Department of Agriculture and Fisheries Qld

Ipomoea species - Importation implications

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Innovating new virus diagnostics and plant bed management in the Australian sweetpotato industry

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Introduction

Ipomoea is a large genus within the Convolvulaceae family. Two of the best known members of this genus are Sweet Potato (*Ipomoea batatas*) and Morning Glory (various species).

Plants within the family Convolvulacea take the form of herbs, shrubs, climbers or leafless parasites, many of which occur in tropical and subtropical regions[1]. Overall the family is dominated by twining or climbing woody or herbaceous plants that often have heart-shaped leaves and funnel-shaped flowers[2]. In Australia there are approximately 20 genera and 130 species and all States are represented in their distribution[3].

Herbaceous indexing, or the use of indicator plants is an integral component of the sweet potato virus diagnostics program at the Department of Agriculture and Fisheries (DAF) Gatton Research Facility (GRF). Sweet potato plants contain chemical inhibitors that can interfere with standard laboratory testing methods such as ELISA or PCR. As sweet potato plants are generally asymptomatic when infected with viruses, grafting of sweet potato scions onto Ipomoea species rootstocks, or indicator plants, allows the virus to multiply in the more sensitive Ipomoea plant. Visual assessment of symptoms and testing of sap from the indicator plant is then possible without interference.[4]

While *Ipomoea setosa*, which is particularly sensitive to virus infection, has been the standard indicator plant used at the Department of Agriculture (DAF) Gatton Research Facility (GRF), other *Ipomoea* species also have potential for use in virus diagnostics. Coleman 2017 [5] examines the potential of *Ipomoea purpurea, coccinea, nil* (various cultivars), *sloteri, plebeia*, and *aquatica* as alternative species. Ipomoea species can also be hosts for sweetpotato infecting viruses, samples were collected throughout the project and screened for susceptibility to sweetpotato infecting viruses.

This review investigates available information on Ipomoea species for use as alternative virus indexing species and will highlight species already endemic in the Australian landscape as potential virus reservoirs. The number of species within the genus *Ipomoea* is extensive. Some species are readily available within Australia and obtaining seed through collection or purchase is relatively easy. The availability of *Ipomoea* species for import is restricted to seeds that can be sourced through on-line suppliers, international collaborators and ultimately by quarantine protocols. The Australian Government Department of Agriculture and Water (DAW) publishes a Permitted Seeds List, Chapter 4 of 7 records the following species as allowable imports into Australia (Table 1).[6]

Table 1: DAW Permitted Seeds List [6]

Ipomoea species permitted seeds list	
Ipomoea alba	*Ipomoea nil*
Ipomoea aquatica	*Ipomoea nil var. limbata*
Ipomoea cairica	*Ipomoea palmata*
Ipomoea cyamoclita	*Ipomoea pes-caprae*
Ipomoea dissecta	*Ipomoea purpurea*
Ipomoea diversifolia	*Ipomoea quamoclit*
Ipomoea hirsutula	*Ipomoea sinuata*
Ipomoea mexicana	*Ipomoea triloba*

The *Ipomoea* species selected to be tested as potential indicator plants will be determined by availability, with a focus on native Australian species, allowable imports and those introduced weeds which have become endemic within the Australian landscape and commercial production areas. These plants are of particular interest as potential reservoirs of virus diseases and hosts for virus vectors.

Ipomoea seeds that are not currently available in Australia but can be purchased on line were initially considered for import through the AQIS system with strict protocols around their use and disposal at GRF. However some species of the *Ipomoea* genus pose a significant potential biosecurity threat as evidenced through *Ipomoea aquatica, Ipomoea cairica* and others discussed below which, although on the permitted list, have become significant invasive weed pests. Consequently DAF staff at GRF are reluctant to import unnecessary potential weed seeds.

This review will focus on;

- Ipomoea species native to Australia; *costata, muelleri, plebeia and pes-caprae*.
- Ipomoea species which are allowable imports as outlined in The Australian Government Department of Agriculture and Water, Permitted Seeds List.
- Ipomoea species which have become naturalised in the landscape; *cairica, indica, alba and aquatica.*
- Ipomoea species which are readily available to purchase; *purpurea and nil.*

Native Ipomoea Species

Common Australian native species that can be purchased from seed suppliers include *Ipomoea costata* and *Ipomoea muelleri*. Seeds of *Ipomoea plebeia and Ipomoea pes-caprae* are readily collected from plants within the environment.

Ipomoea costata

Ipomoea costata is an Australian native plant also known as desert yam or bush potato. Bush potato species include *Ipomoea costata*, *Ipomoea polpha* and *Ipomoea argillicola* of which *costata* is the most wide spread [7]

A description of this plant is difficult to find however The Western Australian Herbarium[8] describes it as a prostrate or climbing perennial, herb or shrub or climber, up to 3m high. Its flowers are purple-blue-pink, and occur from Feb to Nov in W.A. Plants grown at GRF (Figure 1), have oval to heart shaped leaves with a leathery texture.

