Asian origin.

Medicinal Uses

As with many plants (Etkin 2006, Ogle *et al*. 2003), this is considered a food with medicinal effects. *Ipomoea aquatica* is considered a laxative, is recommended for piles, and "in certain nervous conditions with sleeplessness and head-ache" (Burkill 1966, Read 1936, Van Valkenburgh & Bunyapraphatsara 2001). Some say the plant has a calming impact on people, an action that McDonald (pers. comm. 2006) referred to as "hypnotic." Eating the plants is thought to aid in getting to sleep, and he agrees that eating a sufficient quantity brings on drowsiness. Naples (2005) also thought that "Eating a lot of the plant has a nerve-calming effect in cases of sleeplessness, stress, headache, general weakness and leukorrhoea."

The laxative effect may have been why Heyne (1927) recommended water spinach for treating hemorrhoids, but more likely it was applied directly as a poultice. People in Borneo, Cambodia, and Malaysia use it as a poultice to treat fever with delirium and put buds on ringworm lesions (Menaut 1929 in Burkill 1966, Van Valkenburgh & Bunyapraphatsara 2001), or on boils (Heyne 1927). In Burma, India, and Indonesia the juice is used as an emetic to treat poisoning from opium, arsenic, and from drinking polluted water (Kapoor & Kapoor 1980, Uphof 1968, Van Valkenburgh & Bunyapraphatsara 2001). Heyne (1927) said "**Anderen echter waarschuwen tegen het gebruik van veel kangkoeng, omdat het witten vloed zou opwekken**" (Others, however, warn against the use of much **kangkoeng**, because it causes leukorrhoea). Naples (2005) agreed.

One aspect recorded by Naples (2005) is that "the seeds are a strong pesticide killing earthworms, leeches, pig tapeworm and other intestinal parasites." This trait has not been located elsewhere, but is not surprising since there are many poisonous compound found in the family (Austin 2000, Austin *et al*. 2001, Schimming *et al*. 2005).

In much of southeastern Asia, *I. aquatica* is considered a tonic. The species contains several vitamins, including A, B, C, E, and "U" (S-methyl-methionine), and is used to treat gastric and intestinal disorders (ISSG 2005, Roi 1955, Watt 1889 [1972], Westphal 1993). The species also contains aliphatic pyrrolidine amides, carotenoids, hentriacontane, β-sitosterol and its glycosides, prostaglandin, leukotrine, N-trans- and N-cis feruloyltyramines (Bruemmer & Roe 1979, Chen & Chen 1992, Snyder *et al*. 1981, Sundar Rao 1990, Tofern *et al*. 1999, Van Valkenburgh & Bunyapraphatsara 2001, Wills & Rangga 1996, Wills *et al*. 1984). Fresh plants have from 1.9-4.6% proteins; carbohydrates average ca. 4.3% (Wills *et al*. 1984, Yamaguchi 1990). In the Philippines a mouthwash made of water spinach was experimentally shown to be effective against *Escherichia coli* and *Staphylococcus aureus* (Castillo 1982).

In Africa *I. aquatica* is used to treat diabetes as it is in Sri Lanka (Iwu 1993, Malalavidhane *et al*. 2000). Plants contain insulin-like compounds clinically shown to be effective. For West Africa, Iwu (1993) gives no references for this species. Elsewhere the species is used to treat abscesses, mental illness (Tanzania), and intestinal problems (Somalia) (Haerdi 1964, Samuelsson *et al*. 1992).

There are records of *I. aquatica* being used medicinally in at least Africa, Borneo, Burma, Cambodia, China, India, Indonesia, the Philippines, and Sri Lanka. Medical use focuses around southeastern Asia. Scarcity of use suggests that the plants began being used as medicine in Africa comparatively recently.

Phylogenetic Relationships

Choisy (1845) created *Ipomoea* section *Erpipomoea*, including *I. aquatica*, *I. pes-caprae* (L.) R. Brown in Tuckey, and a series of other species. Hallier (1893, 1905) did not use the Choisy name, but proposed and then emended section *Leiocalyx*, and placed *I. cairica* (L.) Sweet, *I. obscura* (L.) Ker Gawler, and *I. ochracea* (Lindley) G. Don with *I. aquatica* and *I. pes-caprae*. Van Ooststroom (1940) and Van Ooststroom and Hoogland (1953) also included *I. aquatica*, *I. cairica*, *I. ochracea*, and *I. pes-caprae* in section *Leiocalyx*. Subsequent authors have adopted section *Erpipomoea*, the earliest name for a group including *I. aquatica*.

At least in recent years, it has been widely acknowledged by taxonomists that *Erpipomoea* was probably polyphyletic. The taxon was retained because there was no clear alternative. Both morphological and molecular genetic studies now indicate that *I. asarifolia* (Desrousseaux) Roemer and Schultes and *I. pes-caprae* are related, and that the others probably are not that close to this pair (Austin 2005).

Exactly what other species are related to *I. aquatica* is problematical. No thorough morphological study has been made, although cotyledons have been examined in a few species, as have isozymes (Das & Mukherjee 1997). These authors concluded that *I. aquatica* was basal to the other species studied, although Ogunwenmo (2003) thought that was because of parallel evolution in cotyledons. Still, even he considered *I. aquatica* basal to the small sample he examined.

Molecular genetic data published to date also have been ambiguous about placement. Miller *et al*. (1999) found that ITS sequences grouped *I. aquatica* and the Australian endemic *I. diamantinensis* J. M. Black with 100% bootstrap support. This pair was joined with *I. obscura* and *I. ochracea* with 66% of replications.

Other sequences used to examine relationships within *Ipomoea* were waxy (Manos *et al*. 2001, Miller *et al*. 1999), and the four chloroplast regions rbcL, atpB, psbE-J operon, and the trnL-trnF intron/spacer (Stefanovic *et al*. 2002). In addition, Miller *et al*. (2002) made a comparison of Bayesian and maximum likelihood techniques. Each of these studies found somewhat different results, from no resolution (Stefanovic *et al*. 2002) to alliance with different arrays of species (Manos *et al*. 2001, Miller *et al*. 1999). Some studies suggested an alliance of *I. aquatica* with section *Mina*, but Miller *et al*. (2004) excluded it, without comment, from further study of that group. All molecular genetic studies gave somewhat different results when indicating the species related to *I. aquatica*. Similarly, Bayesian and consensus methods of analyzing molecular data sets gave distinct groupings.

Still, some morphological and molecular data indicate that *I. aquatica* is indeed allied with *I. cairica* and *I. ochracea*. Thus removed from the type species of *Erpipomoea* (*I. pes-caprae*), the next earliest name for a section containing *I. aquatica* is *Leiocalyx* (type *I. kentrocarpa* Hochstetter ex A. Richard). With this altered circumscription, *Erpipomoea* is restricted to *I. pes-caprae*, *I. asarifolia*, and their allies.

Several relatives of *I. aquatica* (i.e., *I. cairica*, *I. obscura*, *I. ochracea*) are spread from western Africa across the Indian subcontinent and northern Australia to China. All of the likely close relatives are now pantropical through introduction except for *I. diamantininsis*. That species is endemic to northern Queensland in Australia. Because several of the molecular genetic studies excluded this endemic (Hulsenbeck *et al*. 2002, Manos *et al*. 2001, Miller *et al*. 2002, 2004), not much more can be concluded. What can be said is that phylogenetic affinity does not negate a southeastern Asian origin for *I. aquatica*.

Common Names

Common names were espoused by De Candolle (1886) and more recent authors (e.g., Austin 1998, Burkill 1953, Jain 1963) as one way of determining the region of oldest use for plants. There are two verifiably old names for *I. aquatica* and at least one other that is perhaps as old (Table 1, Appendix 1).

The Sanskrit **kalamba** is the most ancient name known for *I. aquatica*. Sanskrit was spoken by people moving into northwestern India before 1000 B.C., and its names for organisms typically are estimated at 2000-200 B.C. years old (cf. Decker-Walters 1999 for recent summary). For water spinach, Monier-Williams (1899) listed the names **kaDamba**, **kalamba**, **kalambaka**, and **kalambukA**. Thus, before ca. 250 B.C., when Prakrit evolved from Sanskrit, there were at least four variations of the word (Malten 2003). The spellings **kaDamba** and **kalamba** were translated by Monier-Williams (1899) as “the stalk of a potherb,” and both **kalambaka** (crane potherb), and **kalambukA** (laughter potherb) were said to be kinds of **kalamba**.

The Sanskrit **kalamba** shows that people were aware enough of the plants to give them a name by at least 200 B.C. and possibly earlier. Since people recognized two "kinds," it is possible that they were referring to cultivated and wild plants, but there are not enough data in the dictionaries to know what they meant. Also, the ancient **kalamba** left descendant words in Bengali (Bangladesh; West Bengal, south to Uttar Pradesh, India), Hindi (across northern India, south to at least Orissa), Mundari (eastern India; Nepal), Nepali (Nepal), Tamil (Tamilnadu and nearby states), and Parbati, Satar, and Tharu (all Nepal). The languages Bengali, Hindi, and Nepali are considered to be directly related to Sanskrit (Gordon 2005). This lineage of Austro-Asiatic, Indo-European, and Sino-Tibetan language families (Appendix 1) denotes an early high importance of *I. aquatica* to several widely spread Indian cultures and their closest neighbors.

The oldest Chinese document clearly referring to *I. aquatica* was written by Ji Han (A.D. 304) during the Chin Dynasty (A.D. 290-307). This book describes the modern Kwangtung [Guangdong] and Kwangsi [Guangxi] provinces of southern China and the central and northern parts of Vietnam. The original Chinese text is reproduced by Li (1979) where this plant is rendered 蓊. He added modern Cantonese *yung ts'ai* (蓊菜); this is **wéng cài** in **pinyin**.

