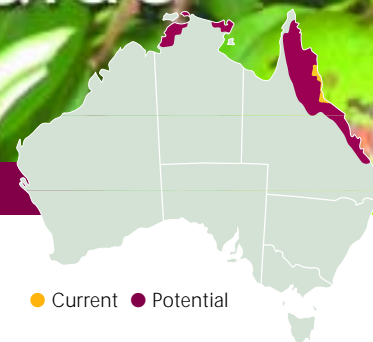


Weed Management Guide

Pond apple – *Annona glabra*



● Current ● Potential

Pond apple (*Annona glabra*)

The problem

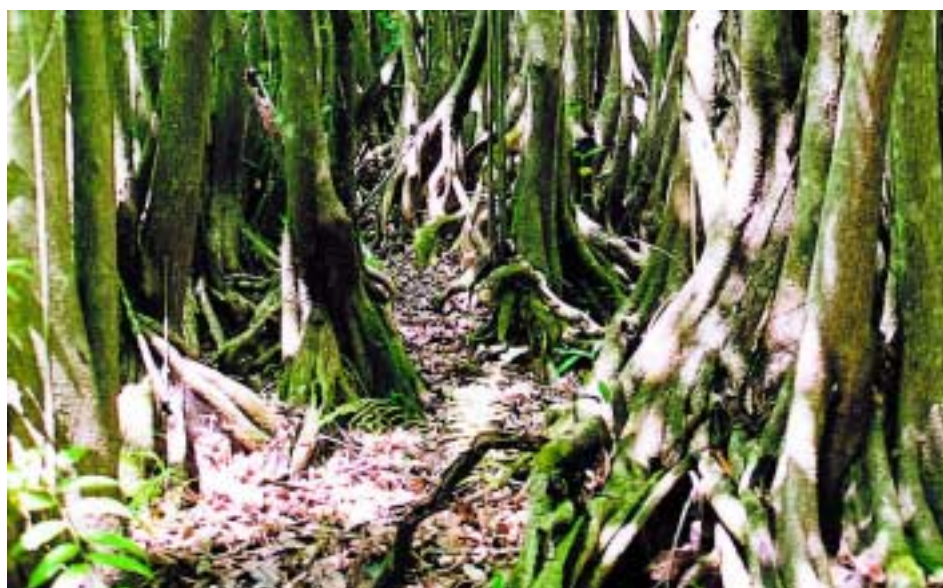
Pond apple is a *Weed of National Significance*. It is regarded as one of the worst weeds in Australia because of its invasiveness, potential for spread, and economic and environmental impacts. Introduced as grafting stock for the closely related custard apple, it is a very hardy tree and an aggressive invader. Over time the dense thickets it forms can gradually replace everything else in the canopy and create an undesirable new habitat.

Its ability to grow in flooded areas and to tolerate salt water has enabled it to spread through much of northern Queensland's wet tropics area. It now infests more than 2000 ha of the Wet Tropics Bioregion, and threatens melaleuca wetlands and native mangrove communities.

While pond apple is considered an environmental weed, its commercial impacts are also increasing as it spreads. It is now threatening the cane and cattle industries by growing in and along creeks, fencelines and farm drains. Unlike many weeds, it can invade and transform undisturbed areas.

The weed

Pond apple is a semi-deciduous woody tree, usually about 3–6 m tall, although it can grow up to 15 m. The plants have alternate leaves, 70–120 mm long with a prominent midrib. The leaves have a light- to dark-green upper surface



Pond apple seedlings mature quickly into tall dark forests.
Photo: Peter van Haaren, Qld DNRM

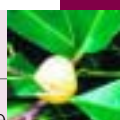
depending on their age, and are paler on the underside. The flowers are creamy white to light yellow, about 20–30 mm in diameter and are not easily seen on the tree. They have three leathery outer petals and three smaller inner petals, with a red inner base.

The edible fruit looks like a smooth-skinned custard apple, is similar in shape to a mango and 50–150 mm in diameter. It contains about 140 pumpkin-like seeds.

The plants have grey bark, usually with a single trunk but multiple-stemmed plants are also common since several seedlings may germinate together. It may have swollen bases or slightly buttressed roots. Stems often fuse together giving the appearance of a single trunk, but each one maintains its own sap system.

Key points

- Pond apple is an aggressive invader of native wetlands, reducing biodiversity and threatening some rare species of flora and fauna.
- Pond apple is difficult to manage because it grows in sensitive areas and control methods must avoid adverse impacts on non-target plants or the surrounding environment. It also grows in areas that are hard, and sometimes dangerous, to access.
- The challenge is to ensure early detection and control of all new infestations.
- Dispersal agents such as feral pigs and cassowaries make it difficult to contain.