This species is found in arid tropical Australia and therefore unlikely to be grown in sweet potato production areas however as a native species, knowledge of its characteristics and virus status would be beneficial. Seeds are available through collection or purchase from a number of seed companies listed in the appendix. Seeds have been obtained and propagated at GRF and are currently being assessed for suitability as graft material for herbaceous indexing.

Figure1: *Ipomoea costata* growing in the secure tunnel house at GRF.

Ipomoea muelleri

Ipomoea muelleri is a native species with most occurrences recorded in Northern and Central Australia[9] Also known as Poison Morning Glory this perennial vine has trailing or twining stems. Leaves are oval to triangular in shape and up to 8 cm long and 7 cm wide.
Flowering may occur all year and appear in wiry clusters with 1–3 large funnel-shaped, pale rose-purple flowers with a slightly darker throat. [10] [11]

There is very little information about this species so its suitability as an indicator plant is unknown but will be assessed if suitable plants can be grown. Seeds have been obtained and propagated at GRF (Figure 2) however plant growth has been poor. Its suitability as graft material for herbaceous indexing will be assessed if possible.This species is not common in sweet potato growing areas (Figure 3) so its potential as a virus source is unlikely to be relevant.

Figure 2: *Ipomoea muelleri* growing in the secure tunnel house at GRF.

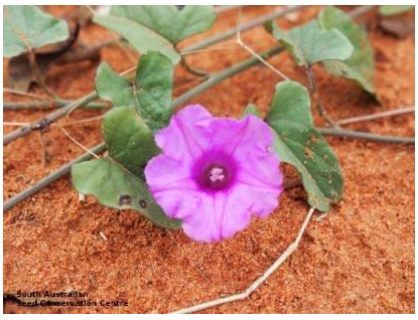
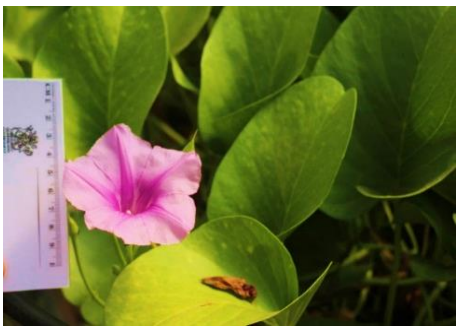


Figure 3: *Ipomoea muelleri (*photo S.A. Seed Conservation Centre)

Ipomoea pes-caprae

Ipomoea pes-caprae (Figures 4, 5 and 6) is a beach plant, common throughout coastal tropical and subtropical areas of the world. In Australia it is often referred to by the common name of Goats Foot Convolvulus or Beach Convolvulus and is also known as Railroad Vine and Bay Hops in other countries. It occurs along beaches and coastal strips in Australia and in tropical North and South America, Africa, India and Asia. [12]

The plant has a vigorous rambling growth habit with numerous long vines producing a milky sap when broken. The West Australian Herbarium[11] describes it as a prostrate, creeping or trailing perennial. Flowers are pink/purple and can appear from January to November on sand or clay loam in coastal areas.



Figures 4 and 5: *Ipomoea pes-caprae* growing in the secure tunnel house at GRF, DAF 2018

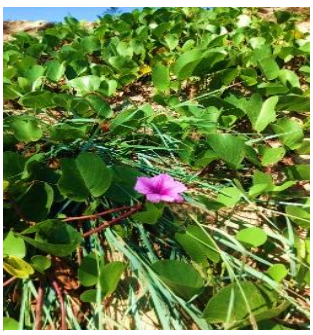


Figure 6: *Ipomoea pes-caprae*, Kingscliff, N.S.W. 2018

The rounded leathery leaves have a notch at the top and are generally 6.5-11.5 cm long and 5-9 cm wide. Flowers are generally 7- 10cm in diameter. The fruit is round, about 1.3 – 2 cm in diameter and contains dark brown seeds which are densely covered in brown hairs.[13] Seeds from *Ipomoea pes-caprae* have been propagated at GRF and its suitability as graft material for herbaceous indexing will be assessed. As this plant commonly occurs near sweet potato growing areas it should be included in any sampling activities for virus monitoring. It is also a known host for sweet potato weevil (Dennien S, pers. comm.)

Ipomoea plebeia

Ipomoea plebeia is commonly known as Bell Vine. It is an Australian native species and occurs in the northern areas of the country in Western Australia, Northern territory, and Queensland and as far south as north-eastern New South Wales.[14] This species usually grows in open forest but also in vine thicket and rainforest. It has become a weed of pasture and cultivation and is common in crop production areas.

The vines are slender and twinning and densely covered in small hairs. The oval to heart shaped leaves are (Figure 7) 2.5 - 8 cm long and 1- 6 cm wide and arranged alternately along the vine. The upper and lower surfaces of the leaves, stems, and petioles are covered in pale-coloured hairs. The white flowers (Figures 8 and 9) are bell or funnel shaped and about 5 -10 mm long and 1- 1.5 cm in diameter and borne in the leaf forks (i.e. axils) usually singularly but sometimes in clusters of up to three. Flowering occurs from summer to autumn. (Australian Tropical Rainforest Plants) [14]. The fruit capsule is 5 -7 mm long, oval or rounded and contains four brown seeds which can be spread in contaminated agricultural produce, equipment or soil and by water movement. The cotyledons of seedling plants are quite distinctive as they are deeply notched and form a V-shape. (Brisbane City Council) [15]

Figure 7: *Ipomoea plebeia* growing in the secure tunnel-house at GRF, 2018.