Ji Han noted the morphological similarity of **yung** (蓊) to **lo-k'uei** (落葵, *Basella rubra* L.). That comparison, the character used, and the growing of the plants in mats floating on water confirm the identity as *I. aquatica*. Ji Han wrote in the 300s that this was "a strange vegetable of the south" to people in northern China.

According to Ng (1954), Ching (1968) and Edie and Ho (1969), the modern name **wéng cài** (蓊菜) appeared in writing with Chiang Yu Shik (A.D. 1056-1063), in the Sung Dynasty. During the Ming Dynasty (1590-1596), Li Shih Chen (1596, Read 1936) quoted Ji Han of the Chin Dynasty (Edie & Ho 1969). Li Shih Chen added that the name 蓊菜 (buried potherb) came from the method of planting and growing the vegetable (cf. Appendix 1).

To make the situation confusing, a second name for these plants 甕菜 is written differently but pronounced the same (homophones)-**wéng cài** in **pinyin**; **ong ts'ai** in Cantonese (Figure 5). This Cantonese and Taiwanese name has a venerable usage (Ching 1968, Edie & Ho 1969), although its age is yet to be determined. One story I was told in 1980 by Shu-Chen Yu Hu, a skilled caligrapher from Hebei province, is that 甕菜 was applied during a period in Chinese history when people were forced to flee their homelands by boats and took along one of their favorite vegetables in earthen pots. Ching (1968) and Edie and Ho (1969) consider this a legend particularly common in Fukien and Taiwan. The story holds that the ancestors of the Chinese in Taiwan came from Fukien to escape the reign of a tyrant (unnamed) "many centuries ago." These people loaded provisions on their vessels and the only vegetable that would remain fresh during the voyage was a wild plant along the river banks. They put this 甕菜 in pots and propagated it during the voyage. In Taiwan, they turned this wild plant into an important cultivated vegetable crop. Mainland people were settling on the island of Taiwan by A.D. 1167 and maybe before. Fukienese seem to have been the first on the island although Hakkanese from Hong Kong are also common.

Figure 5. Caligraphy of **ong ts'ai** [**wéng cài**] 甕菜 written by Shu-Chen Yu Hu.

There are other interpretations of 蓊 and 甕 and their origins (Lee 2006). The true ages remain uncertain, but the words 蓊 (buried propagule) and 甕 (earthen jar or urn) are so old that few modern Chinese speakers recognize or really understand them (cf. Lee 2006). The second name is used in some dialects, but less often in formal writing. Still both words are included in the Wade-Giles system (cf. Mathews 1944-甕 p. 1062; 蓊 p. 1134), and in the Chinese Character Dictionary (Chin *et al*. 1995-2006). Also, Yung and Yao (1985), Staples (1998), and Peng (2000) list 甕菜 for Taiwan.

Although perhaps younger than the Indian name, **wéng** 蓊 still appeared in Chinese documents by ca. A.D. 300. Inclusion of the name in modern Chinese dialects as different as Cantonese, Hakkanese, Mandarin, and those spoken in Taiwan also points to an ancient use in that region.

The most widespread name for *I. aquatica* is **kangkong** and its variants (Table 1, Appendix 1). Blust (2000) considered **kangkong** either Malay or from one of the languages in the Philippines; he could determine no more closely with linguistics. Rumphius (1741-1750) thought that **kangkong** meant, "it is restless." That meaning cannot be confirmed by modern speakers or dictionaries (Horne 1974, Winstedt & Wilkinson 1949, Lau pers. comm. 2006), however, there is a proverb in Malay that refers to *I. aquatica* as "the ill weed that grows apace" (Winstedt & Wilkinson 1949). Perhaps it was that comparison that Rumphius was alluding to.

Dictionaries also show the word **kangkong** for a species of frog in Malaysia that is supposed to say its name with its onomatopoetic call. Otherwise, to most modern speakers of Malay **kangkong** is simply the word for water spinach. **Kangkong** is applied to several other plants, but usually with modifiers (e.g., **kangkong pasir** for *Xenostegia tridentata* (L.) D.F. Austin and Staples; **akar kangkong gajab** for *Vitis lanceolaria* (Roxburgh) Wallich).

The name **kangkong** apparently has been carried by people speaking Malay, or the Europeans who adopted the name, across much of Malaysia, Indonesia, and the western Pacific Islands (Table 1, Figure 6). Malays, Portuguese, Spanish, or Dutch, all early traders in that region, may have carried the name **kangkong** and the vegetable with them from place to place. Rumphius (1741-1750) recorded that the people of Ambon (Moluccas Islands) had no name of their own for the plants, but used the Malay **kangkong**. Transport is also indicated by the fact that **kangkong** is a loan word in Guam and the nearby Marianas Islands (Blust 2000). While the Chamorro-speakers on these islands were derived from the Philippines, Blust (2000) thought that either the Malays (beginning ca. 1292) or the Spanish (beginning 1565) introduced the name **kangkong**. He favored the Spanish, although he did not mention possible transport elsewhere by the Portuguese and Dutch.

The Portuguese took Malacca on the Malay Peninsula opposite the straits and Sumatra in 1511 and dominated spice trade with Europe for about 94 years. They then were replaced by the Dutch in 1605 (Forrest 1995), who established their headquarters in Batavia (modern Jakarta, Java). The Dutch dominated trade through the Vereenigde Oost-Indische Compagnie (VOC or Dutch East India Company) for the next 190 years (Adams 1996). Either group could have spread the name **kangkong**, if not the plants. Although Blust (2000) did not think that the Malay traders took the word to Guam in the 1200s, he did not exclude their taking it elsewhere. Even the early date

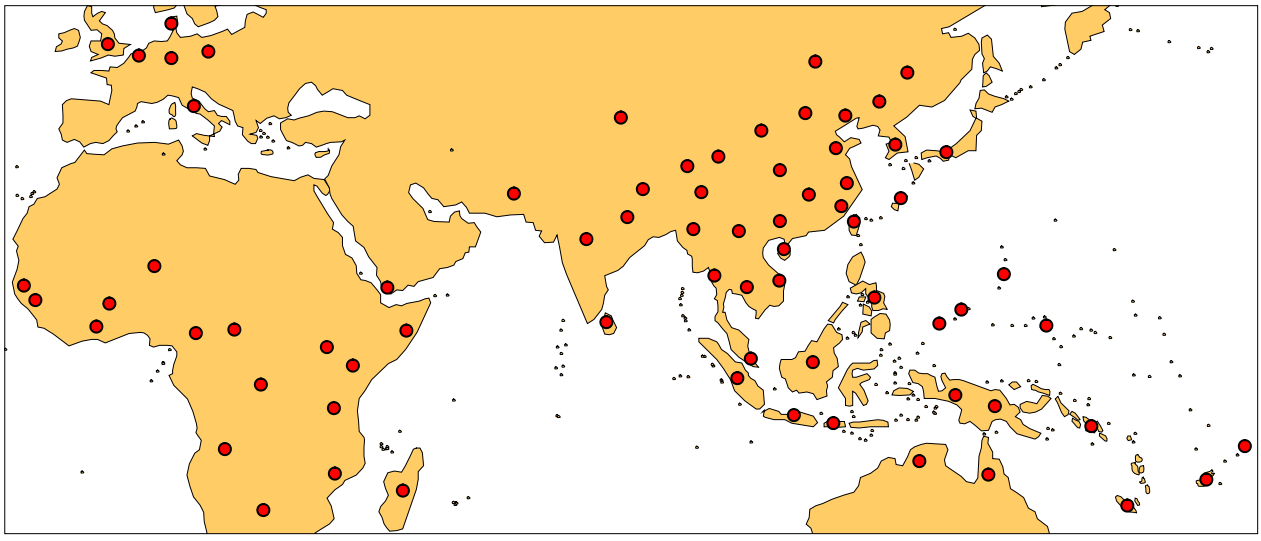

Figure 6. Distribution of *Ipomoea aquatica* in the Old World. Based on herbarium, literature, and other records. Dots represent country, state/province, or island records; all are used because source data are variable.

of the 1200s is markedly younger that those for Chinese and Sanskrit.

No direct dates are available on **kangkong**. Although botanical literature says the word has been loaned to English, none of the etymological dictionaries even list **kangkong** (e.g., American Heritage Dictionary 2006, Cambridge Dictionary of American English 2006, OED Online 2003, Webster 1996). The same seems to be true of Danish and Dutch. **Kangkong** is a loan word in Bali, Bukit, Chamorro, Javanese, Madurese, Malay, Minangkabau, Palauan, the Philippine languages, Sinhalese, Tok pisin, and Yapese; it may be in several others (Table 1, Appendix 1). Historical data indicate that **kangkong** is younger than either **kalamba** and **wéng cài**, but that does not confirm that use of the plant in the Malay Peninsula is younger. It simply indicates a lack of data.

People in neither Burma, Cambodia, Laos, Thailand, nor Vietnam, use one of these affirmably ancient names (Appendix 1). Instead, each country has its own unique designations for *I. aquatica*. No historical documents or etymological data have been found to suggest ages of either of the names used in these areas. Names do not suggest recent adoption of the plants, but give unique local views of the species. Since these countries have different names for the species, perhaps that indicates marked antiquity in those areas.

The fact that language families as distinct as Austro-Asiatic, Dravidian, Indo-European, Sino-Tibetan, and Tai-Kadai show a diversity of names must indicate great age in southeastern Asia. There is some name variety in Africa and the Pacific, but it does not seem to be as great as in continental southeastern Asia. Names and their historical origins point to southeastern Asia as the cradle of *I. aquatica*.

Plant Pathogens and Pests

A series of problems (Westphal 1993) are created by *Pythium*, causing damping-off, *Cercospora* leaf spot, and root knot nematodes (*Meloidogyne incognita* (Kofoid & White) Chitwood and *M. javanica* (Treub) Chitwood). Aphids may be pests in fields, particularly those with "ratoon cropping" (as a perennial with new shoots coming up from the root). None of these are host-specific.