Growth calendar

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flowering	■	■	■	■							■	■
Fruit formation	■	■	■	■								■
Fruit drop	■	■	■	■	■							
Leaf fall								■	■	■	■	
Germination	■	■	■	■	■	■	■	■	■	■	■	■

■ General pattern of growth ■ Growth pattern in suitable conditions

Pond apple plants start reproducing after two years, producing pale yellow to cream flowers. The flowers do not self-pollinate and pollination is probably brought about by beetles. The fruit form over summer and autumn and drop from the tree after only a short time. The fruit matures after being dropped, the skin turning from green to yellow to black while the flesh turns orange. Leaves of mature trees turn yellow and fall in the dry season. Germination peaks after rainfall and requires a period of temperatures above 25°C.



Seeds are spread over long distances in the droppings of feral pigs (shown here) and cassowaries.

Photo: Ian Holloway, QPWS

How it spreads

Some of the characteristics that make pond apple a successful invader include its ability to form dense thickets, tolerance to salt and inundation, effective seed dispersal by water and animals, and a germination period spread over several months.

The fruit and seeds both float, which helps it spread in flowing water. The hard seeds can remain viable for some time in fresh, brackish or sea water.

Seeds are also spread by animals such as cassowaries and feral pigs. Research suggests that cassowaries can spread seed 1–2 km, and that feral pigs can carry it as far as 10 km.

Pond apple's massive seed production can result in a 200 mm thick carpet of seed covering the ground. Disturbance, either natural or of human origin, can play an important role in encouraging infestations. For example, cyclones create gaps in the canopy and let in light, helping pond apple to grow; or excessive draining of coastal land through land reclamation raises saline watertables, killing paperbarks and allowing the more salt-tolerant pond apple to invade.

Where it grows

Pond apple is a native of North, Central and South America and West Africa. It

grows in fresh, brackish and salt water and affects a wide range of disturbed and undisturbed coastal ecosystems. It thrives in moist, sunlit conditions where millions of seedlings can germinate, excluding all other species.

Pond apple can grow in the same environments as native mangroves. It can withstand extensive flooding and trees can spend weeks at a time with their roots under water. It does well on riverbanks, in naturally open or disturbed wetlands, and in rainforests. However, it does not thrive in areas that are permanently flooded or too shady.

The wide range of habitats being invaded by pond apple includes stream and river banks, paperbark and pandanus wetlands, sedgeland, mangrove communities and high tide zones on beaches. It is found mostly between Ingham and Cooktown on the Queensland north coast but also south to Mackay and north to some of the Torres Strait islands. More than 600 ha of the Russell River catchment south of Cairns is infested with pond apple.

Pond apple is still used commercially as a salt- and water-tolerant rootstock for custard apple in northern Queensland.



Flowers are only present for a short time during summer.

Photo: Ian Holloway, QPWS



Potential distribution

Areas at immediate risk from pond apple are the estuaries and floodplains of northeastern Cape York. Without intervention, its potential distribution based on climate could include parts of the Top End of the Northern Territory, and the thin coastal strip from the tip of Cape York to Bundaberg, Queensland.

What to do about it

Preventing further spread

Prevention and early intervention are the most cost-effective methods of controlling any weed. The pond apple problem is relatively new and not many land managers know about the species and its impact. Many of the sites infested with pond apple are remote and potentially dangerous (crocodile habitat), and options for control are limited. The use of fire, revegetation methods and biological control are possibilities that may be considered. Experience with other invasive trees may also help when controlling pond apple.

The success and type of control measure used will depend on the situation. Pond apple usually grows in sensitive areas so methods should be chosen that do not have an adverse impact on non-target plants or on the surrounding environment.



Pond apple grows in mangrove communities and can tolerate salt inundation.
Photo: Ian Holloway, QPWS



Pond apple fruit looks like a smooth-skinned custard apple.
Photo: Peter van Haaren, Qld DNR

The present limited distribution of pond apple and the relatively short life span of its seed are good reasons to try to eradicate all infestations. Isolated outbreaks should be treated immediately. Large infestations need to be controlled by a coordinated approach which includes the development of buffer zones.

Check before using herbicides

Herbicides available for woody weeds are effective in controlling pond apple. However, note that the only herbicides recommended to control pond apple are available at present through permit for 'minor off-label use'. Check with your state/territory weed management agency or local council for more information on herbicide use.

