

Pond apple

Annona glabra



Pond apple is a major environmental weed of the Wet Tropics bioregion of Far North Queensland and a Weed of National Significance. Small infestations occur in South East Queensland. This small to medium size tree forms dense stands, particularly in swamp areas. Pond apple invades fresh, brackish and saltwater areas and its thickets are capable of replacing whole ecosystems. Its seed is primarily dispersed by water, especially during floods. Disturbed flood-prone ecosystems are most at risk from pond apple invasion, particularly mangroves, melaleuca woodlands, riparian areas, drainage lines, coastal dunes and islands.

Pond apple currently covers around 2000 ha of the Wet Tropics bioregion in Queensland; there are also isolated occurrences on the eastern coast of Cape York. Its potential to spread throughout coastal regions of tropical and subtropical Australia is considerable.

Dispersal of fruit and seed by water and animals allows pond apple to be easily spread within and between catchments. Unlike many weeds, pond apple has an alarming ability to invade relatively undisturbed areas. Pond apple is also a pioneering plant and will opportunistically invade areas after disturbances such as cyclones and floods.

Pond apple (also known as cherimoya) is a native tree of tropical North, Central and South America and West Africa where it occurs in fresh and brackish swamplands.

It was originally introduced to Australia as grafting stock for commercially grown custard apple in 1912 and still remains as a root stock in old orchards. It has become a serious invasive plant in Queensland with the potential to spread throughout northern Australia and as such, it is listed as a Weed of National Significance.



**Queensland
Government**

Legal requirements

Pond apple is a category 3 restricted invasive plant under the *Biosecurity Act 2014*. It must not be given away, sold, or released into the environment. The Act requires everyone to take all reasonable and practical measures to minimise the biosecurity risks associated with invasive plants under their control. This is called a general biosecurity obligation (GBO).

At a local level, each local government must have a biosecurity plan that covers invasive plants in its area. This plan may include actions to be taken on pond apple. Some of these actions may be required under local laws. Contact your local government for more information.

Description

Pond apple is a semi-deciduous tree that can grow up to 15 m high; however, it typically grows to 3–6 m. Pond apple individuals are usually single-stemmed, but when seeds germinate in groups the resulting plants have a multi-stemmed appearance. Over time these stems may fuse together, giving the appearance of a single plant.

Each original stem maintains its own sap stream, which can complicate control when herbicide injections are employed as each individual stem must be injected. Young pond apple plants often have stems with swollen bases. Mature plants may develop slightly buttressed roots.

Stems of pond apple are softwood with a thin grey bark bearing prominent lenticels (pores). Lenticels are involved in gas exchange and appear on the stem as small, raised structures of cork-like composition. Native mangroves also have lenticels, so care should be taken during identification.

The leaves of pond apple are alternate, 7–12 cm long and have a prominent midrib. The upper surface of the leaves varies from light to dark green depending on the age of the plant. Leaves are paler on the underside and there is a distinctive small fold where the leaf blade joins the leaf stalk. The leaves emit a distinct smell (similar to the smell of green apples) when crushed—another feature that can distinguish pond apple from mangroves. In the dry season, the more mature leaves yellow and this can aid in detecting pond apple infestations.

Flowers, short-lived and rarely noticed, are 2–3 cm in diameter, pale yellow to cream, and consist of three leathery outer petals and three smaller inner petals. The inner base of the flower is bright red in colour.

The fruit is spherical, about 5–15 cm in diameter and green in colour. Fruit have the appearance of a smooth-skinned custard apple. The ripe fruit falls from the tree when yellow/orange and turns black on the ground. The flesh turns orange at maturity. Each fruit contains 100–200 seeds that are similar in size and shape to pumpkin seeds.

Life cycle

Trees begin to flower and produce fruit when they are at least two years old. The main flowering period in the Wet Tropics is from December to February with fruit formation following in January to March. From February to April the fruit falls from the tree and matures on the ground. Sporadic flowering and fruiting can also occur at other times of the year.

Both fruit and seed can float and remain viable for many months in fresh to saline water and germination can occur in fresh or brackish situations. The success of seed dispersal can be attributed to the fruiting period coinciding with the wet season when flooding is common. Ocean currents also play a role in transporting seed along the coast and seed can germinate above high tide level when deposited during flood events or tidal surges.

Pond apple seeds are relatively short-lived and when conditions are suitable, seed banks can be rapidly depleted through mass germinations within six months of fruit fall. Few pond apple seeds survive longer than one year, with the seed bank completely depleted within three years provided that no new seed input occurs.