Lepidoptera that feed on the plant are *Diacrisia strigatula* Walker and *Spodoptera litura* (Fabricius) (Westphal 1993). Both of these are polyphagous, feeding an a number of host plants. The genus *Diacrisia* (Arctiidae) includes the familiar "woolly-bear" caterpillars (*D. virginica* [Fabricius]) of the eastern United States. *Diacrisia strigatula* (Chinese tiger moth) is another species with wide food preferences.

Larvae of *Spodoptera* (Acronictinae, Noctuidae) are often called "armyworms" and examples in temperate regions are *S. dolichos* (Fabricius) (sweet potato armyworm), *S. eridania* (Stoll) (southern armyworm), *S. exigua* (Hübner) (beet armyworm), and *S. frugiperda* (J.E. Smith) (fall armyworm). All of these are generalists, feeding on 80 or more different plant species in a range of families (Capinera 2001). *Spodoptera litura* (tobacco cutworm, cluster caterpillar) is considered an "international pest" (Herbison-Evans & Crossley 2006) and the larvae eat a wide array of cultivated plants, ranging from vegetables to ornamentals.

There are several species of *Albugo* (Albuginaceae, Peronosporales, Oomycota, Straminopila), protists formerly considered fungi, that have been named after *Ipomoea* species because they were thought to be confined to those (Holliday 1980, Sawada 1922). These include *A. ipomoeae-aquaticae* Sawada, *A. ipomoeae-hardwickii* Sawada, *A. ipomoeae-panduratae* (Schweinitz) Swingle, and *A. ipomoeae-pes-caprae* Ciferri.

There has been ambiguity about the species that causes problems with *I. aquatica*—some call it *Albugo candida* (Persoon ex Lévillé) Kunze and others say it is *A. ipomoeae-aquaticae* (e.g., Chen *et al*. 1986, Gacutan *et al*. 1978, Ho & Edie 1969, Khoo & Lim 1989, Naples 2005, Shivas *et al*. 1996). The organism has even been called *A. ipomoeae-panduratae*, and both that and *A. candida* are known to occur on a range of species. *Albugo candida* is a pathogen on many Brassicaceae and Capparidaceae, while *A. ipomoeae-panduratae* infects an array of *Convolvulus* and *Ipomoea* species.

Holliday (1980) recorded experimental attempts to infect several species of both *Convolvulus* and *Ipomoea* with *A. ipomoeae-aquaticae* and it grew only on *I. aquatica*. *Albugo ipomoeae-aquaticae* occurs at least in China (Hong Kong, Fuzhou), India, the Philippines, Singapore, Taiwan, northern Australia, and Irian Jaya. Although the range now has been expanded from the places where Holliday (1980) knew the species, no other references have been found of this pathogen on any plant but *I. aquatica*.

Albugo ipomoeae-aquaticae is a specialist pathogen on *I. aquatica* and has a range restricted to southern and southeastern Asia. These data point to an origin of both in that region.

Origin Debates

Everyone agrees that *I. aquatica* is native in southeastern Asia (e.g., Filatenko *et al*. 2003, Li 1970). Within Asia, however, there are two places that are typically cited as having domesticated the plants. One opinion is that the food species was originally Chinese. Purseglove (1968) implied that it was domesticated there and Sinskaya (1969 in Filatenko *et al*. 2003), Chang (1970), and Li (1970) clear-

ly held that it was. More recently Langeland and Burks (1998) indicate China as its homeland. Others propose India as the place of domestication. Herklots (1972) wrote that the species was "possibly Indian in origin." Westphal (1993), Van Valkenburgh and Bunyapraphatsara (2001), the Singapore Science Center (2002), Owens (2003), and Van Wyk (2005) also suggest an origin in India. Van (1998) cited both China and India.

Neither the proponents of either China or India give supporting data other than the references to when *I. aquatica* appeared in historical Chinese documents. No archaeological records were found and molecular genetics has not been applied to this problem.

There is similar doubt about whether the species is native in Africa. *Ipomoea aquatica* may be part of the indigenous flora, or it could have been introduced from farther east as were a number of other cultivated species (e.g., Mbida *et al*. 2006, Rossell 1998). Indeed, the history of the travels of Chinese mariner Cheng ho [Zheng he] during his seven expeditions of 1405-1433 note that he carried **wéng cài** (Lee 2002). Each of his 300 ships brought enough provisions to last the whole voyage, in case local choices were not acceptable. In addition to rice and other food that could be preserved, the ships carried huge tubs of earth on deck so that vegetables and fruits could be grown (Leo 2006). Cheng ho visited, in addition to coastal places in southern Asia, Mecca in Arabia, Egypt, Somalia, and Yemen (Lee 2002).

The few references to people using water spinach for any purpose in Africa (e.g., Dalziel 1937, Haerdi 1964, Iwu 1993, Malaisse 1997, Samuelsson *et al*. 1992, Vaino-Mattila 2000, Williams 1949) and its complete absence from Chweya and Eyzaguirre (1999) point to a comparatively late introduction. It seems likely that Cheng ho introduced this vegetable to Africa, particularly since Yemen is where Forsskåll discovered it in the 1770s.

The plants also grow in the northern parts of Australia (Figure 6). *Ipomoea aquatica* has been presumed to be native there (Brock 1988), but its absence from the aboriginal diet makes that problematical. The indigenous people in Australia are renowned for having eaten an amazing variety of native plants, and *I. aquatica* is not among them (Isaacs 1987). Payne (1956) thought the species had been introduced into Australia. Cribb and Cribb (1987) speculated that water spinach was little known until recent years when Asian immigrants began offering the herbs in oriental food shops. The plant apparently has no indigenous common name, but is called by either the English names or **kangkong**.

All of the six data sets point to southeastern Asia as the cradle of this cultigen. Because there is the Sanskrit name **kalamba** for the species, it might be argued that there is linguistic support for domestication in India. From there it may have spread to the other countries, but we have no direct evidence comparable to that in the western Pacific.

There is, however, a long record of plant exchange between India and China. When Ji Han wrote in A.D. 304, there had already been about four centuries of overland and marine trade between these two regions (Li 1979). Ji Han listed numerous plants in southern China that are now known to have been imported Indian or western Asian natives. A few of these are *Citrus medica* L., *Jasminum officinale* L., *J. sambac* (L.) Aiton, *Phoenix dactylifera* L., and *Piper nigrum* L. Some of the imported plants were taken overland by the "Silk Road" (e.g., *Phoenix dactylifera*, Hu 2005), but others seem more likely to have been moved along the maritime routes.

Li (1979) gives an account of trade between China, Greece, and Rome, and tells of Indian colonization of Java, Sumatra, and Cambodia reaching a climax between the third and second centuries B.C. On the other hand, China began long-distance sea travel in about the second century B.C. By the third and fourth century A.D. when Ji Han wrote, there was considerable Indian influence in Chiao-chih (modern Hanoi, Vietnam) that was part of Chiao-chou (modern Kwangtung [Guangdong] and Kwangsi [Guangxi] provinces, Hainan Island, and northern and central Vietnam). Present day Burma, Thailand, and Cambodia were called Fu-nan because of Indian presence and influence there. In spite of this history, there remains no direct evidence of trade of *I. aquatica* between these regions at this time.

Ji Han simply said that *Ipomoea aquatica* was "from the south." Of some plants known to be foreign in China, he said they were from Ta-ch'in (land west of Chiao-Chih and Fu-nan), or that they were "brought over from Western countries." He made no comment about the origin of others.

Although available data make it tantalizing to suggest that the cultigens were introduced from India to China, proponents of neither Chinese nor Indian theories can be shown as wrong. Indeed, it cannot be shown that Indochina is not the place of origin, but there are fewer data for there than India and China. In view of the recent study of rice, the species may have been taken into cultivation in all these places. Londo *et al*. (2006) found data indicating that rice had been domesticated more than once, from different genetic lineages, in both China and India. More data are needed from additional studies to determine which, if either, of these views may be correct with *I. aquatica*.

Acknowledgments

Numerous people have graciously provided information regarding plants, literature, and names. Among these, and the area(s) they provided help, are Eugene N. Ander-

son (Chinese history), Henrik Balslev (Danish), Dorothea Bedigian (Africa), Sebsebe Demissew (eastern Africa), Eckart Eich (chemistry; Africa), Frederick and Yau-Ping Hu Essig (China), Karchi Gandhi (India), Shu-Chen Yu Hu (Chinese history), Kaoru Kitajima (Japanese), Pakshirajan Lakshminarasimhan (Indian languages), Han Lau (Malay), Christine Lockhart (Polish), Manorak Luangkhot (Thai), Andrew McDonald (Cambodia); Lytton Musselman (Africa), My Lien Nguyen (Vietnam), Cho Yeon and Robert W. Pemberton (Korea), C. Rajendran (Sanskrit), Albert M. Salamanca (Philippines), M. Sivadasan (Sanskrit), George W. Staples (Asian Convolvulaceae), Estelle Syrk (Polish), Mats Thulin (Somalia), and Valeria C. Volin (Italian), Worraruethai Pensuk (Thai). Will McClatchey provided the map, skillfully drawn by Piet Lincoln. Photographs in Figures. 1 & 2 were taken by Greg Jubinsky, courtesy of Kenneth Langeland, Institute of Food and Agricultural Sciences, Gainesville, FL. Permission to use data from his studies of African names was given by R. M. Blench. I thank Eckart C. Eich (Freie University, Berlin), Ching-I Peng (Academia Sinica, Taiwan), and Lianfen Qian (Florida Atlantic University) for reviewing parts or all of a draft of the mss.

Literature Cited

Adams, J. 1996. Principals and agents, colonialists and company men: The decay of colonial control in the Dutch East Indies. *American Sociological Review* 61(1):12-28.

American Heritage Dictionary of the English Language. 2006. www.bartleby.com/61/.