Figures 8 & 9: *Ipomoea plebeia* leaf and flower, Buaraba, Queensland, 2018.

Exotic Ipomoea species listed as allowable imports to Australia

Ipomoea alba

Common names *for Ipomoea alba* include Moon flower and White morning glory, Evening glory, Giant moonflower and Tropical white morning glory, *Ipomoea alba* is an ornamental, originating in the Americas, that has escaped cultivation and invaded various environments in eastern Australia where it can form very dense mats of vegetation that smother native species. It has been recorded from central to south-east Queensland and the coastal districts of northern New South Wales where it is regarded as an environmental weed.[16]

This species is characterised by its large white flower (Figure 10) and as it usually flowers at night and is often referred to as moon flower. It has hairless stems and relatively large leaves (Figure 11) which can be 5-20 cm long and 4-20 cm wide.

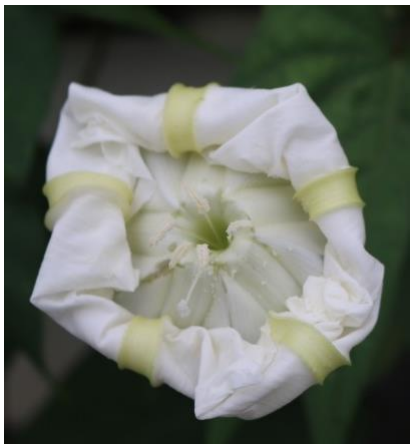


Figure 10: *Ipomoea alba* flower partially closed by early morning GRF.

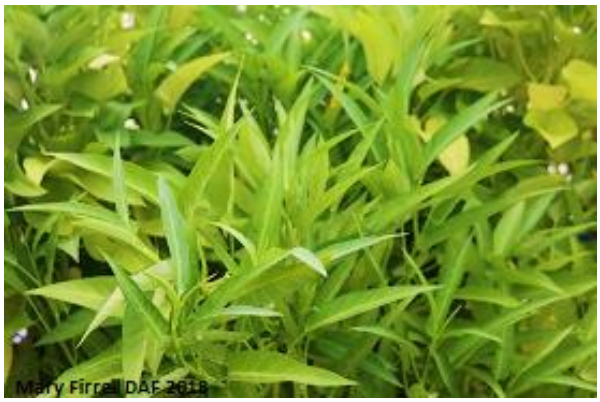
Figure 11: *Ipomoea alba* growing in the secure tunnel house at GRF 2018.

These leaves are usually strongly heart-shaped. Large, white, tubular flowers with a diameter of 10 – 15 cm are produced from spring through to autumn.[17] The resulting seed capsule is 2-3cm long and contains four whitish coloured seeds. These seeds are reported to have poisonous or hallucinogenic properties so care must be taken to avoid ingestion.

The potential of *Ipomoea alba* as an indicator plant is unknown and plants have been propagated at GRF where grafting of virus infected sweet potato material is underway. As this weed is extending its geographic boundaries into the sweet potato production areas around Northern NSW and potentially Bundaberg, growers should be aware of this plant and remove it if found. Its potential as a virus host is unknown.

Ipomoea aquatica

Ipomoea aquatica (Figures 12 and 13) has many common names and is also known as Swamp morning glory, Swamp cabbage, Aquatic morning glory, Water spinach, Kangkong and Ung-choi. It is a native of Asia and is commonly used as a vegetable in Asian cuisine.



Figures 12 & 13 *Ipomoea aquatica* in the DAF tunnel, GRF 2018.

It grows vigorously in wet environments and has become an invasive species in some areas. The Gold Coast City Council (Queensland) has found *Ipomoea aquatica* growing in Wetland areas of South East Queensland where it considered highly invasive as it out-competes and replaces native plants. The plant can form dense floating mats over the surface of water and can also be found on muddy banks along streams.[18]

Ipomoea *aquatica* is described in The Global Invasive Species Database (GISD) 2015 as a trailing vine with milky sap. Stems are hollow, up to 3m long or more, rooting at the nodes when floating in aquatic situations. The leaves are usually between 5-15cm long, 2-10cm wide and arrow shaped. The flowers are funnel shaped and either solitary or in few-flowered clusters; petals are white to pink. [19]

Seeds of *Ipomoea aquatica* have been acquired and propagated in the secure plant tunnel at GRF. Its potential as an herbaceous indicator is being assessed and upon completion of the experiments will be destroyed to prevent spread to the surrounding environment from the DAF facility. As the weed has been recorded in areas close to the sweet potato growing areas of Northern New South Wales.