Pond apple is opportunistic and tends to establish in disturbed areas affected by floods or cyclones, but it can also establish in relatively undisturbed environments. While seedlings need light for rapid growth, they can remain dormant in semi-shaded conditions until a gap in the canopy is created.

Methods of spread

Although generally spread by water, seed can also be disseminated by feral pigs, wallabies, cassowaries and other fruit-eating animals.

Some plants may exist where they were used for custard apple grafts but the orchard has since been abandoned and the pond apple has reverted to form.

Habitat and distribution

Pond apple requires moist soil with regular inundations of fresh to brackish water. It can withstand periods of flooding with its roots under water for weeks at a time; however, it does not appear to survive permanent inundation.

In Australia, pond apple is invading a wide range of habitats such as:

- creeks, riverbanks and floodplains
- wetlands, including melaleuca and pandanus swamps and sedge lands
- mangrove communities and beach high-tide litter zones
- rainforest areas
- dams
- agricultural drainage systems.

In particular, melaleuca wetlands and *Heritiera littoralis* mangrove communities are at risk.

Over 2000 ha of the Wet Tropics bioregion of Far North Queensland are currently covered by pond apple.

Infestations occur between Cardwell and Cooktown. It has also been found as far south as Brisbane and far north to Cape York and the Torres Strait.

Predictive modelling programs have identified that areas most at risk of invasion include the north-eastern side of Cape York, the Gulf of Carpentaria river systems, the top end's wetland areas (including Kakadu) and the coastal strip from Cape York to Brisbane.

Control

Managing pond apple

The GBO requires a person to take reasonable and practical measures to minimise the biosecurity risks posed by pond apple. This fact sheet provides information and some options for controlling pond apple.

The best time of year to undertake control of pond apple is during the dry season (August to November) when access to waterways and wetlands is easier. Control work should start at the top of the catchment or the uppermost section of the creek, river or waterway. This will reduce the risk of seed being transported into clean or previously treated areas downstream.

Control methods for pond apple include mechanical control, herbicide control and fire. Often a combination of methods can be used to achieve effective control. Follow-up treatment is essential to identify missed plants, regrowth and any problems with the initial control method.

When choosing control options consider size and density of infestation, accessibility, safety hazards, presence of non-target species, life cycle stage of the plant, and the time of year.

Prevention

The two most cost-effective methods of managing pond apple are the prevention of infestations and early intervention. While prevention is the best way to control invasive plants, this is not always possible as natural means, such as floods and animals, easily disperse seed. New infestations must therefore be quickly identified and controlled before they become widespread.

Mechanical control

Mechanical options for clearing pond apple infestations include hand pulling, chain pulling and dozer pushing. These methods (except hand pulling) are only suitable on flat country, in areas free of sensitive vegetation, where machines can manoeuvre easily, and where the risk of soil erosion is low. Ensure that the roots of uprooted trees are not in contact with soil or plants may resprout.

Fire

Pond apple is very susceptible to fire. For control using fire, sufficient fuel is required. Unfortunately, this is not often available in dense pond apple infestations. When using fire, the entire circumference of the plant must be burnt to effectively kill pond apple. Depending on its intensity, a fire can destroy seeds lying on the ground but seeds in cracks or on moist soil, where fire will not burn, can remain viable. Follow-up work is therefore required to control seedlings that germinate following fire.

Herbicide control

Herbicides can be applied to pond apple when it is actively growing in a number of ways. **Stem injection** is recommended for aquatic areas as it minimises herbicide run-off and off-target impacts.

There are two ways to achieve stem injection. The axe cut method involves making horizontal cuts into the sapwood around the circumference of the stem, as low to the ground

as possible. While still in the cut, lean the axe out to make a downward angled pocket in which herbicide is injected. A double row of cuts, with the second row placed under the spaces created by the first row, is recommended for maximum kill rate.

The drill and fill method involves drilling downward angled holes, 5 cm apart around the circumference, with a powered drill. Herbicide is then immediately injected into the holes.

Stem injection is not generally suited to larger trees due to the number of cuts/holes required. It is also difficult to control multi-stemmed trees where each separate stem requires treatment.

The **basal bark application** method involves spraying or painting an herbicide and diesel mix around the circumference of the stem, from ground level up to 50 cm. This is a rapid method of control in areas with large monocultures of pond apple, where off-target vegetation will not be affected. It should not be used in aquatic situations for both environmental and effectiveness reasons.

Foliar application or the **overall spray** method is useful for dense monocultures of young plants up to 1 m high where there is no risk of damaging native vegetation.

Table 1 lists the herbicides registered or permitted for control of pond apple.