Austin, D.F. 1980. Convolvulaceae. Pp. 288-363 in *A Revised Handbook of the Flora of Ceylon* Volume 1. Edited by M.D. Dassenayake & F.R. Fosberg. Amerind Publishing Co., New Delhi.

Austin, D.F. 1998. The indiscriminate vector: Human distribution of *Dichondra micrantha* (Convolvulaceae). *Economic Botany* 52:88-106.

Austin, D.F. 2000. The search for "**kaladana**" (*Ipomoea*, Convolvulaceae). *Economic Botany* 54:114-118.

Austin, D.F. 2005. The enigmatic **salsa da rua** (*Ipomoea asarifolia*, Convolvulaceae). *Ethnobotany* 17:41-48.

Austin, D.F. & S. Ghazanfar. 1979. Convolvulaceae Pp. 1-64 in Flora of West Pakistan Volume 126. Edited by E. Nasir & A.I. Ali. University of Karachi and National Herbarium, Islamabad, Pakistan.

Austin, D.F., K. Kitajima, Y. Yoneda & L. Qian. 2001. A putative tropical American plant, *Ipomoea nil* (Convolvulaceae), in Pre-Columbian Japanese art. *Economic Botany* 55:515-527.

Blench, R.M. 2003a. Hausa names for plants and trees. www.rogerblench.info/Ethnosciencedata/Hausaplantnames.pdf

Blench, R.M. 2003b. Fulfulde names for plants and trees in Nigeria, Cameroun, Chad, and Niger. www.goto.glocalnet.net/maho/webresources/atlantic.html

Blust, R.A. 2000. Chamorro historical phonology. *Oceanic Linguistics* 39:83-122.

Bodner, C.C. & R.E. Gereau. 1988. A contribution to Bontoc ethnobotany. *Economic Botany* 42:307-369.

Brock, J. 1988. *Top End Native Plants*. Published by author, Darwin.

Bruemmer, J.H. & R. Roe. 1979. Protein extraction from water spinach (*Ipomoea aquatica*). *Proceedings of the Florida State Horticultural Society* 92:140-143.

Burkill, I.H. 1953. Habits of man and the origins of the cultivated plants of the Old World. *Proceedings of the Linnean Society*, Session 164:12-42.

Burkill, I.H. 1966. *A Dictionary of the Economic Products of the Malay Peninsula*. Ministry of Agriculture and Cooperatives, Kuala Lumpur.

Burman, N.L. 1768. *Flora Indica: cui accedit series zoophytorum indicorum, nec non prodromus florae capensis*. Cornelius Haak/Johannes Schreuder, Leiden.

Cambridge Dictionary of American English. 2006. www.dictionary.cambridge.org

Capinera, J.L. 2001. *Handbook of Vegetable Pests*. Academic Press, San Diego.

Castillo, F.S. 1982. Oraphyl-a saline mouthwash powder from **Kangkong** (*Ipomoea reptans*) leaves. Thesis, CEU. Abstract at www.pchrd.dost.gov.ph/herdinneon/.

Chang, K-C. 1970. Beginnings of agriculture in the Far East. *Antiquity* 44:1-12.

Chen, B.H. & Y.Y. Chen. 1992. Determination of carotenoids and chlorophylls in water convolvulus (*Ipomoea aquatica*) by liquid chromatography. *Food Chemistry* 45:129-134.

Chen, G.F., B. Li, S.M. Chen & X.Y. Zhuo. 1986. **Chih wu pao hu hsueh pao** [Study on infection sources and the development of the white rust of water spinach]. *Acta Phytophylacica Sinica* 13:97-101.

Chiang, Yu Shik. 1056-1063. 本草拾遗 **Jiayou Bencao** [Supplement to Materia Medica. From the Sung Dynasty. Not seen]

Chin, T., S. Chan & R. Chan. 1995-2006. Chinese Character Dictionary. www.chineselanguage.org.

Ching, B.H.W. 1968. Cultivation and white rust disease (*Albugo* sp.) of *Ipomoea aquatica* Forsk. in Hong Kong. MS thesis, University of Hong Kong.

Choisy, J.D. 1845. Convolvulaceae. Pp. 323-465 in Prodromus Volume 9 Edited by A. DeCandolle. Geneva.

Chweya, J.A. & P.P. Eyzaguirre. 1999. Editors of *The Biodiversity of Traditional Leafy Vegetables*. International Plant Genetic Resources Institute, Rome, Italy.

Clarke, C.B. 1885. Convolvulaceae Pp. 179-228 in *Flora of British India.* Volume 4. Edited by J.D. Hooker. Reeve & Co., London.

Cornelius, J., J.A. Nugteren & E. Westphal. 1985. **Kangkong** (*Ipomoea aquatica* Forssk.): An important leaf vegetable in Southeastern Asia. *Abstracts on Tropical Agriculture* 10(4):9-21.

Cribb, A.B. & J.W. Cribb. 1987. *Wild Food in Australia*. Collins Publishers, Sydney.

Dalziel, J.M. 1937. *The Useful Plants of West Tropical Africa*. Crown Agents for Oversea Governments and Administrations, London.

Das, S. & K.K. Mukherjee. 1997. Morphological and biochemical investigations on *Ipomoea* seedlings and their species interrelationships. *Annals of Botany* 79:565-571.

De Candolle, A. 1886. *Origin of Cultivated Plants*. Reprinted 1959 by Hafner Publishing Company, New York.

Decker-Walters, D.S. 1999. Cucurbits, Sanskrit, and the Indo-Aryas. *Economic Botany* 53:98-112.

Deroin, T. 2001. Famille 117-Convolvulaceae. Pp. 11-287 in *Flore de Madascar et des Comores*. Edited by P. Morat. Muséum National d'Histoire Naturelle, Paris.

Edie, E.E. & B.W.C. Ho. 1969. *Ipomoea aquatica* as a vegetable crop in Hong Kong. *Economic Botany* 23:32-36.

Etkin, N.L. 2006. *Edible Medicines: An Ethnopharmacology of Food*. The University of Arizona Press, Tucson, Arizona.

Fang, R.-C. & G.W. Staples 1995. Convolvulaceae. Pp. 271-325 in Flora of China. Volume 16. Gentianaceae through Boraginaceae. Missouri Botanical Garden, St. Louis, MO.

Filatenko, A.A., K. Pistrick, H. Knüpffer & K. Hammer. 2003. E.N. Sinskaya's inventory of plant taxa in the basic and dependent areas of the historical development of the flora of cultivated plants. Pp. 222-256 in *Rudolf Mansfeld and Plant Genetic Resources*. Proceedings of a Symposium dedicated to the 100th Birthday of Rudolf Mansfeld, Gatersleben, Germany, 8-9 Octover 2001. Edited by H. Knüpffer & J. Ochsmann. Schriften zu Genetischen Ressourcen, Band 22, Zentralstelle für Agrardokumnetation und IInformation (ZADI), Informationszentrum Biologische Vielfait (IBV), Bonn, Germany.

Forrest, P. 1995. *The Tiwi Meet the Dutch: The first European contacts*. The Tiwi Land Council, Winnellie, Australia.

Forsskåll, P. 1775. *Flora Aegyptica-Arabica*. ex officina Mölleri, Hauniæ (Copenhagen).

Fosberg, F.R., D. Otobed, M.-H. Sachet, R.L. Oliver, D.A. Powell & J.E. Canfield. 1980. V*ascular plants of Palau with vernacular names*. Department of Botany, The Smithsonian Institution, Washington, D.C.

French, B.R. ca.1986. *Food Plants of Papua New Guinea. A Compendium*. Published by author, Sheffield, Tasmania, Australia.

Gacutan, M.V.C., T.H. Quimio, M.V.C. Gacutan, T.H. Quimio & M.V.C. Gacutan. 1978. Studies on the white rust disease of **kangkong** (*Ipomoea aquatica* Forsk.). *Philippine Phytopathology* 14:69-77.

Gagnepain, P. & F. Courchet. 1915. **Convolvulacées de l'Indo-Chine**. Pp. 228-313 in *Flore Générale de L'Indo-Chine*. Volume 4, fascicle 3. Edited by H. Lecomte & H. Humbert. Masson et Cie, Paris.

Gangstad, E.O. 1976. Potential growth of aquatic plants in the Republic of the Philippines and projected methods of control. *Journal of Aquatic Plant Management* 14:10-14.

Gordon, D.R. & K.P. Thomas. 1997. Florida's invasion by nonindigenous plants: History, screening, and regulation. Pp. 21-38 in *Strangers in Paradise*. Edited by D. Simberloff, D.C. Schmitz & T.C. Brown. Island Press, Washington, DC.

Gordon, R.G., Jr. 2005. Editor of *Ethnologue: Languages of the World*, Fifteenth edition. SIL International, Dallas, TX. www.ethnologue.com/.

Gotfredsen, E. 2006. *Liber Herbarum II* [www.liberherbarum.com/pn6117.HTM].

Guppy, H.B. 1917. *Plants, Seeds, and Currents in the West Indies and Azores. The Results of Investigations Carried out in those Region between 1906 and 1914*. William & Norgate, London.

Haerdi, F. 1964. *Die Eingeborenen-Heilpflanzen des Ulanga-Distrikts Tanganyikas*. Acta Tropica, Supplement 8, Basel, Switzerland.

Hallier, H. 1893. Convolvulaceae Africanae. *Botanische Jahrbücher für Systematik, Pflanzengeshichte und Pflanzengeographie* 18:81-160.

Hallier, H. 1905. Convolvulaceae Pp. 62-206 in *Flora of Tropical Africa*. Volume 4(2). Edited by A.B. Rendle, D. Oliver & W. Thistelton-Dyer. L. Reeve & Co. Reprint by Beadley Brothers Ltd., Kent, 1959.