Ipomoea cairica

Ipomoea cairica has many common names but is generally known as Coastal morning glory, Mile-a-minute or Cairo morning glory in Eastern Australia. In Queensland and NSW it is a significant environmental weed. The website, New South Wales Flora on Line have listed it as a declared noxious weed.[20]

Although it's origin is uncertain it is found throughout tropical areas of the world and occurs as an introduced species in the coastal districts of Queensland and New South Wales and occasionally in the coastal districts of south-western Western Australia and southern South Australia, on Lord Howe Island, Norfolk Island and Christmas Island. [21]

This species has a vigorous growth habit (Figure 14) and can develop into a thick ground cover or climbing vine which can smother other vegetation. The vines can reach up to 5 m or more in height and scramble over other plants or creep along the ground. *Ipomoea cairica* has deeply divided leaves usually with 5 to 7 lobes. It has lavender or pink to purplish, funnel-shaped flowers (Figure 15) with a darker purple centre although occasionally plants will produce white flowers.[22]. These flowers are 4-6 cm long with a diameter of 5-8 cm and have five petals that are fused into a tube. Flowering occurs throughout most of the year followed by seed capsules containing four hairy seeds.

This species can be found along coastlines and river banks in Queensland and Northern New South Wales and has the potential to be a weed in sweet potato production areas therefore its potential as a virus host needs to be determined and its geographical distribution assessed.

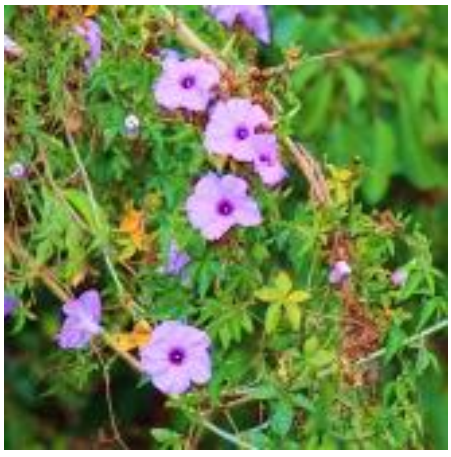


Figure 14: *Ipomoea cairica* © The State of Queensland 1995–2018

Figure 15: *Ipomoea cairica* collected at Cudgen N.S.W. 2017

Ipomoea cyamoclita and Ipomoea quamoclit

The website Botany cz. [24] and The Plant List[25] both identify the name *Ipomoea cyamoclita* as a synonym for *Ipomoea quamoclit*. This plant is often referred to by the common names; Cardinal climber, Cupid's flower, Cypress vine, Cypress vine morning-glory, Vine morning glory, Star glory, star of Bethlehem and Sweet Willy.[26] *Ipomoea quamoclit* is thought to have originated in India [27] but is now naturalised throughout many countries of the world.

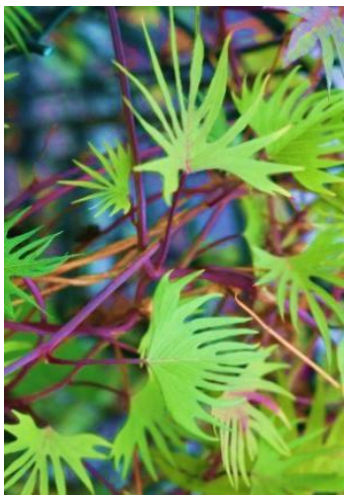
In Australia, it is considered to be an environmental weed and is most commonly found in the northern parts of the Northern Territory, coastal districts of Queensland, and in the Kimberley and north-western region of Western Australia. It has also become naturalised in the coastal districts of northern New South Wales where it is regarded as a "sleeper weed" or potential environmental weed. It has adapted to a number of different habitats including mangrove fringes, rainforests and eucalypt forests and riparian zones. It can outcompete native species and may smother trees and shrubs.[26]

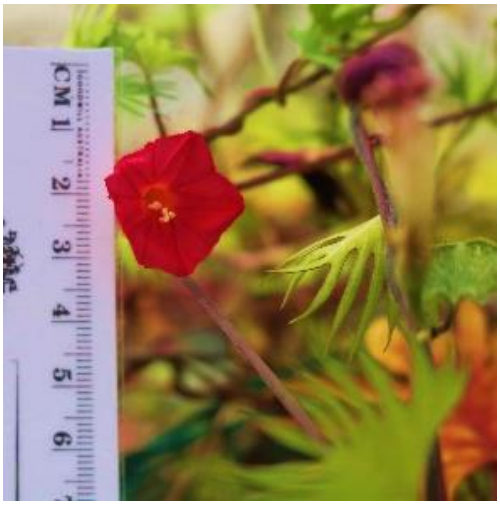
The leaves of this species are markedly different from many other Ipomoeas as they have a fern like appearance. The Australian Tropical Rainforest Plants website describes the species as having a slender vine with a leaf structure that "can be interpreted in two ways:

1. Leaves compound with 16-24 leaflets, (Figure 16) basal pair of leaflets bi-lobed. Leaflet stalks absent.
2. Leaves simple and deeply lobed almost to the midrib, each leaf about 2.5-4.5 x 2.5-4 cm, petioles about 1-4 cm long. Lobes 8-15 per leaf. Very small finely divided leaves usually on the twig at the base of each petiole."[24]

The flowers are tubular (Figure 17) or funnel shaped, about 1.7-3.5 cm in diameter and 2.5-3.5 cm long. The star-shaped flowers are crimson-red in colour with 5 petals, each of which have a pointed tip.[28]

The early-stage seedlings are bi-lobed but at the tenth leaf stage become very dissected and lobed to resemble the fern-like adult leaf form.[27]





Figures 16 and 17: *Ipomoea quamoclit* growing in an enclosed tunnel house at DAF, GRF.