Herbicides must be used with care; therefore, before use:

- ensure all permit conditions are met
- read instructions and conditions for use on the label
- consider possible impact on non-target vegetation and surrounding environment
- adhere to individual product label grazing withholding periods and restraints for treated areas.

More information

More information is available from your local government office or visit biosecurity.qld.gov.au.

Table 1. Herbicides for the control of pond apple

Situation	Herbicide	Rate	Registration status	Comments
Riverbank areas, swamp areas, irrigation channels, dams, enclosed water bodies, coastal areas, fence lines and pastures	120 g/L Picloram + 240 g/L Triclopyr (e.g. Access®)	1.67 L product per 100 L of diesel	PERMIT 13684 (expires 02/2026)	<p>Basal bark: DO NOT apply to trees growing in a water body. Basal bark plants with stems up to 20 cm basal diameter. Ensure all stems on multi-stemmed plants are treated. Spray the bark around the stems from the ground level to a maximum height of 50 cm wetting thoroughly to allow the spray mix to soak through the bark.</p> <p>DO NOT treat wet stems with basal bark mix as this can repel the diesel mixture.</p>
	333 g/L Fluroxypyr (e.g. Starane Advanced®)	900 mL product per 100 L of diesel	Starane Advanced is registered for basal bark application	
Non-agricultural areas, public lands, and rights-of-way	360 g/L Glyphosate (e.g. Roundup Biactive®)	500 mL product per 1 L of water	Consult label	<p>Stem injection: Cuts should be made at waist height. To make an injection pocket at waist height, use a ¾ length axe with a blade width of 5–7 cm. The cut of injection must be through the bark and deep enough to place the herbicide in contact with the sap wood. The herbicide must be applied immediately after the dose pocket is made. Apply herbicide with an applicator fitted with a tree injector kit which can be accurately calibrated. Set the vaccinator to deliver 1 mL of prepared solution per cut. Space cuts at 13 cm around tree. When treating trees less than the width of the axe, ensure herbicide does not run out of the sides of the cut. This can be overcome by using the corners of the axe to make the pocket.</p> <p>Overall spray: DO NOT spray past the point of runoff. Ensure thorough spray coverage of all foliage. Incomplete coverage will result in regrowth. Apply to actively growing plants up to early flowering. Avoid spraying when plants are stressed or fruiting. Repeat spray application when re-infestation occurs.</p> <p>DO NOT apply to plants in water. Lower the water level to expose the weed infested band, before application.</p> <p>DO NOT allow spray to drift to nontarget vegetation. Maintain a distance of at least 10 m to nontarget terrestrial vegetation.</p> <p>A spray shield should always be used.</p> <p>DO NOT apply more than two applications per year, six months apart.</p> <p>Treated dams should not be allowed to overflow. DO NOT use foliar spray application where dams may overflow.</p> <p>Apply as close as possible to the foliage. A distance of not greater than 30 cm is recommended.</p> <p>DO NOT apply directly or allow drift onto water.</p> <p>Apply at 200 g imazapyr/100 L of water, to a maximum volume of 1500 L/ha.</p> <p>Spot spray the weed using handheld equipment at low pressure (≤ 250 kPa/2.5 Bar) to produce a coarse to very coarse spray.</p> <p>DO NOT spray if rainfall or elevated waterflow are expected within 48 hours of application.</p> <p>DO NOT apply to trees greater than 2 m in height.</p> <p>Stop spraying before the herbicide droplets on the leaves begin to coalesce and run off.</p> <p>DO NOT apply under meteorological conditions or from spraying equipment which could be expected to cause spray to drift onto wetlands, natural surface waters, soil, neighbouring properties or other sensitive areas.</p> <p>Avoid soil contamination – DO NOT spray past the point of runoff.</p>
	200 g/L Triclopyr + 100 g/L Picloram (e.g. Conqueror®)	100 mL product per 1 L of water		
	250 g/L Imazapyr (e.g. Unimaz® 250 SL)	800 mL product per 100 L of water		

It is a requirement of the permit that all persons using the products covered by this off-label permit read and comply with the details and conditions listed in the permit. In addition, read the herbicide label carefully before use and always use the herbicide in accordance with label directions unless otherwise stated in the permit.

Read the label carefully before use. Always use the herbicide in accordance with the directions on the label.

Fact sheets are available from biosecurity.qld.gov.au. The control methods recommended should be used in accordance with the restrictions (federal and state legislation, and local government laws) directly or indirectly related to each control method. These restrictions may prevent the use of one or more of the methods referred to, depending on individual circumstances. While every care is taken to ensure the accuracy of this information, the department does not invite reliance upon it, nor accept responsibility for any loss or damage caused by actions based on it.