Harwood, E. & M. Sytsma. 2003. *Risk assessment for Chinese Water Spinach (Ipomoea aquatica) in Oregon*. Portland State University, Portland, OR. www.oregon.gov/ODA/PLANT/docs/pdf/oisc_ipaq_ra.pdf.

Herbison-Evans, D. & S. Crossley. 2006. *Spodoptera litura (Fabricius 1775)*. www.usyd.edu.au/macleay/larvae/acro/litura.html.

Herklots, G.A.C. 1972. *Vegetables in South-east Asia*. George Allen & Unwin, Hong Kong.

Heyne, K. 1927. *De Nuttige Planten van Nederlandisch Indië*, Second Edition. Department van Landbouw, Nijverheid & Handel, Buitenzorg.

Ho, B.W.C. & H.H. Edie. 1969. White rust (*Albugo ipomoeae-aquaticae*) of *Ipomoea aquatica* in Hong Kong. *Plant Disease Reporter* 53:959-962.

Holliday, P. 1980. *Fungus Diseases of Tropical Crops*. Cambridge University Press, New York.

Horne, E.C. 1974. *Javanese-English Dictionary*. Yale University Press, New Haven.

Hu, S.-Y. 2005. *Chinese Food Plants*. The Chinese University Press, Hong Kong.

Hulsenbeck, J.P., B. Larget, R.E. Miller & F. Ronquist. 2002. Potential applications and pitfalls of Bayesian inference of phylogeny. *Systematic Botany* 51:673-688.

Irving, C. 1995-2006. *Clay's Kitchen*. www.panix.com/~clay/cookbook/bin/show_ingredient.cgi?swamp-cabbage.

Isaacs, J. 1987. *Bush Food. Aboriginal Food and Herbal Medicine*. Weldon Publishers, Willoughby, NSW.

Islam, R., D.K. Paul & R.K. Shaha. 2004. Nutritional importance of some leafy vegetables available in Bangladesh. *Pakistan Journal of Biological Sciences* 7:1380-1384.

ISSG. 2005. *Global Invasive Species Database*. Invasive Species Specialist Group. www.issg.org/database/species/ecology.asp?si=477&fr=1&sts=sss.

Iwu, M.M. 1993. *Handbook of African Medicinal Plants*. CRC Press. Boca Raton, FL.

Jain, S.K. 1963. Studies in Indian Ethnobotany: The origin and utility of some vernacular plant names. *Proceedings of the National Academy of Sciences of India* 33:525-530.

Ji, H. A.D.304. *Nan-fang ts'ao mu chuang* 南方草木状 [**Nanfang caomu zhuang**, Plants of the Southern Regions].

Kapoor, S.L. & L.D. Kapoor. 1980. Medicinal plant wealth of the Karimnagar district of Andhra Pradesh. *Bulletin of Medico-Ethnobotanical Research* 1:120-144.

Kays, S.J. & J.C. Silva Dias. 1996. *Cultivated Vegetables of the World. Latin Binomial, Common Names in 15 Languages, Edible Parts, and Method of Preparation*. Exon Press, Athens, GA.

Khoo, K.L. & G. Lim. 1989. White 'rust' disease of *Ipomoea aquatica* in Singapore. *Journal of Plant Protection in the Tropics* 6:119-122.

Langeland, K.A. & K.C. Burks. 1998. Editors of *Identification & Biology of Non-Native Plants in Florida's Natural Areas*. University of Florida, Gainesville.

Lee, S.L. 2002. *Chinese mariner Zheng He [Cheng Ho]*. www.chinapage.com/history/zhenghe2.html.

Lee, S.L. 2006. 也**说**"蕹菜"[Also called "**Weng Cai**"]. / www.jwc.fudan.edu.cn:8080/yayan/showArticle.php?akey=137.

Leo, R.K.H. 2006. *The admiral of the Western Seas – Cheng Ho (Zheng He)*. www.planet.time.net.my/CentralMarket/melaka101/chengho.htm

Li, H.-L. 1970. The origin of cultivated plants in Southeast Asia. *Economic Botany* 24:3-19.

Li, H.-L. 1979. *Nan-fang ts'ao-mu chuang written by Ji Han. 307*. A fourth century flora of Southeast Asia: Introduction, translation, commentaries. Chinese University Press, Hong Kong.

Li, Shih Chen 李時珍. 1596. *Pen tsao kang mu* 本草綱目 A.D. 1596. [Li Shi Zhen. 1596. **Ben cao gang mu**, A Compendium of Medicinal Herbs].

Linnaeus, C. 1753. *Species Plantarum*. Facsimile edition with introduction by W.T. Stearn, 1957, Ray Society, London.

Londo, J.P., Y.-C. Chiang, K.-H. Hung, T.-Y. Chiang & B.A. Schaal. 2006. Phylogeography of Asian wild rice, *Oryza rufipogon*, reveals multiple independent domestications of cultivated rice, *Oryza sativa*. *Proceedings of the National Academy of Sciences* 103:9578-9583.

Ly, J., P. Samkol & T.R. Preston. 2002. Nutritional evaluation of aquatic plants for pigs: pepsin/pancreatin digestibility of six plant species. *Livestock Research for Rural Development* 14(1). www.cipav.org.co/lrrd/lrrd14/1/ly141a.htm.

Malaisse, F. 1997. *Se nourrir en forêt claire africaine. Approche écologique et nutritionnelle*. Centre Technique de Coopération Agricole et Rurale, Wageningen.

Malalavidhane, T.S., S.M.D.N. Wickramsinghe & E.R. Jansz. 2000. Oral hypoglycaemic activity of *Ipomoea aquatica*. *Journal of Ethnopharmacology* 72:293-298.

Malten, T. 2003. Cologne Digital Sanskrit Lexicon (from Monier-Williams' Sanskrit-English Dictionary). www.webapps.uni-koeln.de/tamil/

Manandhar, N.P. 2002. *Plants and People in Nepal*. Timber Press, Inc., Portland, Oregon.

Manner, H.L. & E. Mallon 1989. An Annotated list of the vascular plants of Pulawat Atoll. *Micronesica* 22:23-63.

Manos, P.S., R.E. Miller & P. Wilkin. 2001. Phylogenetic analysis of *Ipomoea*, *Argyreia*, *Stictocardia*, and *Turbina* suggests a generalized model of morphological evolution in morning glories. *Systematic Botany* 26:585-602.

Mathews, R.H. 1944. *Mathews' Chinese-English Dictionary.* Revised American Edition. Reprinted 1979, Harvard University Press, Cambridge.

Mbida, C., E. De Langhe, I. Vrydaghs, H. Doutrelepont, R. Swennen, W. Van Neer & P. de Maret. 2006. Phytolth evidence for the early presence of domesticated banana (*Musa*) in Africa. Pp. 68-81 in *Documenting Domestication. New Genetic and Archaeological Paradigms*. edited by M.A. Zeder, D.G. Bradley, E. Emshwiller & B.D. Smith. University of California Press, Berkeley.

McCann, J.A., L.N. Arkin & J.D. Williams. 1996. *Nonindigenous aquatic and selected terrestrial species of Florida: Statue, pathways and time of introduction, present distribution, and significant ecological and economic effects*. Institute of Food and Agricultural Sciences, University of Florida, Gainesville. www.aquat1.ifas.ufl.edu/mctitle.html.

McCormack, G. 2002. *Cook Islands National Heritage Project database*. Cook Islands Natural History Project. www.hear.org/pier/commonnames/

Merlin, M., A. Kigfas, T. Keene & J. Juvik. 1996. *Plants, People and Ecology in Yap (**Giddi nge gakiiy nu Wa'ab**)*. East-West Center, Honolulu, Hawai'i.

Merrill, E.D. 1917. *An Interpretation of Rumphius's Herbarium Amboinense*. Bureau of Printing, Manila.

Merrill, E.D. 1939. The identity of *Convolvulus reptans* Linnaeus. *Philippine Journal of Science* 59:451-453.

Miller, R.E., T.R. Buckley & P.S. Manos. 2002. An examination of the monophyly of morning glory taxa using Bayesian phylogenetic inference. *Systematic Biology* 52:740-753.

Miller, R.E., J.A. McDonald & P.S. Manos. 2004. Systematics of *Ipomoea* subgenus *Quamoclit* (Convolvulaceae) based on ITS sequence data and a Baylesian phylogenetic analysis. *American Journal of Botany* 91:1208-1213.

Miller, R.E., M.D. Rauscher & P.S. Manos. 1999. Phylogenetic systematics of *Ipomoea* (Convolvulaceae) based on ITS and WAXY sequences. *Systematic Botany* 24:209-227.

Monier-Williams, M. 1899. *A Sanskrit-English Dictionary Etymologically and Philologically Arranged with Special Reference to Cognate Indo-European Languages*. Edited by E. Leumann & C. Cappeller, 1960. The Clarendon Press, Oxford.

Motteler, L.S. 1986. *Pacific Island Names*. Bishop Museum Press, Honolulu.

Naples, M.L. 2005. *Weeds of Rain Fed Lowland Rice Fields of Laos and Cambodia*. M.S. thesis, University of Leiden.

Ng, C.L. 1954. A proposal to introduce wet-land cultivation of water spinach. *Taiwan Journal of Agricultural Forestry* 8:24-25.

Nicolson, D.H., C.R. Suresh & K.S. Manilal. 1988. *An Interpretation of Van Rheede's Hortus Malabaricus*. Koeltz Scientific Books. Koenigstein, Germany.

Ochse, J.J. 1951. Two vegetables for South Florida. *Proceedings of the Florida State Horticultural Society* 64: 104.

OED Online. 2003. *Oxford English Dictionary*. Oxford University Press. 10 Dec. 2004 www.dictionary.oed.com/cgi/entry/00299371.

Ogle, B., M. Ogle, T.T. Ho, N.D. Hoang, N.X.D. Nguyen. 2003. Food, feed or medicine: The multiple functions of edible wild plants in Vietnam. *Economic Botany* 57:103–117.

