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pest series

Pond apple

Annona glabra

DECLARED CLASS 2

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History

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.

Originally introduced to Australia as grafting stock for commercially grown custard apple in 1912, pond apple has become a serious environmental weed in north Queensland with the potential to spread throughout northern Australia.

The problem

Pond apple (*Annona glabra)* is a major environmental weed of the Wet Tropics bioregion of Far North Queensland and a Weed of National Significance (WONS). 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 hectares of the Wet Tropics bioregion in Queensland, as well as isolated occurrences on the eastern coast of Cape York, and its potential for spreading 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.

Declaration

Pond apple is declared as a Class 2 species under the *Land Protection (Pest and Stock Route Management) Act 2002*. A Class 2 pest is one that has already spread over substantial areas of Queensland, but its impact is so serious that we need to try to control it, and avoid further spread onto properties that are still free of the pest. By law, all landholders must try to keep their land free of Class 2 pests and it is an offence to keep or sell these pests without a permit. Local governments may serve a notice upon a landholder requiring control of declared pests.

Description

Pond apple is a semi-deciduous tree that can reach about 12–15 metres (m) in height; 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. However, 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 centimetres (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 seed.

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

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 seed survive

for 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.

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
- agricultural drainage systems.

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

Over 2000 hectares of the Wet Tropics bioregion of Far North Queensland are currently covered by pond apple. Major infestations occur between Cardwell and Cooktown, but pond apple has also been found as far south as Brisbane and northern New South Wales and 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, Gulf of Carpentaria river systems, the top end's wetland areas (including Kakadu), and the coastal strip from Cape York to Brisbane.

Management strategies

A successful pond apple control program should be integrated into an overall property management plan.

1. **Identify and prioritise problem areas**
   - Map pond apple areas on your property
   - Identify seed sources, dispersal routes and areas prone to weed invasion.
   - Focus initial efforts on small infestations or isolated plants.
2. **Determine control options**
   - Decide on the most appropriate method of control in the given situation.
   - Consider integrating control techniques by using chemical, mechanical and fire with regular follow-up treatments.
3. **Schedule control activities**
   - Consider how effective various control methods are at different times of the year.
   - Consider the density of pond apple infestations when choosing control methods.
   - Make pond apple control a regular part of property management and allow for monitoring and follow-up after initial treatment.

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 weeds, 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.

Control

The best time of the 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, chemical 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.

Mechanical/manual 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 else 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.

Chemical control

Herbicides can be applied to pond apple 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 cut stump method is suitable for use on large trees and multi-stemmed plants. The stem of the tree is cut through horizontally, as close to the ground as possible, and the cut surface is treated immediately with herbicide.

The basal bark application involves spraying or painting a 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 of herbicides is useful for dense monocultures of young plants up to 1 m tall where there is no risk of damaging native vegetation.

The following table lists the chemicals permitted for use on pond apple under two 'minor off-label use' permits. These permits are only valid for Queensland and are in force for a restricted time. Permit number PER8297 is valid from 28 April 2005 to 30 June 2010 and permit number PER7485 is valid from 1 July 2004 to 30 June 2009.

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.

Further information

Further information is available from your NRW Service Centre or relevant local government authority.

TABLE 1 – HERBICIDES CURRENTLY REGISTERED FOR USE ON POND APPLE IN QUEENSLAND ONLY, ACCORDING TO THE 'MINOR OFF-LABEL USE' PERMITS

Application Method	Chemical	Rate	Comments
Stem injection	Glyphosate (e.g. Roundup® Biactive)	500 mL per 1 L of water mix	Apply to actively growing plants.
	Triclopyr (100 g/L) + picloram (50 g/L) (e.g. Tordon* Timber Control Herbicide)	200 mL per 1 L of water mix	Do not apply to stressed plants.
Cut stump	Triclopyr (240 g/L)+ picloran (120 g/L) (e.g. Access* Herbicide)	1.67 L per 100 L of diesel	Do not mix with water; cut close to the ground and treat immediately.
	Glyphosate (e.g. Roundup® Biactive)	Undiluted to 1 L per 12 L water	Apply immediately after cutting.
Basal bark	Triclopyr (240 g/L)+ picloran (120 g/L) (e.g. Access* Herbicide)	1.67 L per 100 L of diesel	Do not mix with water; do not treat wet or charcoal coated stems.
	Fluroxypyr (e.g. Starane* 200 Herbicide)	1.5 L per 100 L of diesel mix	Do not apply to stressed plants. Do not apply if rain is likely within one hour. Do not treat wet stems
Foliar	Imazapyr (e.g. Arsenal® herbicide)	800 mL per 100 L of water mix	See permit for critical comments
	Glyphosate (e.g. Roundup® Biactive)	1L per 100 L water	Spot spray for wetland/aquatic areas

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