Ipomoea dissecta

An online search of The Plant List [29] returns 2 results for *Ipomoea dissecta*

- *dissecta* (Jacq.) Pers - is a synonym of Merremia dissecta (Jacq).) Hallierf. (Figure 18)
- *dissecta Willd.* - is a synonym of Ipomoea *coptica (Figure 19)*

The Global Biodiversity Information Facility (GBIF) [30], identifies *Ipomoea dissecta* (Jacq.) Pers. As a synonym for *Ipomoea dissecta* (Jacq.) Pursh and *Merremia dissecta* (Jacquin) Hall. fil. *Merremia dissecta* (Jacquin) Hall. fil. seems to be the more accepted name as the following list of synonyms is attributed to it;

Table 2: Synonyms for *Merremia dissecta*

Table heading		
Convolvulus dissectus Jacq.	*Ipomoea arnottiana* Steud.	*Ipomoea prunetii* Perr. ex Steud.
Convolvulus kleinii Wall.	*Ipomoea dissecta* (Jacq.) Pers.	*Ipomoea sinuata* Ortega
Convolvulus palmatus Mill.	*Ipomoea dissecta* (Jacq.) Pursh	*Ipomoea subpedata* Desf.
Convolvulus pauciflorus var. *chilensis* O. Ktze.	*Ipomoea diversifolia* Arn.	*Ipomoea thonningii* G. Don
Convolvulus variabilis Weinm.	*Ipomoea diversifolia* Arn. ex Steud.	*Ipomoea verrucosa* Ortega
Convolvulus variabilis Weinm. ex Steud.	*Ipomoea prunetii* Perr.	*Merremia dissecta* var. *chacoensis* O'Donell

GBIF—the Global Biodiversity Information Facility GBIF Backbone Taxonomy. [30]

This demonstrates the confusion around species nomenclature even when using scientific names.
Ipomoea dissectca is an allowable import under the Australian Government Department of Agriculture and Water, Permitted Seeds List but which species does this apply to?

Merremia dissecta (Jacquin) Hall (Figure 18) is also known as Alamo vine or Noyau Vine; Noon Flower in Australia. This is an introduced species originally from the Americas, now naturalized in Western Australia, Northern Territory and Queensland from Cape York Peninsula to south-eastern Queensland. Alamo vine usually grows in open forest but also in monsoon forest or disturbed areas on the margins of rain forest. [31]

The website, Convolvulaceae Unlimited, describes *Merrima dissecta* as a twinning plant with a woody stem at the base but with soft growth at the tip of the plant. Vines are 3-4m long with deeply divided palmate leaves. [32] The funnel shaped flowers are borne singularly or in clusters and are white with a purple to red throat. The fruit is papery with lobes that are 25-30 mm long, 10-13 mm wide. The seed capsule generally contains 4 hairless seeds.

Figure 18: *Merremia dissecta*, Alamo vine flower. Photo by Ray Mathews.https://www.wildflower.org/gallery/result.php?id_image=31992

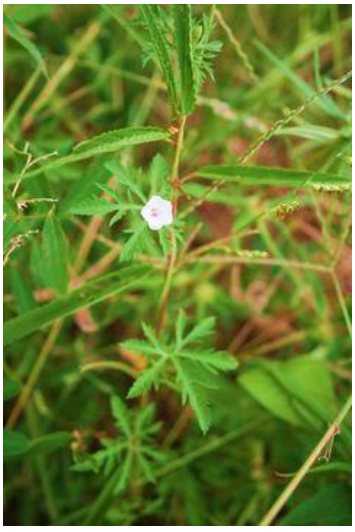


Figure 19: *Ipomoea coptica*
© Marco Schmidt

Ipomoea hederifolia

Has also been known as *Ipomoea angulata* Lam. *Ipomoea hederifolia* is commonly called red convolvulus, ivy-leaf morning glory, red flowered bellvine, redstar, scarlet creeper, scarlet morning glory and trompillo [33] and is increasing in significance as an environmental weed.[34] This species is native to south-eastern USA, Mexico, Central America, the Caribbean and South America.

In Australia it has become naturalised in northern and eastern parts of the country (Figure 20) and is becoming most prevalent in the coastal districts of northern and central Queensland. It also occurs in other sweet potato growing areas of Queensland and New South Wales and in parts of the Northern Territory and in northern Western Australia.[35] It has become naturalised in other tropical areas and on several Pacific Islands.