Ogunwenmo, K.O. 2003. Cotyledon morphology: an aid in identification of *Ipomoea* taxa (Convolvulaceae). *Feddes Repertorium* 114(3-4):198-203.

Owens, G. 2003. ***Kangkong*** *Fact Sheet*. www.nt.gov.au/dpifm.

Patnaik, S. 1976. Autecology of *Ipomoea aquatica* Forsk. *Journal of the Inland Fisheries Society of India* 8:77-82.

Payne, W.J.A. 1956. *Ipomoea reptans* Poir., a useful tropical fodder plant. *Tropical Agriculture* 33:302-305.

PIER. 2005. *Ipomoea aquatica*: *common name details*. www.hear.org/pier/commonnames/details/ipomoea_aquatica.htm.

Porcher, M.H. 1995-2004. *Multilingual Multiscript Plant Name Database*. Sorting *Ipomoea aquatica* and *I. batatas* names. www.plantnames.unimelb.edu.au/Sorting/List_bot.html

Purseglove, J.W. 1968. *Tropical Crops*. Dicotyledons 1. Longmans, Green and Co. Ltd., London.

Read, B.E. 1936. *Chinese medicinal plants from the Pen Tsao Kang Mu* 本草綱目 *A.D. 1596. of a Botanical, Chemical and Pharmacological Reference List*. Third Edition. Peking Natural History Bulletin, Bejing, China.

Rheede tot Draakestein, H.A. van. 1692. *Hortus Indicus Malabaricus*. sumptibus Johannis van Someren et Joannis van Dyck, Amstelaedami.

Roi, J. 1955. *Traité des Plantes Médicinales Chinoises*. Paul Lechevalier Éditeur, Paris.

Rossel, G. 1998. *Taxonomic-Linguistic Study of Plantain in Africa*. CNWS Publications, Leiden.

Roxburgh, W. 1824. *Flora Indica or descriptions of Indian Plants*. Volume 2. Edited by W. Carey & N. Wallich. Oriole Editions reprint, 1975, New York.

Rumphius, G.E. 1741-1750. *Herbarium Amboinense*. Apud Fransicum Changuion, Joannem Catuffe, Hermannum Uytwerf, Amstelaedami.

Samuelsson, G., M.H. Farah, P. Claeson, M. Hagos, M. Thulin, O. Hedberg, A.M. Warfa, A.O. Hassan, A.H. Elmi, A.D. Abdurahman, A.S. Elmi, Y.A. Abdi & H.H. Alin. 1992. Inventory of plants used in traditional medicine in Somalia II. Plants of the families Combretaceae to Labiatae. *Journal of Ethnopharmacology* 37:47-70.

Sawada, K. 1922. Descriptive Catalogue of the Formosa Fungi II. *Report of the Department of Agriculture Govnment Research Institute Formosa* 2:1-173.

Schimming, T., K. Jennett-Siems, P. Mann, B. Tofern-Reblin, J. Milson, R.W. Johnson, T. Deroin, D.F. Austin & E. Eich. 2005. Calystegines as chemotaxonomic markers in the Convolvulaceae. *Phytochemistry* 66:469-480.

Shivas, R.G., S. Suyoko, N. Raga & K.D. Hyde. 1996. Some disease-associated microorganisms on plants in Irian Jaya, Indonesia. *Australasian Plant Pathology* 25:36-49.

Singapore Science Center. 2002. *A Guide to Common Vegetables*. www.sci-ctr.edu.sg/ssc/vegetables/convolvulaceae.jsp.

Smith, A.C. 1991. *Flora Vitiensis Nova. A new flora of Fiji (Spermatophytes only)*. Volume 3. National Tropical Botanical Garden, Lawai, Kauai.

Smitinand, T. 1979. *Thai Plant Names*. Khongrit Ekavibhata, Bangkok.

Snyder, G.H., J.F. Morton & W.G. Gentung. 1981. Trials of *Ipomoea aquatica*, nutritious vegetable with high protein- and nitrate-extraction potential. *Proceedings of the Florida State Horticultural Society* 94:230-235.

Staples, G.W. 1998. Convolvulaceae. Pp. 341-383 in *Flora of Taiwan*. Volume 4. Second Edition. National Taiwan University, Taipei, Taiwan.

Staples, G.W. & D.R. Herbst. 2005. *A Tropical Garden Flora. Plants Cultivated in the Hawaiian Islands and other Tropical Places*. Bishop Museum Press, Honolulu, HA.

Stefanovic, S.L. Krueger & R.G. Olmstead. 2002. Monophyly of the Convolvulaceae and circumscription of their major lineages based on DNA sequences of multiple chloroplast loci. *American Journal of Botany* 89:1510-1522.

Stone, B.C. 1970. The Flora of Guam. *Micronesica* 6:491.

Sundar Rao, K., R. Dominic, K. Singh, C. Kaluwin, D.E. Rivett & G.P. Jones. 1990. Lipid, fatty acid, amino acid, and mineral composition of five edible plant leaves. *Journal of Agriculture and Food Chemistry* 38:2137-2139.

Tay, D.C.S. & H. Toxopeus. 1993. *Brassica rapa* L. cv. group Pak Choi Pp. 130-134 in *Plant Resources in South-East Asia*. Number 8. Vegetables. Edited by J.S. Siemonsma & K. Piluek. Pudoc Scientific Publishers, Wageningen.

Thaman, R.R. 1987. Plants of Kiribati: a listing and analysis of vernacular names. *Atoll Research Bulletin* 296:1-42.

Thaman, R.R., F.R. Fosberg, H.L. Manner & D.C. Hassall. 1994. The flora of Nauru. *Atoll Research Bulletin* 392:1-223.

Tofern, B., P. Mann, M. Kaloga, K. Jenett-Siems, L. Wigge & E. Eich. 1999. Aliphatic pyrrolidine amides from two tropical convolvulaceous species. *Phytochemistry* 52(8):1437-1441.

Uphof, J.C.T. 1968. *Dictionary of Economic Plants*. J. Cramer, Lehre.

USDA. 2006. *PLANTS Database*. www.plants.usda.gov.

Vaino-Mattila, K. 2000. Wild vegetables used by the Sambaa in the Usambara Mountains, NE Tanzania. *Annales Botanici Fennici* 37:57-67.

Van, T.K. 1998. Handle this spinach with care. *Agricultural Research* 46(6):26.

Van Heel, W.A. 1970. Some unusual tropical labyrinth seeds. *Proceedings, Koninklijke Nederlandse Akademie van Wetenschappen. Series C, Biological and Medical Sciences* 73:298-301.

Van Heel, W.A. 1971. Notes on some more tropical labyrinth-seeds. *Blumea* 19:109-111.

Van Ooststroom, S.J. 1940. The Convolvulaceae of Malaysia, III. The genus *Ipomoea*. *Blumea* 3:481-582.

Van Ooststroom S.J. & R.D. Hoogland. 1953. Convolvulaceae. Pp. 388-512 in *Flora Malesiana*, Volume 4, Series 1. Edited by C.G.G.J. van Steenis. Noordhoof-Kolff n.v., Djakarta.

Van Valkenburg, J.L.C.H. & N. Bunyapraphatsara. 2001. Editors of *Plant Resources in South-East Asia*. Number 12. Medicinal and Poisonous Plants Part 2. Prosea Foundation, Backhuys Publishers, Leiden, The Netherlands.

Van Wyk, B.-E. 2005. *Food Plants of the World. An Illustrated Guide*. Timber Press, Inc., Portland, Oregon.

Verdcourt, B. 1963. Convolvulaceae. Pp. 120-121 in Flora of Tropical East Africa. Edited by C.E. Hubbard & E. Milne-Redhead. Crown Agents for Oversea Governments and Administrations, London.

Walker, E.H. 1976. *Flora of Okinawa and the Southern Ryukyu Islands*. Smithsonian Institution Press, Washington, DC.

Watt, G. 1889 [1972]. *A Dictionary of the Economic Products of India*. Bishen Singh Mahendra Pal Singh, Dehra Dun, India.

Webster's Third New International Dictionary, Unabridged. 1996. www.m-w.com/premium/mwunabridged/pop_w3.htm

Westphal, E. 1993. *Ipomoea aquatica* Forsskal Pp. 181-184 in *Plant Resources in South-East Asia*. Number 8. Vegetables. Edited by J.S. Siemonsma & K. Piluek. Pudoc Scientific Publishers, Wageningen.

Wikipedia. 2006. www.wikipedia.org/wiki/Ipomoea_aquatica.

Wills, R.B.H. & A. Rangga. 1996. Determination of carotenoids in Chinese vegetables. *Food Chemistry* 56:451-455.

Wills, R.B.H., A.W.K. Wong, F.M. Scriven & H. Greenfield. 1984. Nutrient composition of Chinese vegetables. *Journal of Agricultural and Food Chemistry* 32:413-416.

Winstedt, R.O. & R.J. Wilkinson. 1949. *A Malay-English Dictionary: Roman characters*. Keiley & Walsh, Singapore.

Wiser, C.V. 1955. The food of a Hindu village in North India. *Annals of the Missouri Botanical Garden* 42:303-412.

Yamaguchi, M. 1990. Asian vegetables. Pp. 387-390. in Advances in New Crops. Edited by J. Janick & J.E. Simons. Timber Press, Portland, OR.

Yung, N. & N. Yao. 1985. *Species List of Vascular Plants of Taiwan*. The Experimental Forest, National Taiwan University, Taipei, Taiwan.

Appendix 1. Some common names used for *Ipomoea aquatica*. Where possible languages have been brought into conformation with Gordon (2005). Synonyms are in brackets. Southeastern Asian countries are delimited following Siemonsma and Piluek (1993), except for the islands of Borneo and Papua-New Guinea. Data typically do not allow separation of those two into Malaysia and Indonesia. Pacific island names follow Motteler (1986). Notes: 1. Probable cognate loan from Malay **kangkong**. 2. Probable cognate loan from Bengali. 3 Probable cognate loan from Sanskrit.