Stem injection is recommended in wetlands

Stem injection is the preferred method for treating pond apple in aquatic habitats because it minimises herbicidal runoff and impacts on non-target plants and animals. However, pond apple's many fused stems can make it difficult and time consuming to ensure that all stems are treated, especially in dense infestations.

Two main methods are used to inject herbicides. Both methods require the application of herbicide immediately after the stem is opened.

The 'drill and fill' approach uses a powered drill to make downward angled holes, spaced approximately 50 mm apart around the circumference of the stem, into which herbicide is immediately injected.

Pond apple is easily confused with native mangroves

Pond apple may be confused with some native mangrove species because they look superficially similar, share many similar features and are often found growing together. Both pond apple and mangroves have lenticels, which are cork-like pores on the bark that allow gases to move into and out of the plant. Both pond apple and mangroves tolerate inundation by salty water. Also, the fruit and seed of pond apple both float, an adaptation shared with mangrove species that aids dispersal by water.

If you require help in identifying pond apple, contact your state or territory weed management agency or local council. If possible, collect a specimen and have it identified by your state or territory herbarium.

Weed control contacts

State / Territory	Department	Phone	Email	Website
NT	Dept of Natural Resources, Environment and the Arts	(08) 8999 4567	weedinfo.nreta@nt.gov.au	www.nt.gov.au
Qld	Dept of Natural Resources and Mines	(07) 3896 3111	enquiries@nrm.qld.gov.au	www.nrm.qld.gov.au
Australia wide	Australian Pesticides and Veterinary Medicines Authority	(02) 6272 5852	contact@apvma.gov.au	www.apvma.gov.au

For up-to-date information on which herbicides are registered to control pond apple and the best application methods and dosages, contact your state or territory weed management agency or local council. This information varies from state to state and from time to time. Contact details are listed above, including contacts for the Australian Pesticides and Veterinary Medicines Authority, which hosts the PUBCRIS database. This database contains information on all herbicides that are registered for use on weeds in each Australian state and territory.

When using herbicides always read the label and follow instructions carefully. Particular care should be taken when using herbicides near waterways because rainfall running off the land into waterways can carry herbicides with it. Permits from state or territory Environment Protection Authorities may be required if herbicides are to be sprayed on riverbanks.



Stem injection can be conducted on foot using a 5 L backpack, injector gun and small axe. Photo: Ian Holloway, QPWS

The ‘axe cut method’, also known as frilling, uses an axe or tomahawk (or for small saplings a machete) to make downward cuts, about 130 mm apart, around the circumference of the stem at waist height. The cuts should be deep enough to reach the sap wood and can be widened by turning the top of the axehead downwards to create a pocket where the herbicide can pool once it is applied.

Spraying may also be used under suitable conditions

In still, dry conditions herbicide can also be applied by basal bark spraying and foliar (ie overall) spraying of seedlings. Both of these methods can be very effective, but care must be taken to prevent spray drift and minimise herbicide runoff and impacts on non-target organisms and environmentally sensitive areas such as wetlands and mangroves.



Treated pond apple in a drain near Liverpool Creek, south of Innisfail, Qld. Photo: Ian Holloway, QPWS

Basal bark spraying is effective on stems up to a diameter of 200 mm at ground level. Spray thoroughly around each stem up to a minimum height of 500 mm (knee height). Although basal bark spraying is generally effective year round, do not spray wet stems.

Foliar spraying is most effective up until early flowering, and is less effective when plants are stressed or in fruit. All foliage must be sprayed, but not past the point of runoff. Though foliar spraying will kill mature pond apple, it is not recommended because it requires large amounts of herbicide, which increases the expense and risk of spray drift and runoff.

Generally, do not spray pond apple trees in water, and do not spray wet trees or before rain.

Mechanical removal

Pond apple has been pulled out and bulldozed successfully in drains at Babinda, south of Cairns. Sites must be monitored and new seedlings removed. Disturbance to surrounding areas must be minimised. In places where weeds are likely to replace pond apple or in areas prone to erosion, revegetate with native plants. As pond apple provides food for the endangered cassowary, it is important to consider its requirements and to revegetate with suitable cassowary food plants.



Controlling pond apple in the rainforests of Mareeba Shire in northern Queensland

Pond apple threatens rainforest as well as mangrove swamp habitats. As part of the project 'Pond Apple eradication in the Mareeba Shire', the Shire Council, with funding from the Commonwealth Government's Natural Heritage Trust, began tackling the problem in 1998. Following a concerted campaign of herbicide application, hand pulling and follow-up control, many areas of rainforest have been restored.