The leaves are usually heart shaped but can be deeply 3-5 lobed. The flowers are bright red to scarlet in colour with white stamens and style projecting out from the centre beyond the flower petals.[33]

Figure 20: *Ipomoea hederifolia,* Black Mountain Cape York, 2017

Ipomoea hirsutula

Ipomoea hirsutula is also known as Woolly morning glory. *Ipomoea hirsutula* is another species listed as an allowable import under the Australian Government Department of Agriculture and Water, Permitted Seeds List.

There is conflicting information about the taxonomy of this species GBIF [36] list this species as a synonym for Ipomoea purpurea as does The Plant List [37]. Elmore C and Schroeder J [38] also identified confusion around the taxonomy of this plant and state “Collections of woolly morning glory from New Mexico were determined to be tall morning glory (Ipomoea purpurea) or, in some cases, ivy leaf morning glory (*Ipomoea* hederacea) by misapplication”

Seeds of *Ipomoea hirsutula* have not been obtained but its synonym Ipomoea purpurea has been propagated at GRF.

Ipomoea Mexicana

Ipomoea mexicana is another species listed as an allowable import under the Australian Government Department of Agriculture and Water, Permitted Seeds List. However GBIF identify this species as a synonym of *Ipomoea* purpurea. [39] Ipomoea purpurea has been propagated at GRF.

Ipomoea nil

Ipomoea nil, also known as Japanese morning glory, is a species with a large number of cultivars. More than 1500 cultivars of *Ipomoea nil* are maintained at Kyushu University as a part of the National BioResource Project.[40] It has been studied extensively particularly in Japan where over 200 different mutant lines with variations in colour and shape of flower and leaf have been described. Iida, S, et al, identified two mutable alleles for flower colour causing fleck and speckle[41]. This explains the wide variation in flower colour that can be seen in this species.

The Australian Tropical Rainforest Plants website describes the leaves as hairy on the upper and lower surfaces, 3-lobed and about 3-11.5 cm long and 4-12 cm wide. Although Duyên, et al, found variation in leaf type from heart-shaped to acuminate or shallowly or deeply lobed.[50]

Flowers are approximately 2-7 cm in diameter and variations in colour can range from pale blue to purple, pink or white with speckled colour, depending on the cultivar. Seeds of *Ipomoea nil cv kadatchi (Figure 21)* have been purchased on-line and propagated at GRF.

Seed has been obtained from suppliers for *Ipomoea nil cv Scarlett O'Hara (Figure 22),* however an internet search returns results for both *Ipomoea purpurea cv Scarlett O'Hara and Ipomoea nil cv Scarlett O'Hara.* Due to the heart shaped leaves of 'Scarlett O'Hara' it is possible that it is indeed I. purpurea rather than nil, however a taxonomic key is needed to correctly identify the species.

Figure 21: Ipomoea nil cv. Kidatchi plants growing in an enclosed tunnel house at DAF, GRF 2018

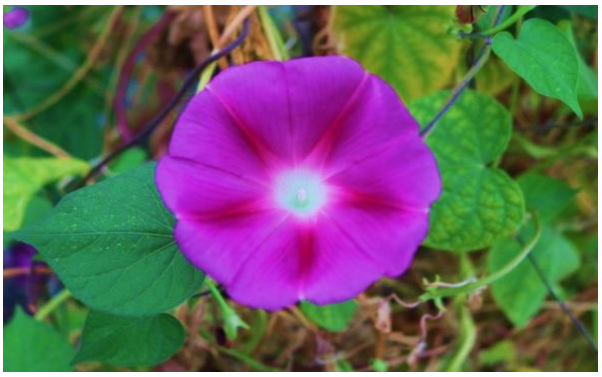


Figure 22: Ipomoea sp. Scarlett O'Hara

Ipomoea pupurea

Ipomoea purpurea (Figure 23) is commonly called Annual morning glory, Common morning glory, Purple morning glory or Tall morning glory. It has become naturalised in the warmer parts of eastern Queensland and the coastal districts of New South Wales where it is regarded as an environmental weed. [42]

It is a strong, twining, climber with a rampant growth habit that is capable of smothering native forest. Leaves are oval shaped to heart shaped. The flowers are funnel-shaped and can be white, pink blue or magenta in colour.[43]

This species is available through internet order from suppliers within Australia with a number of cultivars available including 'Star of Yelta' (Figure 24) and 'Grandpa Ott' (Figure 25), seeds of which have been obtained and propagated in the GRF secure tunnel.

The image below shows *Ipomoea purpurea* plants propagated in the GRF tunnel over summer 2017/ 2018 from seeds obtained from an online supplier. However this plant appears to more closely resemble Ipomoea nil. This highlights the difficulty in obtaining 'true' seed from suppliers and leads to the confusion around nomenclature.

Figure 23: *Ipomoea sp*. propagated in the GRF tunnel from seeds labelled *I. purpurea* obtained from an online supplier.