Language Classification Family (Subfamily) *Language* Region	**Common Names/Comments**	**Information Sources**
Afro-Asiatic (Chadic, West)		
Hausa Nigeria	**áwárwáróó**+ [**awarwaro**]	Blench 2003a, Dalziel 1937
	furen gadu (=wart hog's flower)	Dalziel 1937
Afro-Asiatic (Cushitic, East)		
Somali Somalia	**maaloole**	Samuelsson *et al*. 1992
Austro-Asiatic (Mon-Khmer)		
Khmer Cambodia	**trâ kuön** [**tra kuôn**, **trocoum**]	Gagnepain & Courchet 1915, Ly *et al*. 2002, Porcher 1995-2004
Vietnamese Vietnam	**giàu muông** (**giàu**=potherb, **muông**=funnel)	Gagnepain & Courchet 1915
	rau muông [**mu**[**oos**]**ng**] (**rau**=rich, **muông**=funnel)	Gagnepain & Courchet 1915, Porcher 1995-2004, Van Valkenburgh & Bunyapraphatsara 2001, Nguyen pers. comm. 2006
Austro-Asiatic (Munda)		
Santali/Mundari Andaman & Nicobar Islands, Assam, Orissa, West Bengal, India; Bangladesh, Nepal	**karmira**[2] (=potherb)	Chopra *et al*. 1965
Santali/Satar Nepal	**karmi**[2] (=potherb)	Manandhar 2002
Austronesian (Malayo-Polynesian)		
Aceh/Atjeh Sumatra, Indonesia	**rumpun**	Van Ooststroom & Hoogland 1953
[Kayónon, Súlu/ Philippines?] *Aklanon* Philippines	**kangkong**, **tangkong** [**tangkóng**, **tangkung**][1]	Herklots 1972, Kays & Dias 1996, Van Ooststroom 1940
Bali/Balinese Bali, Indonesia	**kangkong**[1]	Heyne 1927
	pangpong [**pangpoeng**][1]	
Batatana Lauru, Solomon Islands	**sisu lumi** (**sisu**=sweet potato, *I. batatas*)	McClatchey 2005
Bentong Sulawesi, Indonesia	**kangko**[1]	Heyne 1927
Bisáya Philippines	**kangkong**, **tangkong** [**tangkóng**, **tangkung**][1]	Herklots 1972, Kays & Dias 1996, Van Ooststroom 1940
Bolango Sulawesi, Indonesia	**kanto**[1]	Heyne 1927
Bugis Maluku, Indonesia	**naniri**	
Bukitan Borneo, Indonesia	**kangkong**[1]	Van Valkenburgh & Bunyapraphatsara 2001
Buru/Mbero/Boeroe Maluku, Indonesia	**kangko**[1]	Heyne 1927
	utango[1]	Van Ooststroom & Hoogland 1953
Chamorro Guam, Marianas islands	**kankong** [**cancon**, **kankan**][1]	Blust 2000, Stone 1970

Language Classification Family (Subfamily) *Language* Region	**Common Names/Comments**	**Information Sources**
Chuukese Chuuk, Federated States of Micronesia	**seeri** [**seri**, **aseri**]	Manner & Mallon 1989, PIER 2005
Fijian Fiji	**luve ni tombithi**, **ndrinikava**, **ota karisa** [**ota karisi**], **wa kumala** (**kumara**=sweet potato, *I. batatas*)	Smith 1991
Gorontalo Sulawesi, Indonesia	**kangko**[1]	Heyne 1927
	panangoi[1]	
	sajor [**sajoha**]	
	sĕriokang [**sariokang**]	
Ilokano/Ilóko Philippines	**balâñgög** [**balangeg**]	Bodner & Gereau 1988, Porcher 1995-2004, Van Ooststroom 1940
	galatgat	Porcher 1995-2004, Van Ooststroom 1940
	kangkong, **tangkong** [**tangkóng**, **tangkung**][1]	Herklots 1972, Kays & Dias 1996, Van Ooststroom 1940
Javanese Java, Indonesia	**kangkong**[1]	Burkill 1966
Kiribati Kiribati	**te ruku** (historically generic for *Ipomoea*, now for this recent introduction), **te kang kong**[1]	Thaman 1987
Kubu/*Djambi* Sumatra, Indonesia	**daoen deli dili di**	Van Ooststroom 1940
Lembak Lingga, Indonesia	**sajoran lalap**, for leaves	Van Ooststroom 1940
Madura/Madurese Java, Indonesia	**kangkoeĕng**[1], **lalidih**	Heyne 1927
Makasar Maluku, Indonesia	**tanidri**	Rumphius 1741-1750, Van Ooststroom 1940
Malagasy Madagascar	**ialanda** (also used for *I. pes-caprae*)	Deroin 2001
Malay Malaysia	**kang kong** [**kangkong**, **cangong**][1] Rumphius (1741-1750) said that **kangkong** means "it is restless." A dryland cultigen is known as **kangkong puteh** in Singapore	Blust 2000, Herklots 1972, Kays & Dias 1996, Van Ooststroom 1940,
Malay Maluku, Indonesia	**sajor kankong** [**sayor cancong**][1] Rumphius noted that the people of Ambon had no name for it but used Malay **kangkong**	Rumphius 1741-1750, Van Ooststroom 1940
Maluku Maluku, Indonesia	**kingkoi**[1] [**kongkia**]	Heyne 1927
Maluku/Kajeli Maluku, Indonesia	**oetangko**[1]	Heyne 1927
Minangkabau Sumatra, Indonesia	**kalajau**[1]	Van Ooststroom 1940
	roempoen	Heyne 1927
Mongondow Sulawesi, Indonesia	**sajor** [**sajoha**]	Heyne 1927
Nauruan Nauru	**lorenzo**	Thaman *et al*. 1994
Nusalaut/Tengah Maluku, Indonesia	**larĕ** [**lara**, **laraë**]	Heyne 1927, Van Ooststroom 1940
Nusalaut/Tengah Maluku, Indonesia	**nggango dano** [**ango dano**, **kako dano**, dialectic][1]	Heyne 1927
Palauan/Belau Belau	**kangkum** [**kankum**][1]	Fosberg *et al*. 1980

Language Classification Family (Subfamily) *Language* Region	**Common Names/Comments**	**Information Sources**
Pamona/Bare`e Maluku, Indonesia	**tatanggo**[1]	Heyne 1927
[Bílok, Sulu?] *Pampángan* Philippines	**kangkóng** [**cancong**, **kangkung**][1]	Herklots 1972, Kays & Dias 1996, Van Ooststroom 1940
Puluwatese Puluwat, Federated States of Micronesia	**seeri** [**seri**, **aseri**]	Manner & Mallon 1989, PIER 2005
Rarotongan Cook Islands	**rukau taviri**	McCormack 2004 ex PIER 2005
Ririo Lauru Island, Solomon Islands	**sisu lum** (**sisu**= sweet potato, *I. batatas*)	McClatchey 2005
[Bílok, Sulu?] *Tagálog* Philippines	**kangkóng** [**cancong**, **kangkung**][1]	Herklots 1972, Kays & Dias 1996, Van Ooststroom 1940
Tonsawang Sulawesi, Indonesia	**panangoi**[1]	Heyne 1927
	pintoer	Van Ooststroom 1940
Yapese Yap, Micronesian islands	**kangkong**[1]	Merlin *et al*. 1996
Uncertain language Malaysia	**darat**	Van Ooststroom & Hoogland 1953
Uncertain language Malaysia	**paya**	
Uncertain language New Caledonia	**kang koung**[1]	Heine 1984
Uncertain language Sumatra, Indonesia	**kangkuěng**[1], **kalayan**, **lalidih**	Burkill 1966
Creole		
Sranan? [Creole Dutch] Suriname	**dagoeblad** (**dagoe**=dog, **blad**=leaf)	Stephen 1978
Tok pisin Papua-New Guinea	**kango**, **kangkong**[1]	French 1986
Dravidian (Tamil-Malayalam)		
Malayalam Kerala, India	**ballel** (an error for **vallem**=water) Currently no known common name.	Rheede 1692, Nicolson *et al*. 1988
Tamil Tamilnadu and neighboring states, India	**karkarei valli**, [**sarkarei-valli**, **vallai-kirai**, **vellai kěrai**, **walai kěrai**] (**karkarei**=potherb, **valli**=white)	Chopra *et al*. 1965, Watt 1889 [1972]
	koilangu (**kilanga**=tuber)	Chopra *et al*. 1965
	nir-kolmi[3] (**nir**=stream, **kolmi**=potherb)	
Dravidian (Telugu)		
Telugu Andhra Pradesh and neighboring states, India	**thota-kura** [*thota-kura*, **tootie-kura**, **tutikura**] (**túti**=garden, **kúra**=potherb)	Chopra *et al*. 1965, Kapoor & Kapoor 1980, Roxburgh 1824, Watt 1889 [1972], Tirhumala pers. comm. 2006
Indo-European (Germanic)		
Danish Denmark	**gladgrøntsag** (**glad**=happy, **grøntsag**=potherb), **kangkong**[1]	Kays & Dias 1996, Balslev pers. comm. 2006
Dutch Holland	**kangkong**[1]	Kays & Dias 1996
English United Kingdom	Chinese water/tropical spinach, swamp morning glory, water convolvulus [*Ipomoea*], water sweet potato, swamp cabbage, **kangkong**[1]	Kays & Dias 1996, Porcher 1995-2004