When the control program was begun, dense stands of pond apple choked Jumrum Creek, displacing native vegetation to form impenetrable thickets. These thickets have been removed and native bush is regenerating to replace them.

Initially, the council used herbicide applied by stem injection, which was effective in killing 65–70% of mature

trees along Jumrum Creek. They then tackled isolated infestations that had sprung up from seed spread by feral pigs and cassowaries. Most of this control work was carried out on foot. An initial aerial survey was useful in identifying infestations where the canopy was open, but in some areas of mature forest it was impossible to identify infested sites.

Contractors employed by the council treated about 27 km of creekline and then followed up with hand pulling to remove the many thousands of seedlings which germinated.

An important part of the program has been raising public awareness about the weed. Once pond apple was controlled, the rainforest started to regenerate and many of the indigenous trees returned. In places where seed was buried by flood



In moist, sunlit conditions thousands of seedlings can germinate, excluding other species.
Photo: Ian Holloway QPWS

debris or old dams were covered by undergrowth, pond apple seedlings are still emerging, so monitoring will need to continue for several years.



Several seedlings may germinate together, forming multiple-stemmed trunks.
Photo: Ian Holloway, QPWS

Fire has only limited use against pond apple

Although fire destroys pond apple plants and possibly also their seed, the type of environment where pond apple grows usually limits the opportunity to burn. Fire has been used in areas where the understorey is dense enough to sustain it, eg the sedge/grass community in Eubenangee Swamp National Park. However, the effect of inappropriate fire use leading to habitat changes must be considered, and caution is required to prevent destruction of rainforest or mangrove plants.

Biological control is not an option

Biological control has not been investigated for pond apple. Other species in the same genus are grown commercially in Australia – custard apple (*Annona cherimola*), bullock's heart (*Annona reticulata*) and sweet apple (*Annona squamosa*). Other native species belonging to the same

family also occur in the rainforests of northern Queensland. Therefore, any biological agent would need to be species specific to avoid damage to these desirable species.

Legislation

Pond apple is declared as a Class 2 pest in Queensland and landowners are required to destroy it. It has been declared as a 'prohibited entrant' in the Northern Territory and Western Australia. In South Australia the sale of pond apple is restricted. Check with your local council or state/territory government agency about its requirements for pond apple control.

Acknowledgments

Information and guide revision: Philip Maher (Qld DNRM), Sid Clayton (Mareeba Shire Council), Shane Campbell (Qld DNRM/Weeds CRC) and John Thorp (National Weeds Management Facilitator).

Maps: Australian Weeds Committee.

How to control pond apple

Quick reference guide



Pond apple can spread into relatively undisturbed habitats such as paperbark (*Melaleuca*) forests.
Photo: Ian Holloway, QPWS

Be aware of pond apple

Look out for pond apple, especially around old dams or springs and where mangroves grow. It produces an edible fruit that is readily spread by animals, particularly pigs and cassowaries.

New infestations

Because there are relatively few infestations of pond apple, and it can potentially be eradicated before it becomes uncontrollable, any new outbreaks should be reported immediately to your state or territory weed management agency or local council. They will be able to help with any issues relating to identification and control, including the use of herbicides, the disposal of treated material and the need for follow-up work.

Control with stem injection

For mature trees, stem injection with herbicide may be the best option. Check with state or territory authorities or local councils for recommendations. Pond apple usually grows in sensitive environments so methods should be chosen that do not have an adverse impact on non-target plants or the surrounding environment.

Coordinating control of large infestations

Large infestations can be controlled by a coordinated approach that includes the development of buffer zones, and may involve herbicides, hand pulling and, in some cases, fire or mechanical removal.

Ongoing follow-up will be required

Once the initial infestation is controlled, follow-up monitoring and control will be required for several years due to the large seedbank. Seedlings can be removed by hand pulling.

Control options

Type of infestation	Chemical	Physical	Mechanical	Fire
Small, isolated infestations of young plants	In dry conditions, foliar spray with registered herbicide, taking care to minimise spray drift in sensitive areas.	Hand pull young seedlings.	Not suitable.	Not suitable.
Heavy – large number of plants	Use stem injection for mature trees.		In some accessible areas, removal by bulldozer may be possible.	In areas with a dense understorey, fire may be a possible control option but caution is required to prevent destruction of rainforest or mangrove plants. Follow up by hand pulling any germinating seedlings.

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Printed in Australia on 100% recycled paper.
ISBN 1-920932-13-5

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