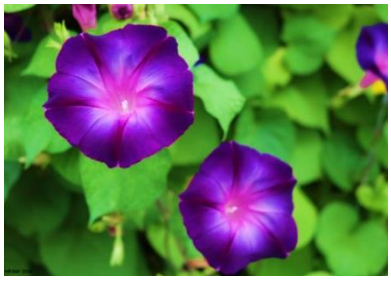


Figure 24: *Ipomoea purpurea* cv 'Star of Yelta'

Figure 25: *Ipomoea purpurea* cv 'Grandpa Ott'

Ipomoea mauritiana

Ipomoea mauritiana has the following listed synonyms; *Ipomoea paniculata* (L.) R.Br., *Batatas paniculata* (L.) Choisy, *Ipomoea digitata* L. var. *digitata*, *Ipomoea digitata* L., *Convolvulus paniculatus* L., It is commonly known as Palmate morning glory.[44]

Ipomoea mauritiana occurs in the Northern Territory and Queensland from Cape York southwards to the central Queensland coast. It is found throughout the tropical parts of the world and grows in forest, rain forest and vine thicket.[44]

The vine is slender with deeply lobed leaves measuring approximately 6-18 cm by 8-22cm. The funnel shaped flowers are pink with a darker coloured throat and about 3.5-8 cm in diameter. The fruit is about 1cm in diameter with seeds that are slightly flattened, and densely clothed in brown hairs. Cotyledons are bi-lobed and become lobed (usually 5 lobes) at around the 10th leaf stage.[44]

Plants of *Ipomoea mauritiana* (Figure 26) were acquired and propagated in the secure plant tunnel at GRF.

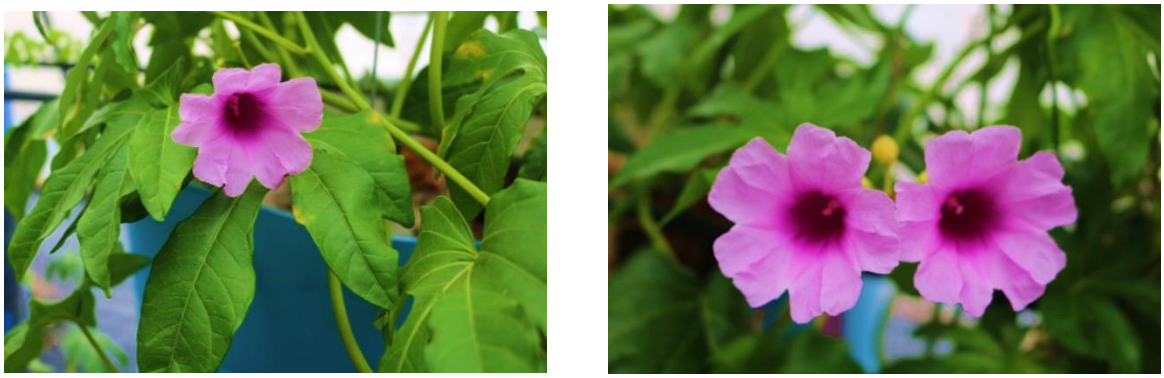


Figure 26: *Ipomoea mauritiana* growing in an enclosed tunnel house at DAF, Gatton Research Facility 2018.

Ipomoea palmata

Ipomoea palmata is listed as an allowable import under the Australian Government Department of Agriculture and Water, Permitted Seeds List. However an online search indicates that the websites Australian Tropical Rainforest Plants, Convolvulacea Unlimited, The Plant List and others consider Ipomoea *palmata* Forsk. is a synonym for *Ipomoea cairica*. [45] [46] [47]

Ipomoea triloba

Ipomoea triloba (Figure 27) is commonly known as Aiea morning glory or Little Bell. It is an introduced species originally from tropical America, and now found throughout many tropical countries. [48]

In Australia it has become naturalised in the Northern Territory and in Queensland from the Cape York to South-eastern Queensland. This species is usually found along creek banks and in open forest areas but also on roadsides and in rain forest. [48] It has not been included in the herbaceous indicator program at GRF.

Figure 27: *Ipomoea* triloba

Other Ipomoea species

Ipomoea indica

Ipomoea indica is known as Blue morning glory and is a common weed in Queensland and New South Wales. It has a vigorous twinning growth habit and while it is most active in the warmer months, it can grow and flower all year round and can quickly out-compete other species. It is a significant environmental weed in Queensland (Figure 30), New South Wales and Victoria.[49]

The leaves can be either heart-shaped or three-lobed and are alternately arranged along the vine. (Figure 28) Leaf size can vary from 5-18 cm long and 3.5-16 cm wide. Blue morning glory has large funnel-shaped flowers which can be 5-10 cm long and 7-10 cm in diameter and are blue or bluish-purple in colour with pale pinkish centres (Figure 29) . They are borne in clusters of two to twelve. The plant reproduces mainly by producing roots from the nodes of the vine so can be spread from broken pieces of plant taking root. It does not produce viable seed in Australia.[49]

This species is likely to occur in sweet potato production areas therefore its potential as a virus host needs to be determined and its geographical distribution assessed.