Language Classification Family (Subfamily) *Language* Region	**Common Names/Comments**	**Information Sources**
German Germany	**Sumpf-Trichterwinde** (=swamp funnel bindweed)	Kays & Dias 1996
	Wasserspinat (=water spinach)	Porcher 1995-2004
Indo-European (Indo-Iranian)		
Bengali Uttar Pradesh, West Bengal, India; Bangladesh	**kalmi sag** [**kalmi-sák**, **kulmi-sag**] (**kalmi**=name of plant, **sag**=potherb)	Watt 1889 [1972], Chopra *et al*. 1965
	nalike (=stream)	Chopra *et al*. 1965
	patuasag [**patu-shaka**, **patun-saga**] (**patua**=leaf, **sag**=potherb)	
Gujarati Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan, India; Bangladesh	**nálichi baji** [**nálichi bhaji**] (**nalichi**=near stream, **baji**=potherb)	Chopra *et al*. 1965, Watt 1889 [1972]
	patuasag [**patu-shaka**, **patun-saga**] (**patua**=leaf, sag=potherb)	Chopra *et al*. 1965
Hindi Andhra Predesh, Bihar, Delhi, Himachal, Madhya Pradesh, Orissa, Punjab, Rajasthan, Uttar Pradesh, India	**kalmi sag** [**kalmisag**, **kalmi-ság**] कलमी साग, (**kalmi**=name of plant, **sag**=potherb), **kalmi** [**karmi**] This is an element of the Unani herbal healers in India.	Chopra *et al*. 1965, Kays & Dias 1996, Islam *et al*. 2004, Kapoor & Kapoor 1980, Patnalk 1976, Watt 1889 [1972], Wiser 1955
	pui-sag (**pui**=?, **sag**=potherb)	Lakshminarasimhan pers. comm. 2006
Hindi Bihar, Delhi, Himachal, Madhya Pradesh, Orissa, Punjab, Rajasthan, Uttar Pradesh, India	**patuasag** [**patu-shaka**, **patun-saga**] (**patua**=leaf, **sag**=potherb)	Chopra *et al*. 1965
Marathi Maharashtra and adjacent states, India	**nadi-shaka** (**nadi**=stream, **shaka**=potherb)	
Nepali Nepal	**kalmi sag** [**kalaamil saag**, **kulum sag**] (**kalmi**=name of plant, **sag**=potherb)	Chopra *et al*. 1965, Manandhar 2002
Panjabi, Eastern Delhi, Haryana, Jammu, Kashmir, Punjab, Rajasthan; Bangladesh	**ganthian**	Austin & Ghazanfar 1979, Chopra *et al*. 1965, Watt 1889 [1972],
	nári [**náli**] (=stream)	
Panjabi, Western Pakistan, mainly Punjab, India	**ganthian**	
	nári [**náli**] (=stream)	
Sanskrit India	**kalamba** [**kaDamba**, **kalambi**, **kulumbee**] कलाम्ब (**ka**=water, **alamba**=supported, suspended) Variations noted in text.	Chopra *et al*. 1965, Kapoor & Kapoor 1980, Malten 1997, Roxburgh 1824, Watt 1889 [1972], Sivadasan & Rajendran pers. comm. 2006
Sinhalese Sri Lanka	**kan-kun**[1]	Watt 1889 [1972]
Tharu Nepal	**kramuwan**	Manandhar 2002
language not specified Uttar Pradesh	**nári** (=stream)	Chopra *et al*. 1965
Indo-European (Italic)		
French France	**liseron d'eau** (=water vine), **patate aquatique** (=aquatic potato)	Kays & Dias 1996, Heine 1984

Language Classification Family (Subfamily) *Language* Region	**Common Names/Comments**	**Information Sources**
Italian Italy	**patate aquatica** (=aquatic potato), **vellucchio d'acqua** (=water twiner)	Kays & Dias 1996, Volin pers. comm. 2006
Latin Ambon	**olus-vagum** (=wandering on mud)	Rumphius 1741-1750
Portuguese Portugal	**batata aquatica** (=water potato), **cancon**[1]	Kays & Dias 1996
Spanish Spain	**batatilla acuatica** (=little water potato), **boniato de agua** (=water sweet potato), **camotillo** (=little sweet potato), **espinaca aquática** (=water spinach, Cuba)	Kays & Dias 1996, Ly *et al*. 2002
Indo-European (Slavic)		
Polish Poland	**wilec wodny** (**wilec**=bindweed, **wodny**=water)	Gotfredsen 2006, Lockhart & Syrk pers. comm. 2006
Isolated		
Japanese Japan	**asagaona** アサガオナ (comparison to **asa gao** アサガオ, 朝顔, *Ipomoea nil*)	Kays & Dias 1996, Walker 1976
	kankon[1], カンコん	
	ku-shin-sai (loan from Chinese **kong xin cai** 空心菜)	Kitajima pers. comm. 2006
	yô-sai 西菜, ヨウサイ [**you-sai**] (=western potherb)	Kays & Dias 1996, Walker 1976
Japanese Japan, Okinawa	**en-sai** [**enn-che**, **untchie**] 蕹菜 [エンチェ] (loan from Chinese **wéng cài**) Arrived via Okinawa & Kyushu.	Kays & Dias 1996, Walker 1976
Korean Korea	**kong sim chae** (loan from Chinese kong xin cai 空心菜)	Staples & Herbst 2005
	mul si keum ch'i 물시금치 **mul**=water, **si keum ch'i**=spinach; translation of English name) Plants are not grown nor eaten in temperate Korea	Porcher 1995-2004, Pemberton pers. comm. 2006
Niger-Congo (Altantic-Congo)		
Fulfulde/Fulani Nigeria	**delbol**, **laylayduuji** [**lailai duji**]	Blench 2003b, Dalziel 1937
Niger-Congo (Mande)		
Mende Sierra Leone	**kpŏkpŏi** (=creeper)	Dalziel 1937
Sino-Tibetan (Chinese)		
Cantonese Chinese, China	**wung ts'ai** 甕菜 [**ong ts'ai**, **ungtsai**, **ong choy**, **ong choi**, **ohng choy**, **nung choi**, **ung tsoi**, **yong ts'ai**, **yung ts'ai**] (=pitcher potherb) **t'ung ts'ai** [**tung tsoi**, **tung choy**] **tong sin tsai** [**toongsintsai**, **hung sam choi**] **ong tsai** [**hung choi**] **wu hsin ts'ai**, **ong tung tsoi** 甕通菜 (=pitcher hollow [macaroni] potherb) Also, see discussion under Mandarin below.	Edie & Hoe 1969, Fang & Staples 1995, Herklots 1972, Hu 2005, Irving 1995-2006, Kays & Dias 1996, Porcher 1995-2004, Roi 1955

Language Classification Family (Subfamily) *Language* Region	**Common Names/Comments**	**Information Sources**
Mandarin Chinese China	**wéng cài** 蓊菜 (=buried propagule potherb) **teng cai** 藤菜 (=climbing/vine herb) or **teng-teng cai**; **tong cai** 通菜 (=hollow [macaroni] potherb),**kong xin cai** 空心菜 (=empty heart potherb) **kong cai** 空菜 (=empty potherb) **wu xin cai** 無心菜 (=without heart potherb) **cao coi** 草菜 (=grass herb) The characters for Mandarin **wéng** (蓊) & Cantonese **ong** (甕), although different, share some basic elements. The first (蓊) means "to bury propagules under the soil." The other (甕) refers to pottery with a closed cover, a jar, vessel, or pitcher. Mathews (1944) says that it was at one time a jar for the ashes of the dead. The pinyin is so simplified that only the bottom of 甕 is recognizable. Aquatic cultigen: **shuǐ wèng cài** 水蓊菜 (=water buried propagule potherb); dryland cultigen: **hàn wèng cài** 旱蓊菜 (=dry [drought] buried propagule potherb)	Edie & Hoe 1969, Fang & Staples 1995, Herklots 1972, Hu 2005, Irving 1995-2006, Kays & Dias 1996, Porcher 1995-2004, Roi 1955
Sino-Tibetan (Tibeto-Burman)		
Karen Thailand; Burma	**no do**	Aoy Pensuk pers. comm. 2006
Parbate Nepal	**kulum sag** (**kulum**=potherb, **sag**=pond)[2]	Watt 1889 [1972]
Tai-Kadai		
Laotian Laos	**pak bung phak bong**, ຜັ້ງ, ຜັ໋ກ (**phak**=potherb, **bung**=caterpiller's), **pak bong phak bong**, (**phak**=potherb, **bong**=caterpiller's), **bôngz** (=**bong**?) The insect larvae belong to at least three families, Arctiidae, Lamantriidae, & Lasiocampidae.	Porcher 1995-2004, Van Valkenburgh & Bunyapraphatsara 2001, McClatchey pers. comm. 2006, Aoy Pensuk pers. comm. 2006/
Thai Shan Mae Hong Son, NW Thailand; SE region, Burma	**kamchon** [**kamchong**] กำจร (=spread?)	Van Valkenburgh & Bunyapraphatsara 2001
Thai Thailand	**pak bung**, ผักบุ้ง [**pak boong**, **paag boong**, **phak bung**] (**phak**=potherb, **bung**=caterpiller's) The word **bung** also means "basket," but that is because it is applied to one whose construction resembles lepidopteran larvae. Cultivars include **pak boong chin** (**chin**=piece; white stem group), and **bai phai** (**bai**=leaf, **phai**=bamboo; bamboo leaf white stem group) **phak thot yot** ผักทอดยอด (**thot**=king?, **yot**=royalty?)	Porcher 1995-2004, Smitinand 1979
Trans-New Guinea		
Marind New Guinea, Indonesia	**beehob**	Heyne 1927
	oetangko[1]	

Language Classification Family (Subfamily) *Language* Region	**Common Names/Comments**	**Information Sources**
West Papuan		
Galela Halmahera, Indonesia	**takako** [**tanggo**][1]	Heyne 1927
Makian Halmahera, Indonesia	**takako** [**tanggo**][1]	
Tidore Tidore, Indonesia	**kako**[1]	
	takako [**tanggo**][1]	
Uncertain Language?		
language? Ghana	**ga kŏkŏle biakŏ**	Dalziel 1937