Figure 28: *Ipomoea indica* collected at Cudgen N.S.W. 2017

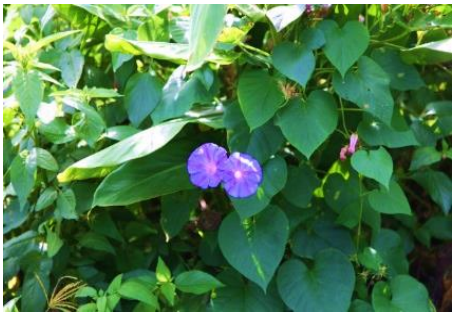


Figure 29: Blue morning glory flowers and leaves © Queensland Government

Figure 30: A large infestation of Blue morning glory© Queensland Government

Ipomoea setosa

Ipomoea setosa is commonly known as Brazilian morning glory and has been the standard indicator plant used for virus indexing at GRF.

The plant has a vigorous climbing habit with thick pink to brown stems (Figure 31) that are covered in thickened hairs. Leaves are tri-lobed and often have a fluted edge. Flowers are pinkish-purple (Figure 32) with a darker coloured throat and are usually borne singularly.

Ipomoea setosa is grown in the secure tunnel house at GRF. Seeds are propagated each year and plants are destroyed at the conclusion of each indexing round.

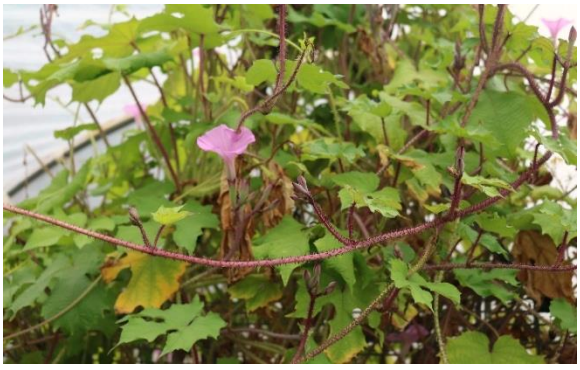


Figure31: *Ipomoea setosa* growing in an enclosed tunnel house at DAF, Gatton Research Facility 2018.

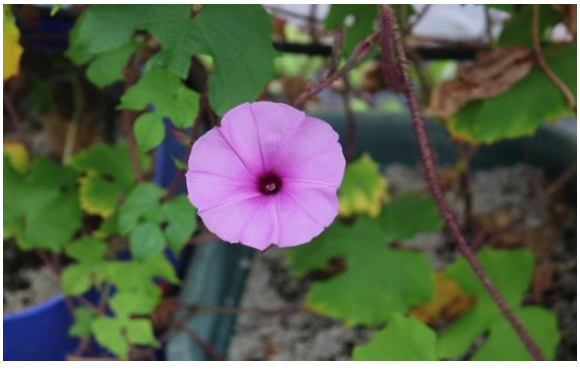


Figure 32: *Ipomoea setosa* growing in an enclosed tunnel house at DAF, Gatton Research Facility 2018

Summary

There are a number of species in the genus *Ipomoea* that have potential for use as herbaceous indicators in the virus diagnostics program at the Gatton Research Facility. Three sources have been identified

- Native species available for purchase on line or through field collection.
- Species listed on the Australian Government Permitted Seeds List.
- Exotic species which have escaped cultivation and become weeds in the environment.

Many species on the Australian Government Permitted Seeds List [6] are also now environmental weeds. Ipomoea species are well adapted to the tropical and subtropical environments in Australia where sweet potatoes are grown and many have become serious invasive pests. Apart from the obvious detrimental effects on our Australian native ecosystems there are concerns around these weeds acting as reservoirs for viruses that may affect sweet potato (*Ipomoea batatas*) crops. Many Ipomoea species have multiple synonyms and this leads to confusion around scientific nomenclature as well as identification using common names.

The import of species in addition to those already in this program was deemed to be unnecessary as there is sufficient scope to work with plants that have already been obtained. Importing plants in addition to those listed in the Australian Government Permitted Seeds List would be a difficult and expensive exercise and have the potential to introduce a new weed pest through inadvertent release.

The following species have been propagated in the secure tunnel facility at DAF GRF for use as indicator plants in the virus diagnostics program.

Table 3: List of *Ipomoea* species propagated in the secure tunnel facility at GRF

Ipomoea species		
Ipomoea alba	*Ipomoea nil var. kidatchi*	*Ipomoea purpurea cv Grandpa Ott*
Ipomoea aquatica	*Ipomoea mauritiana*	*Ipomoea purpurea cv Star of Yelta*
Ipomoea coccinea	*Ipomoea muelleri*	Ipomoea quamoclit
Ipomoea dissecta	*Ipomoea pes-caprae*	Ipomoea setosa
Ipomoea nil	*Ipomoea plebeia*	*Ipomoea* species (*purpurea or nil*) *Scarlett O'Hara*

Figure 31: The enclosed tunnel house at DAF, GRF, 2018.

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